From tree to plank: A multidisciplinary approach to the study of wood use in boatbuilding in the Red Sea

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Abstract

This thesis looks at the use of wood in boatbuilding in the Red Sea from classical antiquity until present times. It draws on primary sources and archaeological evidence from the Graeco-Roman period extending from the 8th century BC to the eve of Islam in the 7th century AD, and from the medieval Islamic period stretching from the 7th century AD to the 15th century AD. In doing so, it seeks to shed the light on timber trade and the timber exploitation processes; and examine how these were interlinked with the geopolitics and socio-economics of the time. It then portrays the Red Sea areas not only as wood importers from a wide array of regions such as the Mediterranean, East Africa, and South Asia, but also as beneficiaries of local wood resources for their boatbuilding needs. In that respect, it stresses that little attention has been given to the exploitation of local woods in favour of a greater reliance on Indian timber, and more specifically on teak. Thus, it suggests the need to consider other timber species than teak which were equally suitable for shipwrightry, as well as other western Indian Ocean wood providers. To illuminate and colour past interpretations of the subject, in addition to document a vanishing craftsmanship, this thesis has drawn on ethnographic research in Egypt, Sudan, Eritrea, Djibouti, Saudi Arabia and Yemen. The ethnographic enquiry focused on the types of timber used in boatbuilding in the Red Sea and their vernacular names, the timber exploitation processes, and the factors and variables that come play in the metamorphosis of a tree into a boat part. Finally, by interlinking diverse pathways of enquiry drawing on primary sources, archaeology and ethnography, this thesis aims to provide the field of maritime culture and maritime archaeology a deeper understanding of wooden boatbuilding in the Red Sea.

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"*The trees have a thousand other uses, all of which are indispensable to the full enjoyment of life. It is by the aid of the tree that we plough the deep, and bring near to us far distant lands; it is by the aid of the tree, too, that we construct our edifices*" (Pliny the Elder XII .2).

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To Marmour, Naddoud, Lallous and Nonni

Abbreviations

Botany

cf.	confer
sp.	species
spp.	several species
subsp.	subspecies
var.	variety

Linguistic

Ar.	Arabic
Eng.	English
Fr.	French
GA.	Gulf Arabic
Gr.	Greek
Lat.	Latin

Chronological/Literary

AD.	Anno Domini
AH.	Anno Hegirae
BC.	Before Christ
c.	circa
ch.	chapter
d.	died

e.g.	*exempli gratia* (for example)
fl.	*floruit* (flourished)
fn.	fn.
ibid	*ibidem* (same source and place)
idem	same author
i.e.	*id est* (that is)
n.d.	no date
pl.	plural
s.	singular
sic.	*sic erat scriptum* (thus was it written)
syn.	synonym/synonymous

Botanical conventions

Binomial nomenclature, commonly called Latin or scientific names, is the way each living species is given a unique and universal identity. It is composed of two parts: the genus and the specific epithet. Combined this constitutes the species name. Following the International Code of Botanical Nomenclature (ICBN), species names are written in italics. The genus name is always written with an initial capital letter but not the specific epithet. The genus and /or the specific epithet are followed by an abbreviation of the authority who first published a botanical name. I followed Brummitt & Powell's (1992) *Authors of plant names* where the name of each author of a botanical name is indicated by a unique abbreviation.

At times, I also used the English common names when indicating a tree genus or species, although with caution, since common names are problematic: many species have several common names, and a common name can indicate more than one species. Thus, when writing a scientific document it is common practice to use binomial nomenclature. Preferably, the species name should always be used in conjunction with common names so the reader knows which species is being referenced. When the binomial name follows the common name, it is mentioned in italics between brackets.

- The abbreviation "sp." is used when the specific epithet is not specified, after the genus.
- The abbreviation "spp." (plural) indicates "several species", after the genus.
- The abbreviation " cf." is used when the identification is not confirmed, before the genus, subfamily or family.
- The abbreviation "subsp." indicated a subspecies and figures after the specific epithet.
- The abbreviation "var." indicates a variety, that is a mutation of a species occurring naturally; it figures after the specific epithet of the subspecies and before the variety name, e.g.: *Olea europaea* subsp. *europaea* var. *sylvestris*.

Literary conventions

I have adopted the Library of Congress Arabic Transliteration System for names of medieval Islamic authors, Muslim rulers, technical Arabic terms, and bibliographical Arabic entries. Place-names of towns such as Aden, Aydhab, Jeddah, and Quseir or countries like Iraq, Oman and Yemen are kept in this form rather than using the Transliteration System.

Islamic dates precede Christian dates if the subject concerns the Islamic period; otherwise only the date of the Christian era is mentioned. In the text and bibliographical references, the word Ibn (son) occurs at initial position with classic and medieval Muslim writers, e.g. Ibn Jubayr , but an abbreviated *b.* is used in the middle of a name, e.g. Ibrāhīm b. Muḥammad al-Iṣṭakhrī. The names of classic and medieval Muslim authors starting with *al*- are listed in the bibliography under the first letter following *al*-, e.g. al-Maqrīzī under 'M'.

Transliteration System

Consonants

ʾ	ء	s	س	l	ل
t	ت	sh	ش	m	م
th	ث	ḍ	ض	n	ن
j	ج	ṭ	ط	h	ه
ḥ	ح	ẓ	ظ	w	و
kh	خ	ʿ	ع	y	ي
d	د	gh	غ		
dh	ذ	f	ف		
r	ر	q	ق		
z	ز	k	ك		

Vowels

Long	ā	ا	Short	a	َ
	ū	و		u	ُ
	ī	ي		i	ِ
	ō			o	
	ē			e	
Doubled	iyy (final form = /ī/)	يّ			
	uww (final form = /ū/)	وّ			
Diphthongs	ay	ـَيْ			
	aw	ـَوْ			

1 Introduction

1.1 Aims and objectives

This thesis considers how the use of wood in boatbuilding developed in the Red Sea from the classical period until present times. It is the first study of its kind that looks specifically at the exploitation of trees species in that region, an otherwise understudied subject in Red Sea boatbuilding research. It draws on a multi-disciplinary approach including the study of textual sources, archaeological and ethnographic data as well as wood sampling and identifying. Such an approach assesses to what degree these disciplines are instrumental in respect to the study of nautical timber.[1]

This study has three main objectives: First, to assess, analyze, and interpret data on the use of wood in boatbuilding in the past by drawing on classical and medieval Islamic texts, and archaeological resources. This aims at recognising the types of timber that have been used for boatbuilding in the region since antiquity and the physical and conceptual reasons justifying this use in specific boat components. It also explored to what extent were indigenous timbers used and how great was the reliance on imported wood. Second, to consider and document ethnographic data related with the use of wood in contemporary boatbuilding, a rapidly vanishing craftsmanship, whilst establishing a first-of-its-kind inventory of vernacular names of timber used in the Red Sea; third, to correlate the practice of nautical wood exploitation between past and present, in order to investigate issues of timber trade and timber use, and how these were influenced by the Red Sea geographical settings as well as by political, socio-economic, cultural, and more individualistic factors. Most importantly, this thesis has identified substantial gaps in our knowledge about timber exploitation for boatbuilding purposes in the Red Sea regions, and a lack of communication with data sets whether these are textual or archaeological. Therefore, it hopes to address such caveats as comprehensively as possible through its novel multi-disciplinary approach. It also contributes to a better understanding of the processes and parameters, past and present, that come at play in such exploitation.

[1] I will refer to the timber used for boatbuilding purposes as "nautical timber" or "nautical wood", in order to avoid repetition of the expression "timber/wood used in boatbuilding".

1.2 Thesis structure

Chapters 2 to 4 situate the study among the available literature on boat studies pertaining to specifically the Red Sea, and more broadly the western Indian Ocean; as well as locating it geographically and theoretically. They contribute to shaping a comprehensive backdrop to the study and contextualise it both spatially and hermeneutically. Chapter 5 presents the methodological approach considered in this thesis. The subsequent two chapters (Chapters 6 and 7) provide a historical context to the study of wood use in boatbuilding in classical antiquity and medieval Islamic period. The final three chapters (8, 9, and 10) pertain to the ethnographic study of the use of wood in boatbuilding in the Red Sea, while foregrounding the narratives, accounts and perspectives of my informants before my own interpretation.

Chapter 2 situates the study among modern and contemporary boat studies which have but only highlighted the issue of the use of wood in boatbuilding. While acknowledging the debt it owes to pioneering research studies on boatbuilding in the Red Sea and the western Indian Ocean, this thesis aims at a broader scope whilst considering a deeper understanding of timber trade networks, wood exploitation processes and the implication of other issues such as agencies, phytogeography, and political, economic, social, and environmental parameters. Moreover, this chapter reviews major primary sources encompassing classical European authors and medieval Islamic literature, which include works by botanists, historians, geographers, travellers and lexicographers. It also sums- up the main secondary sources pertaining to archaeology and dealing with nautical wood in the adjacent areas of the Red Sea and the Persian Gulf.

Subsequent to situating the study among current literal works, Chapter 3 provides the geographical and environmental context to this thesis. The Red Sea region was the academic research focus of the MARES Project[2] to which this author belonged. Aspects of maritime culture have been poorly explored in this region and more specifically in boat archaeology and ethnography. This shortcoming contrasts with the rich maritime

[2] The MARES Project team members are: ethno-linguist and researcher in Maritime Material Culture Prof. Dionisius A. Agius acting as principle investigator, ethnographer and maritime archaeologist Dr. John P. Cooper and maritime archaeologist Dr. Chiara Zazzaro as researchers, and myself as an ethnographer, maritime archaeologist and PhD candidate.

heritage of a region which constitutes a cross-road of cultures from the Mediterranean and in the Indian Ocean.

Chapter 3 explores the physical geography, climate and phytogeography of the Red Sea adjacent countries as well as India. The countries studied here are the ones where the MARES team members and I undertook ethnographic research; whilst India is considered as being a major wood provider in both ancient and present times. Thus, this chapter puts forward several wooden resources exploited in boatbuilding, since forest relics of the past still exist in most of the current phytogeographical areas considered here. The extent and nature of the phytogeographical regions concerned also challenges the general assumption that local timber resources were inexistent in areas of the Red Sea. Thus, these regions do hold timber producing species suitable for structural and hull elements in boatbuilding, which were locally exploited since antiquity.

Chapter 4 looks at the theoretical framework of this thesis. It starts by defining traditional practices and societies. It then investigates the concept of ethnoarchaeology and the use of direct analogy, and how these paradigms can colour archaeological interpretations of the wood use in boatbuilding in the Red Sea. This chapter also considers phenomenological hermeneutics pertaining to concepts of sensory perceptions, the dwelling perspective including the notion of taskscapes and affordances, materiality, craftsmanship and apprenticeship, as well as other understandings of nautical wood and its social engagement. Through these concepts, this thesis challenges the orientalist perception of the peoples of the Arab world by which Arab communities are seen as direct inheritors of a distant past. Also, boatbuilding practices are perceived by prevalent modern scholarly research as unchanged through time. This thesis argues that timber processes are not rooted in a 'traditional' past. It goes on to actually show that these are under constant transformation and adaptation to new socio-economic contexts and other factors. Moreover, this thesis argues that people, environments and things are constantly coming into being. It does so by challenging first, the perceived maritime communities of the Arab world, and the Red Sea in particular as traditional societies through the concepts of living traditions, craftsmanship and apprenticeship. Secondly, it reconsiders the notion of a static landscape which is only acted upon through the concepts of dwelling perspective, affordances and taskscapes. Finally it investigates the notion of materiality of timber which is embedded in a boat's narrative that makes it a fluid thing. The other path this chapter explored is the intangible perception of people and the wood material they work with, and how it imbues their personal dialects and sensory awareness. Otherwise, the human bodily experience must also be dwelt upon, through the blending of the senses whilst building a watercraft. Indeed, exploring the dialectal relationship between action and perception opens new ways of enquiry in boat studies, along with a focus on materiality. Such a material-based approach to material culture, argued below, pushes the perception and interpretation of the significance of nautical wood beyond the simplistic functionalist paradigms.. Both concepts, materiality and bodily engagement, are embedded in social and cultural developments throughout time, with both people and their material world reciprocally creating and shaping one another. The ethnographic enquiry stresses that boatbuilders are social actors with a life context through which they perceive the significance of their craftsmanship. It investigated how they came to be boatbuilders through hereditary apprenticeship, which is deeply grounded in contexts of practice, personal involvement, bodily engagement, internalised skills, and an intimate awareness of the material and tools. Tools become assimilated as part of their bodies, whereby technical practices become embodied practices expressed in a social context. Boatbuilders are part of a larger network connecting other people, environments, materials and boats.

In conclusion, the concepts put forth in this chapter are relevant to the present thesis since they constitute hermeneutic tools with which we can view timber exploitation beyond a functionalist perspective, and gather insights about the people behind such practice.

Chapter 5 considers the methodology adopted in this thesis. This approach is multi-disciplinary and pertains to critically considering and interpreting data from textual sources; archaeological data sets; and ethnographic information. It begins by introducing the type and chronological span of the sources studied, that is the works of a wide array of scholars and travellers from classical antiquity (8^{th} century BC- 7^{th} century AD) and the Medieval Islamic period (7^{th} century AD-15^{th} century AD). While Pharaonic Egypt concentrates the main studies about nautical timber, these periods are much less looked at. Arabic being this author's mother tongue, it was an added contribution to focus on the Arabic literary canon of the medieval period, albeit largely unexplored, in a comprehensive study on wood use.

Chapter 5 then looks at the critical approach adopted to describe, contextualise and establish the relevance of the source material at hand. Special attention is brought to the nomenclature and identification of tree species in ancient and medieval sources, when looking at past nautical wood use and timber trade in the Red Sea and the western Indian Ocean. In other words, how can the scientific species used in past be identified and recognised from historical texts.

Follows a description of the type of data and wood analysis of the archaeological material evidencing the nautical use of several timber species, and their significance in terms of provenance and trade patterns. This section also suggests how to interpret the available evidence about timber provenance as either a result of long distance timber import or local wood exploitation. It also puts forward several research questions that both historical and archaeological sources should seek to answer such as: how ancient and medieval boatbuilders accessed timber resources in the Red Sea and the western Indian Ocean; how does nautical timbers in a given period reflect the geopolitics and economic networks of the day; how these variables influence the types of wood exploited and what was the response of wood merchants and boatbuilders to changing wood availability over time. This gives way to the ethnographic approach have adopted in my research which consists of a multi-sited ethnography method (see Section 5.3), that allowed me and my team members to record a fast disappearing aspect of tangible and intangible maritime cultural heritage. It gave me an opportunity to compare past and present practices of using wood in boatbuilding in the Red Sea. In this section, the ethnographic approach aims and objectives gave way to a description of the fieldwork, the settings and the background, as well as the ethical considerations abided by. Finally, the scientific identification of wood samples allowed the verification of vernacular names with their scientific counterparts. It also filled some gaps, mainly on a functional level, caused by the absence of ethnographic information. Explained here are the naming system adopted in this thesis of general and species and the shortcomings of wood identification method.

Exploring the issue of nautical wood in the past is dealt with in chapters 6 and 7. Chapter 6 does not aim at providing a narrative history of classical antiquity and medieval Islamic times of the Red Sea areas, that is from the 8th century BC to the 15th century AD. However, some scale of historical knowledge about the major events and polities of the region during these periods is crucial to understand the geopolitics powering the use of wood in boatbuilding and timber import to these areas. Chapter 6 mainly considers related primary sources and what they indicate about timber trade and wood use in boatbuilding mainly in the Red Sea, but also in the wider western Indian Ocean. It starts by outlining movements of earlier maritime wood trade and nautical wood exploitation from the 3rd millennium BC in the western Indian Ocean, to provide a wider historical scope of the subject. The Red Sea areas tapped into local wood resources, but wood also came from further afar, from the Mediterranean, East Africa and South Asia. The analysis of the textual evidence also suggests other potential areas for wood resourcing. Both classical and medieval Islamic authors identify some species used in boatbuilding in the Red Sea, the Persian Gulf[3] and the rest of the western Indian Ocean. Chapter 6thus analyses the implications of geopolitics in wood resourcing at different periods and in different places; the reasons behind wood use in a boat and properties of timbers; the type of boatbuilding trends transpiring from the texts; the location of boatyards and their periods of function; the main harbours as points of import/export for timber; the timber trade routes; and the economic parameters of the timber trade.

Such themes invite archaeological interpretation, something which is touched upon in Chapter 7. Evidence of timber use in boatbuilding is startlingly scarce in the Red Sea as boats have not occurred in the archaeological records of the Red Sea for the period under consideration, except in recycled/reused on-land contexts. Also, the discipline of maritime archaeology often falls short of providing an appreciation of nautical wood use in antiquity beyond a functionalist perspective. In spite of these limitations, archaeology allows the validation or not of practices related with ancient use of nautical woods as reported by ancient literature, and adds a time-depth to contemporary practices of wood exploitation. It contributes to our understanding of past timber exploitation patterns by offering tangible evidence for ancient and medieval timber use in boatbuilding. Chapter 7 starts by presenting the historical and geographical contexts of sites where archaeological timbers were unearthed during excavation. It then lists the tree species, their characteristics and their possible origin, to subsequently discuss issues pertaining to the nautical exploitation of endemic and non-endemic species to the Red Sea, and how these species and their provenance are woven into a boat's narrative. Finally,

[3] I am adopting the name 'Persian Gulf' which is the historical appellation rather than using the modern name of 'the Gulf'.

Chapter 7 looks at the significance of recycled planks and shavings and how they inform the temporal dimension of a wooden plank.

The final three chapters of this thesis, chapters 8, 9, and 10, consider the ethnographic record of timber use in boatbuilding in the Red Sea areas where Agius, the MARES Project and I conducted fieldwork. These chapters are vehicles for the voices, the knowledge, and experience of our informants,[4] whilst several accounts about a same subject are drawn together and precede my analysis of them. These chapters put the people in the forefront, whilst reflecting the embeddedness of their social and material worlds. Still, narratives in this thesis are limited by the logistics available at the time of undertaking fieldwork, are coloured by my experience, pre-acquired knowledge and partial perspective as well as those of my colleagues.

Chapter 8 compiles an alphabetical inventory of timber-producing trees and provides for each type of wood its physical description, its geographical origin, its nautical applications, and the reasons behind their use in boatbuilding. Chapter 9 investigates the processes behind timber use in boatbuilding. These consider issues of selecting suitable timber-producing trees; acquisition methods of both local and imported tree species; as well as the felling, seasoning and conversion operations of timber boat components. Meanwhile, Chapter 10 pushes the discussion forward for a deeper understanding of the variables that come at play, such as of environmental, political, economical, functional, and more individualistic and interpersonal factors. Identifying such a set of variables for the ethnographic study of nautical timber use in the Red Sea provides the means to go beyond an exclusive functionalist perspective — without discarding it entirely — and offers a deeper understanding of the subject. Indeed, similar factors explaining the changes or not in timber species and sources of import must have existed in earlier times. It follows that explanations for variation in species and their particular use in a boat cannot be only justified by a thrifty exploitation and carving of a wooden component due to the lack of timber resources in the Red Sea. Environmental conditions do, and did in the past, influence the choice of nautical timbers, but not from

[4] When referring to a same statement that was provided by people interviewed separately or collectively by Agius, Cooper and myself, I will henceforth refer to these interviewees as 'our' informants; unless stated otherwise.

a deterministic perspective. This thesis explores how the peoples involved in fetching and using nautical timbers did so whilst taking advantage of the affordances offered to them by the landscape and vice-versa. They did so in specific prevalent political and economic contexts, while relying on their embodied technical skills, internalised knowledge, personal experience, sensory engagements, and their embeddedness in their material world.

2 Situating the study: a literature review

The present thesis builds on and contributes to research on traditional wooden boatbuilding in the western Indian Ocean with a special focus on the Red Sea areas. Egypt's Nile Valley is also comprised within this geographical context since it was a transport route for timbers transiting from the Mediterranean to Red Sea boatbuilding sites from classical antiquity until medieval times. Indeed, Mediterranean timber-producing species were used in boats plying the Red Sea. In addition to Mediterranean timber, Indian woods made their way to the Red Sea region as far back as antiquity, as will be demonstrated in Chapters 6 and 7. In a general sense, there is a lack of historical, archaeological and ethnographic data on the use of wood in boatbuilding in the Red Sea in all periods. This thesis owes its historical context to primary sources encompassing classical European authors and medieval Islamic literature, which include a wide variety of scholars such as botanists, historians, geographers, travellers and lexicographers. It also analyses sources dealing with nautical wood as part of the archaeological record unearthed in the adjacent areas of the Red Sea and the Persian Gulf; as well as using modern botany and wood identification manuals to support, dismiss, and question related arguments. Moreover, this thesis has benefited from maritime ethnography works related with the western Indian Ocean from the early 19th century until present times. It also owes an interpretative debt to post-processual anthropological paradigms that frames its theoretical approach.

2.1 Primary sources

The primary sources looked at here pertain to Greek authors such as 5th century historian Herodotus and 4th century BC-3rd century BC philosopher Theophrastus; to authors from the Roman period such as 1st century Roman naturalist Pliny the Elder and Armenian historian and geographer Strabo. Medieval Islamic sources are more numerous and their writings span five centuries from the 4th /10th century AD to the 9th/15th century AD. The main authors that provided information on the wood use in boatbuilding are: 4th /10th century Arab scholar al-Masᶜūdī; 5th /11th century Andalusian geographer al-Bakrī; 6th/12th Arab geographer al-Idrīsī and Egyptian historian Ibn Mammātī's; 7th/13th Andalusian traveller Ibn Jubayr; 8th/14th Damascene geographer al-Dimashqī, Moroccan traveller Ibn Baṭṭūṭa, and Egyptian historian Al-Nuwayrī l Iskandarānī; and 9th/15th century Egyptian historians Ibn Taghrībirdī and al-Maqrīzī.

It appears that textual data drawn from Graeco-Roman and medieval Islamic sources evolve around three major themes: the use of wood in boatbuilding in a localised geographical context, that is, a particular area of the western Indian Ocean; the use of wood in boatbuilding in a non-specified region, whereby an authority does not state where the practice of using such wood is happening; and finally boatbuilding sites, trade centres and boat typology with no mention of timber species used in boats or traded at such economic centres. Thus, the main focus of this literature review here is to look at the prime literary works that highlighted the use of wood in boatbuilding in the Red Sea and the wider western Indian Ocean. I have looked at both original texts of primary sources and their translations.

Interpreting historical textual data from Graeco-Latin and medieval Islamic writings can be quite challenging since information is skewed by a range of speculations, exaggerations, inaccuracies, myths mixed with facts, and the bias of writers. All these might have been caused by either a lack of personal knowledge from authors, or coloured by the latter political stands as to promote regal powers. Most of the texts, if not all, are available to modern scholars through a series of copies, transcriptions and translations, as Tomber (2008: 20) rightfully argues. For example, such caveats appear in the work of the 5th century Greek historian Herodotus (d. 425 BC) in his *Historia* when some events are exaggerated or lack accuracy, mixing history with myths. Still, the book provides valuable information concerning ancient boatbuilding and general trade in Egypt, Mesopotamia and India.

Another challenge this thesis faces is that the issue of nomenclature of Greek, Latin and Arabic plant names can be quite problematic. The names which I have encountered in English or French translated versions of primary literature are often the ones provided by the editor(s) and/or translator(s) of the sources. These do not always correspond to the correct tree species. Also, a secure identification between the trees mentioned by primary sources and those of today is very hard to achieve (Stanley Pease 1952: 51). Here the reader is referred to Section 5.1.2 where I further investigate this issue. To mitigate this, I addressed the original Greek or Latin texts, having a basic knowledge of both ancient languages, and referred to related lexicons. Equally important is the use of relevant secondary sources which provide reliable interpretation of primary sources. Such is the case of the substantial translation and critical edition by Amigues (2003) of the 4th century BC-3rd century BC Greek philosopher Theophrastus' (d. 285 BC) botanical treatise (Lat.) *Historia Plantarum*, (Eng.) *Enquiry into plants*. Amigues is distinguished from other translators and editors of classical works by combining both a high competence in the classical languages and an-depth knowledge of botany including plant characteristics, properties and taxonomy (Warren 2004). Contrary to Herodotus, Theophrastus had a more scientific approach, thus contributing to the development of botany and plant description, and laying the foundation of scientific botanical terminology (Stanley Pease 1952: 46) and of phytogeography (Stearn 1976: 286). Among, the nine books of his *Historia Plantarum*, Books III, IV, V study various tree species and describe their use for timber in boatbuilding both related to a general context and to more localised practices in Egypt and the island of Tylos (i.e. present Bahrain). Much of Theophrastus statements about species used in boatbuilding in Egypt and the Mediterranean are echoed in (Lat.) *Naturalis Historia* (Eng.) *Natural History* by Roman naturalist Pliny the Elder (d.79 AD). He is an important reference on the development of early botany, although he has been criticised by some lexicographers as lacking sufficient scientific knowledge (Stannard 1965: 420, ft.1), and a compiler rather than a first-hand observer (Stanley Pease 1952: 49; Tomber 2008: 22). For others, his input originates from personal experience, and he could be acclaimed as the 'Father of the History of Botany' (Stannard 1965: 422, 423). Specifically relevant to this study are Books III-VI on geography and ethnography, and Books XII-XXVII on botany. *Naturalis Historia* also includes information on the ancient geography of India and the maritime trade of luxury goods (Basa & Behera 1999: 22-23).

Other important classical European authorities on the nautical wood use in the western Indian Ocean include Armenian historian and geographer Strabo (d. 24 AD), and Roman historian and military commander Arrianus (d. 160 AD). They mention species felled for boatbuilding by Alexander the Great (r. 336–323 BC) in Babylon and the Indus valley. However, both relied on secondary information from scholars such as the Greek geographer Eratosthenes (d. 194 BC), and Greek historian Aristobulus of Cassandreia (d. 301 BC). Strabo's (Lat.) Geographica, (Eng.) The Geography covered the entire scope of peoples and countries known to both Greeks and Romans during the reign of Augustus (r. 27 BC–14 AD). Strabo's main statements about nautical wood were reappraised by the Roman historian and military commander Arrianus (d.160 AD) whose major works include: (Lat.) Anabasis Alexandri, a substantial account of Alexander the Great (r. 336-323 BC) expeditions and conquests; and (Lat.) Indica, a description of Nearchus' (d. 300 BC) voyage from India to the Persian Gulf following Alexander's conquest of the Indus valley.

The only classical reference explicitly mentioning the trade in timber from India– which is usually only inferred from textual sources– to the Persian Gulf figures in the (Lat.) *Periplus Maris Erythraei*, (Eng.) the *Periplus of the Erythraean Sea* dating from the mid-1st century AD. The *Periplus* is an anonymous account of the lands around the Indian Ocean written by a Greek-speaking Egyptian (Schoff 1912; Huntingford 1980; Casson 1989). A traders' guide, divided into 66 sections, it provides a description of the routes to the Red Sea harbours of Egypt, Somalia, the Southern Yemen coast and the west coast of India and offers trading information about the products exchanged at each port. It also gives insights on sailing conditions, political geography, and natural history of the coasts of the Red Sea, East Africa, and the western Indian Ocean (Casson 1989: 8; Tomber 2008: 20). Despite the wide-ranging subjects it covers, the *Periplus* does not explicitly analyse the existing networks between different regions and trading partners (Tomber 2008: 21). Thus, mechanisms of trade in Indian timbers and socio-economic agencies and contexts remain obscure.

For the medieval Islamic period, this thesis relies on Arabic edited versions of related sources, which provides the present author with first-hand observation and analysis. Arabic being this author's native language. Whenever possible, tree species identification provided by the editors of such Arabic works was compared to information from Arabic lexicons such as Lane's (1968) seminal work *Arabic-English Lexicon*. Information on the nautical exploitation of timber, which is not endemic to Red Sea areas, is discussed by three main medieval Islamic authors. They attest the use of teak in the Red Sea and the western Indian Ocean: Arab scholar al-Masᶜūdī (d. 345/956-7) (Ar.) in his *Mūrūj al-dhahab wa maᶜādin al-jawāhir*, (Eng.) *Golden Meadows and Mines of Precious Stones*; Andalusian geographer al-Bakrī (d.487/1094) in his (Ar.) *al-Masālik wa-al-mamālik* (Eng.) *Book of Itineraries and of Kingdoms*; and damascene geographer al-Dimashqī (d.727/1327) author of the cosmography (Ar.) *Nukhbat al-dahr fī ᶜajāʾib al-barr wa-l-baḥr*, (Fr.) *Manuel de la cosmographie du Moyen-Age*. Al-Masᶜūdī relied on both second-hand information, as well as direct observations from his personal travels in Egypt, Syria, the Caspian Sea, Arabia, Iraq, Persia, and India. His work encompasses issues of history of ancient people and Islam, geographic and ethnographic information (Agius 2005: 4). According to Agius (2008:

26), al-Masᶜūdī's data on maritime culture relies on his "intellectual curiosity and is largely based on the accounts of the sea captains, sailors and merchants". The work of Andalusian geographer al-Bakrī pertains to general geography, the Muslim and non-Muslim peoples with focus on North-Africa. The book provides accurate descriptions of towns, and gives insights into the toponymy of the North of Africa and Sudan, and the economy of these regions such as trade and living costs. Al-Dimashqī provides information on the population, flora, fauna and customs of the lands he describes while dedicating special attention to properties and uses of trees. Another important source on boatbuilding in the western Indian Ocean in the 6th/10th century, and the use and trade of coconut is al-Idrīsī (f. 548/1154) with his comprehensive geographical work (Ar.) *Nuzhat al-mushtāq fī ikhtirāq al-āfāq*, (Eng.) *The Stroll of One Who Desires to Cross the Horizons*. Indeed, coconut was an important material in boatbuilding due to its wood used for planking, and the husk used for coir. Al-Idrīsī provides geographical and ethnographical descriptions, and information on fauna and flora of the countries, which he obtained either through his visits or from second-hand sources.

For medieval travel literature two prominent works deserve mentioning, those of Ibn Jubayr (d. 614/1217-8) and Ibn Baṭṭūṭa (d. 770/1368). Ibn Jubayr's (Ar.) *Riḥla*, (Eng.) *A Travel,* mentions import of wood from India and describes Red Sea boatbuilding practices. He also provides general socio-cultural information on the towns he visited but not in relation with nautical timber use. Ibn Baṭṭūṭa's (Ar.) *Tuḥfat al-nuẓẓār fī gharāʾib al-amṣār wa ʿajāʾib al-asfār,* (Eng.) *The Gift of the Observers on the Curiosities of the Countries and the Wonders of Travels,* also known as *Riḥla,* is a rich description of the port towns and their inhabitants which he visited reaching as east as China. Ibn Baṭṭūṭa does not mention nautical wood species but offers interesting insights into Yemeni and Indian boatbuilding, and gender-related practices when he describes how coir is woven by women in the Maldives archipelago.

Other rich historical sources contributing to this study of nautical wood come from Egyptian historians who inform on local species exploitation. Ibn Mammātī's (d. 578/1182) (Ar.) *Kitāb al-qawānīn al-dawāwīn*, (Eng.) *The Book on Law and Accounts of the Treasury*, describes acacia felling and procurement for boatbuilding at Fātīmid and Ayyūbid arsenals. As well as substantial information on administrative agents and taxes related with the exploitation of arboreal stands. Al-Nuwayrī l-Iskandarāni's (fl. 8th/14th century) (Ar.) *Kitāb al-Ilmām fī mā jarat bihi l-aḥkām al-maqḍiyya fī wāqiʿat* *al-Iskandariyya*, (Eng.) *The Book of Knowledge on the Administration of Provisions for the Battle at Alexandria*, testifies to the import of Mediterranean timber species to Egypt for boatbuilding. He also informs on maritime matters and vessel typology. Likewise, Ibn Taghrībirdī (d. 815/1412) mentions Mediterranean timber species export from Antioch to Egypt in his (Ar.) *al-Nujūm al-zāhirah fī mulūk Miṣr wa-l-Qāhirah*, (Eng.) *The Brilliant Stars on the Kings of Egypt and Cairo*. Finally, another main authority on the Egyptian exploitation of arboreal local species such as acacia, tamarisk and lebbek, is al-Maqrīzī (d. 846/1442). In his major works (Ar.) *al-Mawāʿiẓ wa-l-iʿtibār fi dhikr al-khiṭaṭ wa-l-āthār*, (Eng.) *Admonitions and Parables on the Enumeration of the Districts and Remains*, and (Ar.) *al-Sulūk li maʿrifat al-mulūk*, (Eng.) *The Path to the Knowledge about Kings*, al-Maqrīzī quotes Ibn Mammātī to explicate acacia exploitation for boatbuilding. He also mentions Indian and Sudan wood import to Egypt, as well as peripheral, but no less important, information about boatyards in Egypt and boat typology.

I have also looked at several other Medieval Islamic works, but did not find any information related to the use of wood in boatbuilding. These include[5]: Al-Balādhurī

[5] Al-Balādhurī, Aḥmad b. Yaḥya b. Jāber. 1959. *Ansāb al-Ashrāf: taṣnīf Ahmad bin Yahya al-Ma'ruf bi-l-Balādhurī*. M., Hamid Allah, ed., Cairo: Maᶜhad al-makhṭūṭāt bi-jāmiᶜat al-duwal al-ᶜarabiyyah; Al-Bīrūnī, Muḥammad b. Aḥmad Abu al-Rayḥān. 1995. *Kitāb al-jamāhir fī maʿrifat al-jawāhir* 1st ed. Y. Al-Hadi, ed., Tehran: Sharikat al-Nashr al-ᶜIlmī wa-al-Thaqāfī; Ibn Mājid, Shihab al-Din Aḥmad b. Mājid al-Najdī. 1971. *Arab Navigation in the Indian Ocean before the Coming of the Portuguese: being a translation of Kitāb al-fawāʾid fī uṣūl al-baḥr wa-l-qawāʾid by Aḥmad b. Mājid al-Najdī*. G.R. Tibbetts, ed., London: The Royal Asiatic Society of Great Britain and Ireland; Ibn Ṭuwayr, Muḥammad al-Murtaḍā ᶜAbd as-Salām b. al-Ḥasan al-Qaysarānī. 2002. *Nuzhat al-muqlatayn fī Akhbār-daulatayn: Ibn aṭ-Ṭuwayr Muḥammad al-Murtaḍā ʿAbd as-Salām b. al-Ḥasan al-Qaysarānī 524-617/1130- 1220*. A.F. Sayyid, ed., Bibliotheca Islamica. Stuttgart: Steiner; Isḥāq b. al-Ḥusayn. 1929. *Il compendio geografico arabo di Isḥāq ibn al-Ḥusayn: Kitāb ākām al-murjān fi dhikr al-madāʾin al-mashhūrah fī kul makān*. A. Codazzi, ed., Rendiconti della R. Accademia Nazionale dei Lincei: Classe di Scienze Morali, Storiche e Filologiche, Serie 6. 5:373-463; al-Iskandarī, Abū-l-Fatḥ Nasr b. ᶜAbd al-Raḥmān.1990. *Kitāb al-amkinah wa-l-jibāl wa-l-athār wa naḥwiha al-madhkūrah fī-l-akhbār wa-lashʾār*. Frankfurt: Maᶜhad Tarikh al-Ulm al-ᶜArabyah wa-al-Islmyah. Publications of the Institute for the History of Arabic-Islamic Science. Ser. C, Facsimile editions 53; al-Khawārizmī, Abū Jaᶜfar Muᶜammad. 1926. *Kitāb ṣūrat al-arḍ: Das Kitāb Sūrat al-Arḍ des Abū Ğaʿfar Muḥammad ibn Mūsā al-Ḫuwārizmī*. H. von Mžik, ed., Leipzig: Otto Harraffowitz; al-Maraqūshī, al-Ḥasan b. ᶜAlī. 1935. *Jāmiᶜ al-Mabādīʾ wa-l-ghayāt*. In Y. Kamal, *Monumenta Cartographica Africae et Aegypti*, 3.5.1004v-r. Leiden; al-Masᶜūdī, Abu al-Ḥasan ᶜAlī b. al-

(1959), Al-Bīrūnī (1995), Ibn Mājid (1971), Ibn Ṭuwayr (2002), Isḥāq b. al-Ḥusayn (1929), al-Iskandarī (1990), al-Khawārizmī (1926), al-Maraqūshī (1935), al-Mas^c^ūdī (1894), al-Qazwīnī (1848), Qudāmah (1889), al-Ya^c^qūbī (1892), and al-Zamakhsharī (2007).

In conclusion, in antique and medieval primary sources it is possible to find one-off mentions about nautical wood use and trade, whether foreign or local species to the Red Sea. Most of which focus on wood use in Egypt. Little descriptive and analytic attention has been paid by these sources to other areas of the Red Sea. They also fail to provide an in-depth knowledge on timber trade networks, wood exploitation processes and the implication of broader issues such as agencies, phytogeography, and political, economic, social, and environmental parameters, which this thesis intends to consider in its interpretative approach of the subject. This is why this present study seeks analytical information from the archaeological record pertinent to the Red Sea and the wider Indian Ocean.

2.2 Archaeology publications

Archaeology provides precious datasets for the study of the ancient use of timber species in boatbuilding in the Red Sea and the western Indian Ocean. This thesis has benefited from a substantial body of specialist archaeological literature analysing nautical timber remains in Egypt, Oman and Belitung Island. Although the latter falls outside the geographical context of this thesis, the wooden boat that wrecked in its waters is thought to be a 9th century AD Arabian/Persian vessel (Flecker 2000; 2008).

Ḥusayn. 1894. *Kitāb al-tanbīh wa-l-ishrāf*. M.J. de Goeje, ed., Bibliotheca Geographorum Arabicurom 8. Leiden: E.J. Brill; al-Qazwīnī, Zakariyyā b. Muḥammad b. Maḥmūd Abū Yaḥya. 1848. *ᶜAjāʾib al-makhlūqāt wa-ghārāʾib al-mawjūdāt*: *El-Cazwini's Kosmographie* F. Wüstenfeld. Göttingen: Erster Theil. British Library Oriental Mansuscript OR. 3623; Qudāmah**,** Abū al-Faraj Qudāmah b. Jaᶜfar al-Katib al-Baghdādī. 1889. *Kitâb al-Masâlik wa'l-Mamâlik Auctore Abu'l Kâsim Obaidallah ibn Abdallah Ibn Khordâdhbeh accedent excerpta e Kitab al-Kharâj Auctore Kodâma ibn Dja'far*. M.J. de Goeje. Leiden: E.J. Brill; al-Yaᶜqūbī, Aḥmad b. Abū Yaᶜqūb b. Jaᶜfar b. Wahb b. Wadīh. 1892. *Kitab al-Buldān*: Kitab al-Alak an-Nafisa Auctore Abu Ali Ahmed ibn Omar Ibn Rosteh et Kitab Al-Boldan Auctore Ahmed ibn abi Jakub ibn Wadhih al-Kitab Al-Jakubi. M.J.de Goeje. Bibliotheca Geographicorum Arabicorum 7. Leiden: E.J. Brill. 231- 373; al-Zamakhsharī, Abū al-Qāsim Maḥmūd b. ᶜUmar. 2007. *Al-Jibāl wa-al-amkinah wa-al-miyāh, lil-Zamakhsharī, taṣnīf Abī al-Qāsim Maḥmūd b. ʿUmar al-Zamakhsharī, taṣḥīḥ wa-tadqīq Muḥammad Abū ʿĀmūd.* Cairo: al-Jazīrah lil-Nashr wa-al-Tawzīᶜ.

The chronological span of such datasets extends from the 6th century BC to the 15th century AD.

The nautical wood remains from Egypt are either part of a shipwreck or found on-land in recycled contexts, and are located at three sites from North to South respectively at: Heracleion-Thonis in the Bay of Abukir where over 60 shipwrecks have been identified dating from the 6th to the 2nd centuries BC (Fabre 2011; Belov 2013); at Matariya, Cairo where a Late Period (664 BC-323 BC) vessel was discovered (Ward 2000: 129-135); the port site of Quseir on the Red Sea coast, known as Myos Hormos in the Roman period and Quseir al-Qadim in the medieval Islamic period and where nautical wooden artefacts were recovered from recycled contexts from both periods (Van der Veen 2011); the Roman site of Berenike on the Red Sea coast where nautical planks and beams were recycled in on-land buildings (Vermeeren 2000a). Evidence from the 10th-15th centuries contexts at al-Balid site, Oman also consists of hull planks reused as construction material in buildings in the Islamic citadel of the site (Belfioretti & Vosmer 2010).

In these writings it is possible to find descriptions and analyses of nautical wood remains, dating and speculations on origins of timbers and the boats they once constituted, which this thesis intends to question and investigate in light of historical and ethnographic data as well as phytogeographical and taxonomic input. Indeed, the focus of most of these papers is the boats themselves, as they meticulously describe and emphasize the naval architectural aspect.

The Late Period shipwrecks of Heracleion-Thonis (Fabre 2011; Fabre & Belov 2011; Belov 2013) are considered here even if related to a Mediterranean context, because they put forward evidence for exploitation of local species to Egypt such as acacia, sycomore, and oak. Fabre (2011: 17) speaking of a Mediterranean context rightfully notes that: "the use of different woods in shipbuilding is well-documented in the ethnographic and historical literature, which enable a better understanding of the use of certain woods in naval architecture and the selection criteria behind these decisions". Such is not the case in the Red Sea, a gap which this thesis intends to fill. Still Fabre (2001) does not provide ethnographic examples in his analysis which might have informed him on an alternative explanation Fabre exposes potential sources for nautical timber by relying on antique textual evidence but does not establish other archaeological parallels such as with the boat discovered at Matariya. Indeed, a Late Period (664 BC-323 BC) vessel was discovered in 1987 in the Cairo suburb of Matariya in Egypt and comprised of local Egyptian wood species such as sidr and sycomore (Ward 2000: 129-135). Ward states that a further three species were identified but fails to provide the species' names, since the identification she obtained was provided to her by Dr. Shawki Nakhla, the now retired chief conservator of the Supreme Council of Antiquities (SCA), who excavated the boat in 1988. It seems that the conservation was unsuccessful and remains deteriorated,[6] and no further related publications were issued.

The Roman port-sites of Myos Hormos and Berenike and Medieval port-site of Quseir on the Red Sea coast held substantial nautical wood remains which are investigated in Chapter 7 of the present thesis. They highlight the use of both endemic and imported species to Egypt. From the identified imported species a few were from East Africa, while the majority were made of teak from India (Blue 2009: 8-9). This indicates a variety of scenarios as to the place of construction of vessels to which such timbers once belonged (see Section 7.3.3).

Comprehensive publications on the site of Quseir include the article of Gale & Van der Veen (2011) *Wood identifications of the maritime artefacts and timbers* in the second volume published by Peacock & Blue (Eds.) about Myos Hormos/Quseir al-Qadim dedicated to the finds from the excavations from 1999 to 2003. This section on the maritime artefacts of Quseir was also reappraised by Van der Veen *et al.* (2011) in their article entitled *Woodworking and Firewood-Resource Exploitation* in another volume dedicated exclusively to the botanical remains of Myos Hormos/Quseir al-Qadim entitled: *Consumption, trade and innovation, Exploring the botanical remains of the Roman and Islamic ports at Quseir al-Qadim, Egypt*, edited by Van der Veen (2011). Such technical site reports use both quantitative and analytical archaeological data coloured by historical and economic input, to inform on a more human aspect of the trade, that is on the lives of the merchants and other inhabitants of the port. These publications also allowed to correct the identification with teak of a few boat planks which were recycled in medieval burials at Quseir. These were in such a state of deterioration that an identification could not be reached upon re-examination (Van der Veen *et al.* 2011: 207, Table 5.1). Thus, the suggestion of teak import or teak

[6] Dr. Emad Khalil Personal Communication by email on 24th April 2010.

exploitation in boats, dating from the Islamic medieval period and which wrecked in Quseir, was abandoned. This supports the idea of an increase in the use of local Egyptian timbers in the Islamic period, compared to the Roman period, when woods originated in East Africa and India.

Berenike's timbers were analysed and published by archaeobotanist Vermeeren (1999; 2000a; 2000b) and presented in three main reports— the two dating to 2000 are two copies of the same report. They mainly consist of a technical report on desiccated woods from Berenike with emphasis on the methodology of sampling and the microscopic identification of species, and scientific results. Wooden maritime artefacts form only part of the reports, and they consist of recycled hull planks and rigging elements made with Indian and Mediterranean species. Conclusions reached by Vermeeren remain however limited in their scope as they only ponder upon the origin of boats that wrecked at Berenike.

As for the 9th century Belitung wreck it figured in three articles by archaeologist Flecker (2000; 2001; 2008) who was employed in 1999 to continue the excavations started by the commercial company Sea bed Explorations a year earlier. The well-preserved hull has a 15.3 metres long keel and sewn planking over wadding both inboard and outboard and stitched-in frames indicating a western Indian Ocean method of boatbuilding. A first set of wood sampling results was obtained by Forestry and Forest Products Division of the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) in Australia (Flecker 2000, 2001). A second set of results was done by Nili Liphschitz of the Institute of Archaeology, Botanical Laboratories, Tel Aviv University. The comparison of these two sets of results is analysed by this author in Section 7.3.3.2, and their interpretation as to determining the origin of the ship. I also re-question Flecker (2008)'s seemingly biased decision to adopt Liphschitz's results which confer an Arabian/Persian identity to the wreck.

The only site on the Arabian Peninsula that has revealed nautical timber remains to date al-Balid site on the western Indian Ocean coast of Oman. These were parts of boats reused as construction material in buildings in the Islamic citadel of the site (Belfioretti & Vosmer 2010). Belfioretti & Vosmer's (2010) article is the only one which informs us on the nautical timber remains. It possesses numerous caveats which render the interpretation of such archaeological datasets quite challenging (see Section 7.3.3.2).

Issues such as the level of wood identification reached which is neither secure, and this often happens in archaeological wood; nor it is narrowed to species level which consequently restrains the phytogeographical distribution of timber and thus their origin. The *in situ* context from which samples were taken is also not indicated. In the "Observations" part of the article, it seems that the discussion concentrates on interpreting the evidence from the Belitung wreck rather than al-Balid. A rough estimation of the size of the ships from which al-Balid timbers originated is not clearly speculated but only compared with other kind of evidence. Seeking answers to such information gaps, the present author exchanged emails with Vosmer.[7] Failing to answer my queries, he recommended contacting Juris Zarins for more information on the contexts in which these timbers were found. The latter did not reply to this date so re-visiting such data remains an open question, awaiting more wood identification results and in-depth analysis and interpretation.

In conclusion, the archaeological record of nautical wood in the Red Sea and wider Indian Ocean is patchy and inconclusive. Most of the data is concentrated in Egypt, causing a gap in the inquiry pertaining to other areas of the Red Sea, the Persian Gulf and the western Indian Ocean. There are also limitations to the wood identification which the present thesis will shed the light on and how these play in the interpretation of the origin of boats. In trying to complete the picture, along with textual and archaeological datasets, information is sought in ethnographic material related with the use of wood in traditional boatbuilding.

2.3 Ethnography of nautical wood

The study of nautical wood in traditional wooden boats of the Red Sea and the wider western Indian Ocean is at the heart of the present thesis which differs from other boat studies, that rather focus on boat typology and boatbuilding. In most of these latter writings, it is possible to find descriptions and technological or environmental analyses on the wood use in boatbuilding which this thesis does not intend to match. What it rather does is to present a broader perspective on the subject than is usually managed, with an attention to the socio-cultural dimension, and to issues of vernacular names, bodily engagement, taskscapes, and affordances, and a fuller sense of the range of social actors involved in wood cultivation, procurement, and exploitation in boatbuilding,

[7] Emails exchanged on 20th and 26th December 2011.

within a framework which conveys a deeper understanding of such practice. These concepts are quite relevant to this thesis, as they offer an alternative theoretical approach to the concept of analogy in its processual sense (See Chapter 4). They also provide insights into the processes of wood use, the people and their engagement with these processes, which are often absent in the archaeological or historical record.

This research also stands out from other ethnographic studies through the scientific identification of nautical wood samples taken while on fieldwork in the Red Sea areas, to corroborate vernacular names. If it is successful in these respects then much is owed to the boatbuilders and wood merchants of the Red Sea, to the members of the MARES Project who kindly shared their ethnographic data with me, and to the exemplar work of Dr. Rainer Gerisch who identified the wood samples (See 12.5 Appendix 5).

First, I will start reviewing the ethnographic literature related to the use of wood in boatbuilding in the Red Sea areas as well as early ethnobotanical works which inform on vernacular names of local species. Wood species used in boatbuilding were not only endemic to the Red Sea areas but timber sources were brought from further afar in the western Indian Ocean. Thus, this literature review includes ethnographic works pertaining to places such as the Persian Gulf and India. It also encompasses early works that are those of imperial officers of the 19th century, which represent a point of departure for subsequent ethnographic works undertaken by scholars in the course of the 20th and 21st centuries. It has to be said that there is a lack of substantial works dealing with the western Indian Ocean exclusively dedicated to the typology and import of wood to the Red Sea. Most of the works consist rather of articles than books, which contain incomplete or inaccurate information. This is perhaps due to the fact that the subject of recognising wood species is more of a recent subject of interest.

2.3.1 The Red Sea areas

A few references mention the wood species used in traditional boatbuilding in the Red Sea. Quite often such publications adopt the prevalent typo-technological approaches to traditional wooden boats. As Ransley argues: "The typo-technological discussion of boats in traditional boat studies, with its functionally and environmentally determinist perspectives, is underpinned by the separation of technology from social relations" (Ransley 2009: 174). Thus, the socio-cultural background of boatbuilders is often lacking as well as an investigation of timber exploitation processes and the parameters that come in play (See Chapters 9 and 10). Still such ethnographic studies open the door for further investigation, and for a comparative approach for the scope of this thesis.

In terms of content, information is also patchy. Even if some works hint at the exploitation of local woods, at times the species remain unidentified by authors. As such, in his article on *Craft of the Red Sea and Gulf of Aden*, maritime historian Alan Moore (1920: 142) says: "No doubt they [the Red Sea peoples] could import better timber and canvas and rope, but they manage with what they have, and if it serves, why use other?". Despite this, Moore remains an important contribution to Red Sea vessels' typology which he observed in various areas such as Massawa in Eritrea, Port Sudan in Sudan, Yanbu in Saudi Arabia and Aden in Yemen.

In the early mid-20th century, Hornell (1942: 17-20) says Malabar teak shapes the hull planks of the *sanbūq* which are nailed together, while the frames are made of natural crooks of jungle wood (ibid: 19). The *sanbūq* Hornell describes is a cargo ship of the Red Sea carrying cargo and passengers, and is involved in pilgrimage of Muslims from Africa through Quseir and Suakin to Jeddah, and from there to Mecca (ibid: 18). With his pioneering article on the classification of Arabian sea-craft, Hornell set the original archetype for boat typology in the Red Sea and the Persian Gulf. The article is focused on construction and categorisation of vessels disembedded from their socio-cultural contexts.

Subsequent ethnographic work done by scholars in the Red Sea somehow follow this trend and mainly pertain to Yemen. They do give more information on local tree species as well as types of imported wood. In his comprehensive book on dhows, Hawkins (1977: 58) enumerates the types of nautical wood he observed at a boatbuilding yard at Ma'alla, Yemen. These include: jungle wood for the frames imported from Malabar in India along with "jackwood and babul" timber; for the planking "teak and venteak" are used; and for the masts and spars "punnai" is used. Hawkins does not provide any scientific identification of these woods. But he does justify the use of *punnai* for the masts by being stronger and more flexible than teak that can be "too brittle and liable to fracture under stress" (ibid: 94). Prados (1997) explains the use of the different woods he recorded in the Tihama, Yemen from an economic point of view. He says to cut costs, Tihamese boatbuilders have substitute teak planking with "less expensive grade of wood" such as "pine (red pine), spruce (Picea) or *zinjil* (*Kapar* [*Dryobalanops*])". It is not clear how Prados identified *zinjil* with *Dryobalanops* sp. He describes *zinjil*, imported from India and Java, as being a reddish hardwood, stronger than pine, used in the lower planking below the waterline, but is not as durable as teak against marine borers. Pine, imported from Italy and Sweden, is used for the rest of the hull planking also in an attempt to reduce costs (ibid: 194-195). He also reports the use of "*ʿarj* (*Ziziphus spina-christi*), *sumar* (a species of *Acacia spp.*), and *hulaj* (*Balanites aegyptiaca*)", as natural crooks of wood for frames in the extended log hūrīs he observed in Yemen (Prados 1996: 94). During Agius *et al.*'s (2010) fieldwork in Yemen, they note the use of local species for the frames such as *damas* (*Conocarpus lancifolius*) and *muraymirah* (*Melia azedarach*). In their article Agius *et al.* provided a few insights on the socio-cultural backgrounds of these boats.

Apart from Yemen, there is a stark absence of publications about ethnographic boat studies in the Red Sea — a gap which the present thesis as well as the work of the MARES Project aims to fill. The members of the MARES team including myself conducted technical and non-technical surveys in several areas of the Red Sea while adopting a multi-disciplinary methodology combining ethnography with archaeology, socio-historical and cultural approaches and linguistics (see Section 5.3.2). Such coherent teamwork is the first of its kind in Red Sea boat studies. The fruit of the MARES team research will be published in the near future in two or more monographs. The first forthcoming book is Agius's *The Life of the Red Sea Dhow: A Cultural History of Seaborne Exploration*, who has been surveying the northern region of the Red Sea coasts for the past 12 years. The second consists of an archaeological survey of southern Red Sea boats, and is authored by John P. Cooper and Chiara Zazzaro with contributions from Agius. Noteworthy is Madani's (1986) theses on boatbuilding in the Sudan and how material culture contributes to the understanding of Sudanese cultural morphology. Madani does not dedicate a chapter of his book to timber species but only mentions the local acacia and imported *zan* (?) wood through the conversations with his informants. He remains an important reference in indigenous work on Sudanese maritime ethnography. Finally, the *Boutres de Djibouti* by Perrier (1992) is a modest book where he presents an overview of traditional boats he observed there but also in Yemen with sketches, notes and photographs. He does not dedicate a section of his book to wood but rather mentions wood types as footnotes since he explains that he could not verify the information he was provided with. He notes the use of local species to Yemen such as *kusra* and *arg*, as well as wood imported from India such as *benteak* and *jingali*. He does not however justify the utilisation of wood in the correspondent boats components (Perrier 1992: 54, 56, 58, 59, 60, 70).

Now that an overview of the ethnographic material related with the use of wood in traditional boatbuilding has been investigated above, this author will review ethnographic material pertaining to botany and vernacular names of endemic arboreal species, exploited for nautical uses in the Red Sea. These constitute essential references when investigating vernacular names of trees (Chapter 8).

2.3.2 Ethnographic work on tree species in the Red Sea

In 1761, naturalist Peter Forsskål (d.1763) was sent by the Danish crown, along with four other scholars, to study the flora, fauna and minerals of Egypt and Yemen and their local Arabic names. They all died before returning to Copenhagen except for surveyor and cartographer Carsten Niebuhr who published the work of Forsskål on plants and trees under the name *Flora Aegyptiaco- Arabica* in 1775. This flora collection was revisited by several botanists from then until the more recent publication of Hepper & Friis's (1994) *The plants of Pehr Forsskål's Flora Aegyptiaco-Arabica*, complimented by Provençal's (2010) *The Arabic plant names of Peter Forsskål's flora Aegyptiaco-Arabica*, who mainly treated the linguistic material. Forsskål collected herbarium material and recorded the local Arabic names of plants and trees in Arabic and Latin characters; and "if the same item had different names in different places, the variants of these names" were also noted (Provençal 2010: 9).[8] "One of the great contributions to botany from the 18th century" and to the "study of Classical Arabic botanical texts" (Provençal 2010: 9-10), Forsskål's work remains a crucial reference for tree species of the Red Sea.

Another important early contribution to the flora of the Red Sea is the archives of the Botanical Collecting Expedition in the Anglo-Egyptian Sudan 1933-1934. It consists of the diaries and photographs of English botanist James Edgar Dandy, and Dunstan Skilbeck specialist in rural economy (Keenan 2011). Their expedition aimed at studying the soil and vegetation of the South Western Sudan, and the scientists collected some 732 specimens of the region's flora. The photographs are particularly interesting as they

[8] See Hepper & Friis (1994: 23-51) and Provençal (2010: 9-11) for more on the linguistic and taxonomic contribution and treatment of Forsskål’s work.

illustrate trees species that formed the landscape of Sudan at that time, but also show some traditional sailing boats plying the White Nile. The archival material fails however to provide vernacular names of trees and their use in boatbuilding. Worth noting is a picture taken by Dandy that illustrates a man holding a paddle on a dug-out canoe used for fishing (Keenan 2010: 332, 341, number 308, 342) (Figure 2.1). The picture is titled: "A native in his dug-out canoe on the River Jur at Gorinti. Same canoe in which I went out. 25 Mar. 1934". No further information is provided about the type of tree the canoe was hollowed from or the carving process. The log is most probably of an endemic tree species from the Gorinti forest stands. Now, much earlier in the 19th century, in his "Travels in Nubia", Burckhardt (1819: 270) observed "ferry-boats" hollowed out of a "large Nebek tree" on the Nile at Damer, in north-eastern Sudan; This "Nebek" is enigmatic as Burckhardt did not mention its scientific name. I trust it cannot be considered as a phonetic error for nabq (Lat. *Ziziphus spina-christi* (L.) Desf) since it is a relatively short tree of 5 metres; nor can it be a lebbeck tree (Lat. *Albizia lebbeck* (L.) Benth.) (Figure 12.10), since lebbeck was only introduced from India to Sudan in the 1960s (Elzaki *et al.* 2012: 76). This enigmatic Nebek might be the tree pictured by Dandy (Figure 2.1). Otherwise, in a personal communication with Mary Keenan[9] she tentatively suggests the canoe might have been made from the Kapok tree (*Ceiba pentandra* (L.) Gaertn.). It is a tree which can reach 70 metres in height and is used for canoes (Mabberley 1998: 163). Keenan adds that it grows in Southern Sudan around the Yei-Maridi area, and was noted but not collected by the expedition (Keenan 2010: 244, 255, 257, 290, 291).

Figure 2.1: Indigenous dugout on the river Jur at Gorantini, Sudan (Keenan 2010: 341, number 308).

[9] By email on 11th June 2012 and 18th July 2012.

As seen in the above ethnographic accounts, imported timber to the Red Sea came from afar, originating in areas of the wider western Indian Ocean such as India with its rich arboreal cover. Thus, it is now important to review works pertaining to the ethnography of maritime communities in the western Indian Ocean and their contribution to the use of wood in boatbuilding.

2.3.3 Ethnographic contribution to nautical wood in the western Indian Ocean

There is a wealth of information on ethnographic research of boatbuilding traditions in the western Indian Ocean. It has to be said that such studies depart "from historically-situated perspectives and are shaped by a particular, culturally-specific paradigm" (Ransley 2009: 6). Indeed, in the early 19th and 20th centuries, ethnographic accounts on 'native' vessels of the Indian Ocean and the Red Sea are inscribed in the colonial framework of that time. Such works encompass major contribution to maritime ethnography by the colonial administrators of south Asian ports such as Edye (1834), Pâris (1841-1843), Wilson (1909), and Moore (1920). In these studies, traditional indigenous vessels are described and classified in terms of their dimensions, physical appearance, joining method, means of propulsion, crew, and function. These descriptive catalogues gave way for nautical researchers such as Hornell (1920, 1942, 1946), and LeBaron Bowen (1949) to perpetuate the scholarly practice of classificatory surveying, also focused on typology, construction and propulsion of boats. However credit is due to Hornell's (1946) *Water Transport* for being the first scholarly and comprehensive traditional boat typology from around the world. Still, Hornell's and LeBaron Bowen approach is an external and objective one, which focuses on the evolutionary narrative of boats as technology, dissociated from socio-cultural meanings, and on creating a reference collection for the sake of the recording in itself. These author belong to a colonialist cultural context where there are, as Ransley (2009: 7) rightfully sums it: "no attempts to qualify, analyse or understand the motivations, assumed purpose or supposed applications of the work. Equally, unsurprisingly, these studies are not concerned with the multivalent relations that produce the watery worlds of these boats. These studies are driven by a different impetus and framed by a particular theoretical, scientific paradigm, a *modern*, Western, Cartesian understanding of the world". With this critical framework in mind, what follows draws only on publications that hold information on timber species and their uses in boatbuilding, starting from early ethnographic works of colonial administrators and moving on to modern scholars. Early works do not unfortunately offer much detail into wood exploitation; whereas later research although adopting a thorough methodology have information gaps due to the lack of branching out into other areas of knowledge. Thus, the reason why this section might seem incomplete to an erudite scholar in boat studies, it is because I have only included works that contributed to my study, and thus have information on nautical wood exploitation. This is why most of the major works on boat studies which do not pertain to timber have been excluded.

Starting off with early works, Edye's (1834) paper offers a classification of boat types, and their geographical distribution in India, on the southwest coast of Malabar and the southeast coast of Coromandel, as well as in Sri-Lanka. Interestingly, Edye has noted the wood types- all of which are native species to India- from which these boats are made by mentioning the local nomenclature of the tree and sometimes its English equivalent. He has therefore attempted an identification of the tree species, which could not always be verified, or cross-checked due to a lack of sources on vernacular Indian tree names. For example: He says "*Dúp* wood, or *cherne-maram* (pine tree)" were used for rafts Edye calls catamarans, with a bamboo mast and yard for the sail (Edye 1834: 4). I could not find a related species identification for the *cherne-maram* which Edye indicates as a type of pine. But the closest identification I found of *Dúp* wood is the species *Vateria indica* (L.) from the Dipterocarpaceae family, commonly known as Dhupa or piney varnish tree (Mabberley 2008: 892).[10] This identification seems valid since later Edye mentions both names together, while committing a typo in the 'piney' name. He says that a log of "*dúp*-wood or pine varnish tree" constitutes his "Point-de-galle canoe" (ibid: 5). It is not clear what Edye means by Point-de-galle. Another type of canoe Edye calls "Canoe of the Malabar coast" are hollowed out of either *angeley* wood for the better quality ones, or *cherne-maram* (pine tree) (ibid: 5-6). *Angeley* wood is also used for what he calls the "Snake-boats of Cochin" a long river canoe (Length: between 9-18 metres) for people transport (Edye 1834: 6,7). Edye tentatively identifies *angeley* also called *anjeli* or *anjili* with *Artocarpus hirsuta* (Lam.) (Figure 12.12). Usher (1974: 62) confirms this identification and states that this "dark strong light durable wood" can be used as a substitute for teak. Both Usher (1974: 62) and Mabberley (2008: 71) attest this south Indian wood as being used in boatbuilding. Edye (ibid: 6, 7) describes the wood as originating from "the solid tree" and that it is "very durable, if

[10] http://www.thewoodexplorer.com/maindata/we1216.html [Accessed on 11th November 2014].

kept oiled." As for planked boats, teak was used for the planking and jungle –wood for the frames of the Patamárs; these are around 23 metres in length and can carry up to 200 tons of cargo which might explain the use of strong durable wood such as teak. These vessels are large nailed vessels belonging to Bombay merchants that transport timber, among other cargo, to Bombay (Edye 1834: 10, 11). Edye (ibid: 14) mentions "all sorts" of jungle wood for building of a trading sailing vessel of the Indian Ocean he calls "Boatila Manche". It seems here that 'jungle wood' designates several types of trees, or kinds of timber. However, I have not found an identification of 'jungle wood' to be able to verify this and determine which tree species were exploited in this context. Nevertheless, 'jungle wood' might be similar to local names *zangali*, *zengali* or *jangal* noted by Agius and Cooper during their fieldwork in Djibouti, Eritrea, and Yemen on the Red Sea coast. This type of wood was used for planks, keels, and frames and said to be imported from India and South-East Asia. In my interview with Ibrahim Ahmed Bilghaith[11] a 55-year-old Saudi dhow builder in Jizan, he says that *zangali* is the Yemeni name of *jāwī*, a wood species identified as *Shorea* sp. by Rainer Gerisch from a wood sample taken from Bilgaith shipyard.

A few years later, the French admiral Pâris (1841) dedicates a substantial part of his *Essai sur la construction navale des peuples extra-européens* to the construction of traditional boats of the Indian Ocean. However, he does not provide much information on the use of wood, with the exception of teak, coconut and pine. He states that teak from Malabar, India is used for the 'Arab' ships called Baggalas (Pâris 1841: 10). When describing a Bombay boatyard established by the British, he describes how teak is used in ship construction for its physical properties, and working characteristics. However, he says that due to its high cost it was a wood that was already becoming rare (ibid: 17). Although one would suspect that such economical causation should be inversed i.e. that due to heavy exploitation teak became rare, and thus its price rose. Teak from surroundings mountains was also employed in Cochin's boatyard as the main raw construction material (ibid: 23). Coconut wood was exploited by the Maldives people for their boats along with other wood types they imported from India (ibid: 26). Local pine wood was used for fishing rafts north of Madras on the Coromandel Coast (ibid: 38). Such rafts are most probably catamarans but Pâris fails to refer to them as such. Among the British colonial administrator, Commander Wilson (1909) was the Assistant

[11] Interviewed on 11th May 2010.

Port Officer at Bombay harbour where he recorded the "native vessels" visiting the harbour or being constructed there. He notes that planks made of teak and jungle wood were used for building hulls, with jungle wood serving in the frames, while "paunnai" wood was used for the masts (ibid: 5-6, 14, 20, 31, 42, 50, 62, 71, 75, 81, 88, 93).

As for subsequent scholars who continued the classificatory approach of the above-mentioned imperial officials, noteworthy are the works of Hornell (1942) and LeBaron Bowen (1949). The Arabian ships Hornell (1942: 15-17) described are carvel built, frame-first, built in the ports of the Red Sea, the Persian Gulf, the Gulf of Aden, the coasts of Oman, Somaliland and Zanzibar. He mentions three types of teak: Burma; Mysore; and Malabar as well as the previously mentioned 'jungle wood' which were used in the construction of these ships (Hornell 1942: 13). The nautical researcher LeBaron Bowen (1949: 109, 110, 118) observed that the hulls of dhows of Eastern Arabia were, at his time, made with teak. As for the frames, they were made with "Persian hardwood" because their curves correspond to the contour of the boat (ibid: 109). LeBaron Bowen did not give vernacular or scientific names for this "Persian hardwood", but considering the context he might be hinting at local woods that grow in the Gulf such as *acacia* and *sidr* (Lat. *Ziziphus spina-christi* (L.) Desf.). The same applies nowadays to the Red Sea areas where the MARES team and I conducted fieldwork: the frames are made with local woods, and the planking with imported timber, as I will demonstrate in Chapter 8.

In subsequent publications, some authors continue in the typo-technological approach and conception of boats, with several ethnographic works in the western Indian Ocean as well as in South East Asia involving the classification of watercraft such as Greenhill (1957, 1963), and Hawkins (1965). That is to say that boats are contextualised through a form of technological evolution, and considered as functional objects coming into being through a network of materials, environment and economics. Some of these meet high standards of documentation and accurate recording of boatbuilding techniques, the various types of boats, their geographical distribution, their function and methods of propulsion. They also superficially consider ethno-archaeological, historical and social inputs such as Prins (1986), Kunhali (1993), Blue *et al.* (1997), Prados (1996; 1997; 1998), Vosmer (1997), Kentley *et al.* (1999), Kentley (1987; 1996; 1999), Blue (2002), McGrail *et al.* (2003), Pham *et al.* (2010), Shaikh *et al.* (2012). For a critique of such trends and an alternative approach to ethnographic boat studies, the reader should refer to Ransley's work (2009) on the backwater boats of Kerala. She rightfully estimates that such a version of ethnoarchaeology, the relationship between material culture, social meaning and place remains largely unexplored (Ransley 2009: 8). Indeed, some of the reference mentioned above lack true understanding of the socio-political, cultural and linguistic factors. Also, most who work in Arab countries, do not master the language and thus much can be lost through interpretation and translation. There also seem to be a lack of collaboration among 'western' and 'eastern' researchers as to boat studies in the western Indian Ocean. This is something that I aim to mitigate through my thesis and it has been also adopted by the MARES team members. Indeed, in his books Agius (2002, 2005) has used ethno-linguistic cultural skills and endeavoured to detach himself from Euro-centric approaches by considering prominent Arabic research works for example.

Most directly relevant to this thesis, some of the above-mentioned publications show a vivid interest in the types of woods used in boatbuilding. Some others only generically mention wood use in boatbuilding without providing any species' name, for example: during his fieldwork in Somalia in 1975, Chittick (1980: 302) noted that timber for building a *beden*, a sewn vessel found on the coasts of the country, had either African sources from Mombasa, in Kenya and Tanga in Tanzania, or was imported from India via Mukalla and Aden. Therefore, we do not possess any information as to which types these African and Indian woods belong. In contrast, Falck's (2014) paper on traditional boats around the coasts of mainland Tanzania and the island of Zanzibar, does mention several locally-sourced species for boatbuilding. Thus, we might get an idea of what Chittick (1980) might have encountered. Falck's article is also relevant as it pertains to timber species exploited in East Africa and might have been used in boatbuilding plying the western Indian Ocean since antiquity. The names of tree species referred to in Falck's paper were provided by the builders he spoke with, and were "matched to the respective Latin names based on the geographical occurrence of the species, but no positive botanical identification was undertaken" (Falck 2014: 167). However, Falck only reports one vernacular name of species while the rest are named in English. Falck's (2014) observations on site were contrasted with data from the literature. They are still inscribed in the tradition of constructionalist and functionalist trends focusing on the use of the boat, its construction details and means of propulsion with a few insights on economic implications. Another contribution to sewn boats from around the world, is the work of Prins (1986) which investigates the taxonomy of sewn boats, their construction techniques and their geographical distribution, while focusing on two case studies of sewn boats in Northern Europe and on the Swahili coast. There is not, however, a dedicated section to the timber species that are used in sewn boats and wood types are very rarely mentioned. The information also comes from second hand sources and not from direct observation. Quoting a German biologist who travelled to the Lamu islands in 1903, Prins (ibid: 70) says that mangrove constituted the bowsprit of one vessel he calls "dau la mtepe". Mangrove is also mentioned by Prins (ibid: 84) as being used for the hull planking of a double-ended boat he calls mtepe. Finally, he quotes Lydekker, who describes boats in North Kenya as built with coconut timbers (ibid: 71).

An important and one of the very few Arab scholars who has worked on tradition boatbuilding in the Gulf is Al-Hijji's (2001) *Art of Dhow-building in Kuwait*. Al-Hijji dedicates a chapter of his book on timbers used in boatbuilding in Kuwait at the times of his research including changes in quality, quantity and wood provenance in recent decades. As for South Asia, McGrail *et al.*'s (2003) monograph on the boats of the east coast of South Asia is one of the latest contributions to the ethnographic study of indigenous boats in the Indian Ocean from a technical perspective. The study is based on a classification and typology of traditional boats, their construction, propulsion and function. The papers of this monograph that cite wood species used in boatbuilding are mentioned here, where the method of citing types of wood is neither systematic nor consistent. Indeed, names designating the wood types appear under several formats, throughout the book: The vernacular name is cited either by itself, or with the English equivalent, or with the scientific identification, that is the binominal Latin name, but the three of them never figure together to provide a complete picture of the nomenclature. When the vernacular name figures alone it is up to the reader to enquire further about the scientific identification of the species mentioned. At other times, the authors cite the English name either solely or with the scientific identification, falling short of providing the vernacular name crucial to ethnographic and linguistic reporting. Finally, there is an inconsistency in providing wood names. For example: Kentley (2003: 137) mentions *Shorea robusta* followed by *sal* the vernacular name, and *Syzigium cuminii* without the vernacular name. What he is doing is that in the same sentence he provides a scientific name with its vernacular counterpart, followed by a scientific name without its vernacular counterpart. This skews the information for the reader as he/she misses out on the local names for timbers. Also, it is not clear how the authors provided the scientific identification of vernacular names, i.e. if it was through wood sampling or from oral sources. Another issue is the lack of background context provided for timbers used in the different areas mentioned in this monograph. Not always does one know where the timber originates from and what the reasons or motivations are behind its use in particular parts of boats. Descriptions of different timbers are also lacking. All this might be due to the fact that nautical timber was not given priority in McGrail *et al.* (2003) ethnographic study. Despite these shortcomings, this monograph offers, whenever possible, concise nomenclature of tree species by researchers who are not timber species experts.

Special attention has been dedicated in this thesis to publications by Indian authors pertaining to nautical timber use in India. Such timbers hold the potential, I believe, of having been exported to the Red Sea and the Persian Gulf in ancient times, since they share similar physical properties with the commonly exported teak. Bhattacharyya (2006) provides precious information on both Indian vernacular names of wood used in traditional boatbuilding in India while conferring an economical aspect to his analysis. Other relevant articles on the use of nautical wood include Greeshmalatha & Rajamanickam (1993) on traditional coastal vessels of Kerala; Kunhali (1993) on timbers used in Beypore boatbuilding and the associated social context of boatbuilders; Rajamanickam (2004) on his all-encompassing study of traditional Indian shipbuilding with historical and technological insights; and Shaikh *et al.* (2012) on the sewn-plank boats of Goa. However, in most of these studies, apart from Kunhali, the significance of the socio-cultural context is still lacking.

In conclusion, when wood types are provided in the ethnographic literature related to boat studies, the information is often disembedded from its socio-cultural context. Timbers are perceived as passive materials disengaged from their materiality (see Section 4.4). Data in such literature is limited to the name and use of the wood without socio-technological background, as to choices taken by boatbuilders, their perceptions of the properties of wood or any other impetus that may dictate such choices. Also, there is a staggering gap in such studies in that they dismiss networks of interaction between the material, i.e. timber, people and the environment these people dwell in, and exploit for wood resources. Also, most of the ethnographic literature lack a balance of archaeological, socio-historical and cultural identity, and linguistic input to draw a fuller picture on the exploitation of timbers in boatbuilding. It is by adopting such a multi-disciplinary approach with polyvalent researchers that the MARES Project succeeded in producing substantial research on the Red Sea maritime tangible and intangible cultural heritage.

Finally, the present thesis owes its historical background to the primary sources and archaeological record pertaining to the use of wood in boatbuilding in the Red Sea. It is certain that the picture is skewed by a focus on Egypt, while information on other areas of the Red Sea is absent in these two sources of information. However, the ethnographic literature is quite diverse and provides the present author with enough impetus for processing the data from hers and MARES' fieldwork to investigate timber exploitation processes and timber trade in present times. The present author also draws on ethnography to a better understanding of past timber exploitation processes, while taking a more centred approach on the socio-cultural significance of such processes. Indeed, it is this author's belief that present-day examples can illuminate the archaeological record, while reflexively tackling archaeological interpretations, as well as expand potential readings of archaeological material, rather than to constitute a model on which past reconstructions would implicitly be based and fitted.

3 Physical settings and phytogeography of the western Indian Ocean

This chapter sheds light on the physical geography, climate and phytogeography of the western Indian Ocean, the wider area of concern in this thesis, while focusing on its two main watery arteries: the Red Sea and the Persian Gulf. A wider area is considered here as timber for boatbuilding in the Red Sea was and still is fetched from further afar (See Chapters 6,7, and Appendix 3). This chapter provides the geographical and environmental context of the present thesis and allows the reader to grasp the various wooden resources exploited, since antiquity, in boatbuilding.

Phytogeography is the branch of botany concerned with the geographical distribution of plants. Each phytogeographical region consists of distinct associations of plants (Willcox 1992: 2). Only the phytogeographical regions of the countries bordering the western Indian Ocean basin and their hinterland are studied here; along with the arboreal vegetation which might have been exploited by humans for boatbuilding. The phytogeographical regions are the present-day ones since this thesis deals mainly with the ethnographic aspect of wood used in boatbuilding. Also, more available literature exists on present-day delimitations of regions than historical ones. However, in most of the regions, forest relics of the past still exist in the current phytogeographical areas considered here, and provide us with insights on ancient nautical timber exploitation. The extent and nature of the phytogeographical regions concerned also challenges the general assumption that local wooden resources were quasi-absent in areas of the Red Sea and the Persian Gulf. Thus, these regions do hold timber-producing species suitable for structural elements in boatbuilding, and these were locally exploited since antiquity.

The western Indian Ocean is a maritime space in which the geographical area is bordered by Africa in the west; Antarctica in the south; the Red Sea, the Persian Gulf, the Arabian Sea, and the Bay of Bengal in the north; and the west coast of India in the east (Chakravarti 2002: 30; Pearson 2003: 14-15) (Figure 3.1).

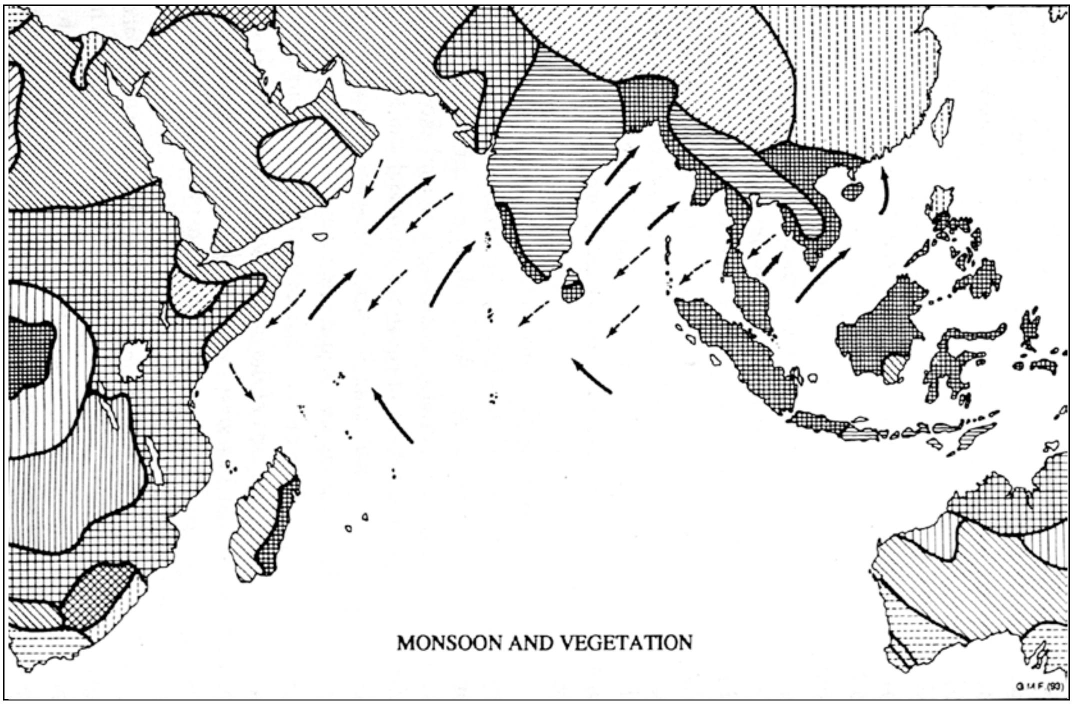
Figure 3.1: Map of the western Indian Ocean (Modified from http://www.geographicguide.com/africa-maps/indianocean.htm [Accessed 28th June 2015]).

Past civilizations of Egypt, Arabia, Mesopotamia, Persia and the Indian sub-continent used the western Indian Ocean to develop their primary maritime trading networks (McPherson 1993: 5). "These sea routes were linked in turn to overland trade routes which bound sea and land in a tight economic relationship, in which the rhythms of agricultural life interacted with the rhythms of the seasonal monsoons to set the pace of maritime activity" (McPherson 1993: 5). The geographical situation of the Red Sea and Persian Gulf made these maritime ways important networks of communication and trade since antiquity, not only linking the Mediterranean world with the Indian Ocean, but also their opposite coasts and connecting rivers such as the Tigris and the Euphrates in the Persian Gulf (Sanlaville 1988: 10, 25).

The sources and distribution of nautical wood species are investigated here, as well as the climate conditions that encouraged their growth. It is noteworthy that the investigation of relict forests in present degraded vegetation of our concerned areas shed the light on ancient potential wood resources, as Willcox (1992: 2) believed.

3.1 Physical features and climate of the western Indian Ocean

The maritime topography of the western Indian Ocean is quite diverse, varying from protected bays to coasts exposed to the ocean, desert to fertile shores, a vast array of islands and coral reefs, and several choke points such as the Straits of Hormuz and the Bab al Mandab (Pearson 2003: 16-19). The Red Sea and the Persian Gulf are two continental seas tributary to the western Indian Ocean which are narrow and penetrate deeply the continental mass on each side of the Arabian Peninsula (Sanlaville 1988: 24) (Figure 3.1). They straddle the level of the Tropic of Cancer and thus enjoy similar climatic conditions to each other, notably an arid environment, high summer temperatures, low rainfall, and the scarcity of water sources (Sanlaville 1988: 10-11, 16, 18). Despite these conditions, the hinterlands of the Red Sea and the Persian Gulf, as will be demonstrated below, held forest and isolated tree stands providing timber for boatbuilding. The mountain stands of Sudan and Ethiopia, the Asir mountains in southwest Saudi Arabia, and mountains in Yemen receive more rainfall than the arid coastal areas of the Red Sea (McPherson 1993: 14; Sanlaville 1988: 11, 18). The Persian Gulf is less arid than the Red Sea and several regions receive some rainfall, such as the mountains of Oman and the Zagros mountain range in Iran (Sanlaville 1988: 11-13). While the northern parts of the Red Sea and the Persian Gulf are affected by scattered winter rainfall, the southern parts are directly influenced by the summer tropical rainfall of the Indian Ocean monsoon cycle[12] (McPherson 1993: 14; Sanlaville 1988: 13). The modern botanist Zohary (1973: 16) explains that vegetation is sustained due to sufficient moisture amount independently of heat degrees or soil types. Thus, the monsoon rain sustains vegetation growth mainly in South Asia with semi-tropical, tropical and equatorial thick forest stands (McPherson 1993: 9, 14) (Figure 3.2). Thus, it was mainly from the Western Indian and the Indus mountains that ancient boatbuilders acquired their timber. Another factor encouraging the growth of trees providing boat timbers is the seawater of the Red Sea and Persian Gulf which are warm and saline; thus favourable to the development of the seaside mangrove trees (Zohary 1973: 458; Sanlaville 1988: 14), which were traded since antiquity for their use in boatbuilding. The several islands dotting the western Indian Ocean such as the Maldives and Madagascar (McPherson 1993: 14), also held important forest resources that were exploited in boatbuilding since at least the Islamic medieval period.



[12] For details on the monsoon cycle refer to McPherson (1993: 9), Arenson (1988: 245-246), Sanlaville (1988: 20), Pearson (2003: 19-21).

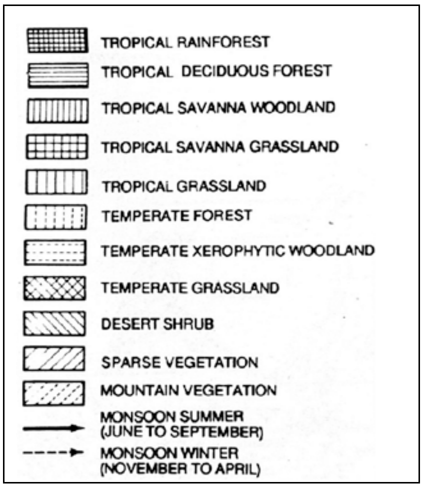


Figure 3.2: Monsoon and vegetation (McPherson 1993: 10-11, Map 1)

3.1.1 The Red Sea

The Red Sea basin is about 2200 km long and up to 300 km wide (Sanlaville 1988: 9). At the entrance to the Red Sea, the Bab al Mandab at its narrowest is only 12 km wide. It is at these choke points that port cities are usually found (Pearson 2003: 19). The Red Sea basin is framed within a mountainous edge which drops sharply on a narrow coastline bordering a deep sea rich in coral reefs and islands (Sanlaville 1988: 17-20).

3.1.2 The Persian Gulf

The Persian Gulf is about 850 km long and up to 350 km wide (Sanlaville 1988: 9). At its narrowest section, in the Straits of Hormuz, is only 48 km wide, and passage through there is made more difficult by many islands and reefs (Pearson 2003: 19). The Arabian coasts are low and flat rich in *sabkhas*.[13] The Iranian coastline is steeper and rougher, dominated by the Zagros mountain chain (Sanlaville 1988: 22), which might have been exploited in antiquity for its timber resources for boatbuilding (Willcox 1992). The Persian Gulf is also rich in water resources including perennial Arabian artesian sources, Iranian sources and rivers, which encouraged early settlements (Sanlaville 1988: 24). The Tigris and Euphrates, which flow into the Gulf, have sustained important irrigation systems since antiquity (McPherson 1993: 14).

[13] Sabkha is an Arabic name for a salt-flat areas of sand or silt lying above the water-table. The term has come into general use in sedimentology (http://www.southampton.ac.uk/~imw/sabkha.htm [Accessed 31st July 2014].

3.2 Phytogeographical regions

The phytogeographical regions studied here follow Zohary's (1973)[14] divisions, which are well-known, in order to avoid confusion with the variety of other conceptions and names of phytogeographical divisions by different authors (Figure 3.3). These regions encompass countries which border the wider western Indian Ocean, such as some Middle Eastern countries, even if the regions themselves are geographically far from its sphere. The reason for this is that forest stands located further away from the western Indian Ocean coast might have been exploited locally for boatbuilding. The focus here is the areas of the Red Sea and the Persian Gulf, with insights on the Western Indian coast due to its timber resources. From the flora of each phytogeographical region, only the major tree species related to nautical wood will be discussed here. These correspond and/or relate to tree species listed in Appendix 3, which are species identified from the textual, archaeological and ethnographical contexts studied in this thesis. The phytogeographical areas are: the Euro-Siberian region; the Irano-Turanian region; the Saharo-Sindian region (Willcox 1992: 2) also referred to as the Saharo-Arabian region when only covering the Middle East (Zohary 1973: 240); the *Sudano-Deccanian* (Willcox 1992: 2) also referred to as the Sudanian region (Zohary 1973: 240) and the Indian Region (Zohary 1973: 81).

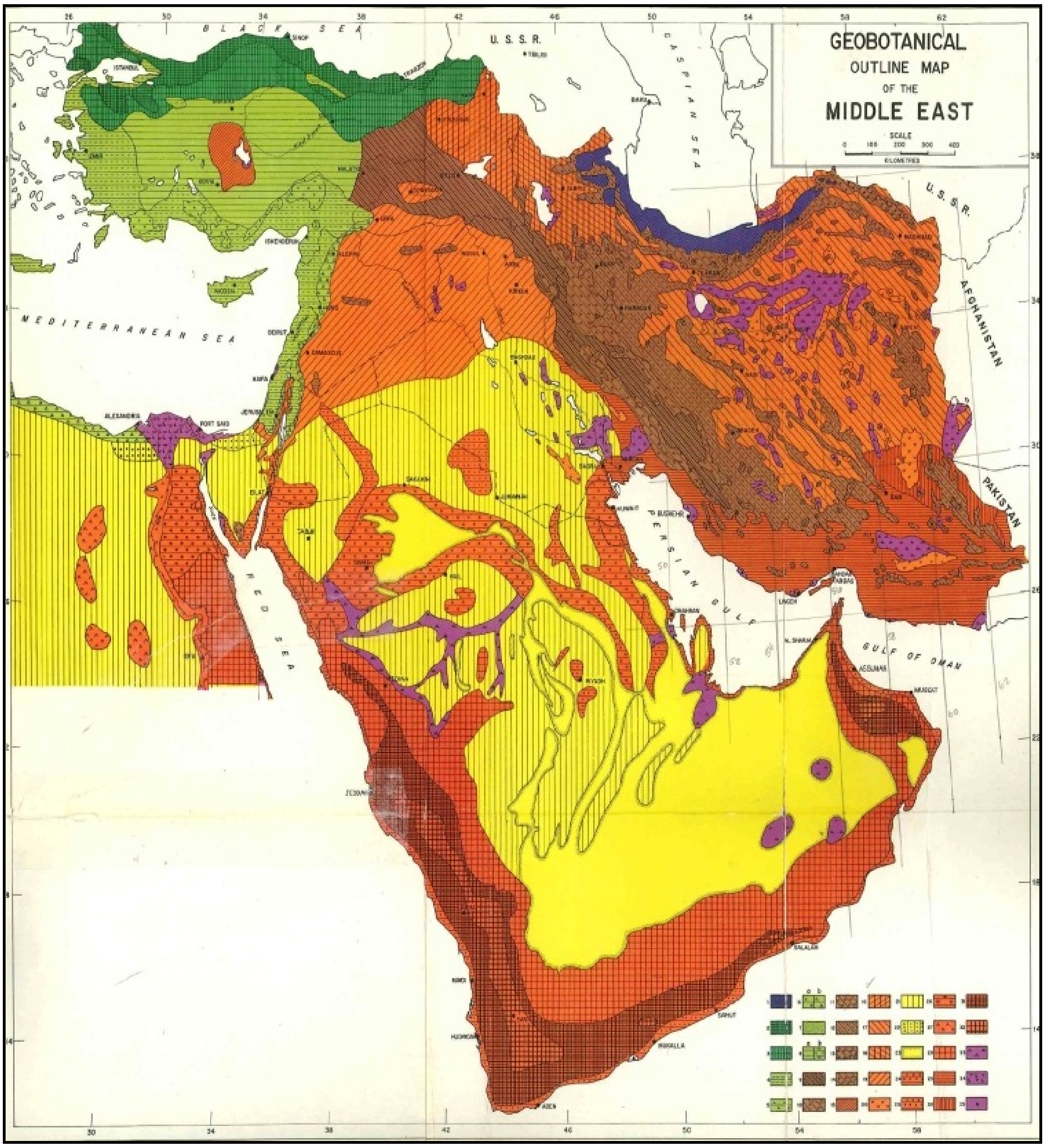
3.2.1 The Euro-Siberian region

This regions extends from Europe to Asia and is bordered in the north but the Arctic, in the south and east by the Mediterranean, the Irano-Turanian, and the Sino-Japanese regions (Zohary 1973: 80). The forests relevant to this thesis are the ones located in northern Iran, adjacent to the Caspian Sea, because they might have provided timber to the Persian Gulf coast of the country in antiquity.

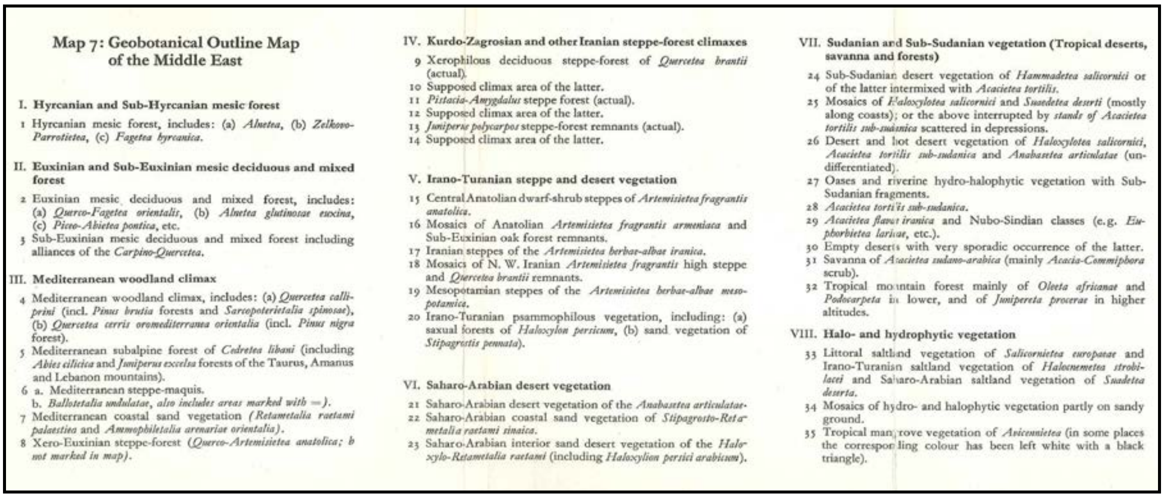
Phytogeographically, these forests are part of the Hyrcanian district which belongs to the Euxino-Hyrcanian subprovince of the Euro-Siberian region (Zohary 1973: 103) (Figure 3.3). The timber producing species suitable for boatbuilding in this district are the Caucasian alder (Lat. *Alnus subcordata* C.A. Mey.), the Mediterranean cypress (Lat. *Cupressus sempervirens* L.), the common beech (Lat. *Fagus sylvatica* L.) and the oriental beech (Lat. *Fagus orientalis* Lipsky.), the common fig (Lat. *Ficus carica* L.),

[14] A critical approach to Zohary's system is found in Al-Nafie (2008: 162-163).

the common ash (Lat. *Fraxinus excelsior* L.), the common juniper (Lat. *Juniperus communis* L.), the Persian lilac (Lat. *Melia azedarach* L.), the black mulberry (Lat. *Morus nigra* L.), the oriental plane (Lat. *Platanus orientalis* L.), several oak species (Lat. *Quercus* spp.), several species of willow (Lat. *Salix* spp.), the small-leaved lime (Lat. *Tilia cordata* Mill.), the red-stem lime (Lat. *Tilia rubra*), and the European elm (Lat. *Ulmus campestris* L.) (Zohary 1973: 125-128, 566, 568, 569). Most of these species grow on the Caspian coastal plain, starting from the lower zone of the northern slopes of the Elburz[15] mountain chain (Zohary 1973: 125). Thus, these species occur on low altitudes rendering their anthropic exploitation ease of access.



[15] Located in Iran, the Elburz chain is 600 km long and 110 km wide running in a West-East direction.



Map 7: Geobotanical Outline Map of the Middle East

I. Hyrcanian and Sub-Hyrcanian mesic forest

1 Hyrcanian mesic forest, includes: (a) *Alnetea*, (b) *Zelkovo-Parrotietea*, (c) *Fagetea hyrcanica*.

II. Euxinian and Sub-Euxinian mesic deciduous and mixed forest

2 Euxinian mesic deciduous and mixed forest, includes: (a) *Querco-Fagetea orientalis*, (b) *Alnetea glutinosae euxina*, (c) *Piceo-Abietea pontica*, etc.
3 Sub-Euxinian mesic deciduous and mixed forest including alliances of the *Carpino-Quercetea*.

III. Mediterranean woodland climax

4 Mediterranean woodland climax, includes: (a) *Quercetea calliprini* (incl. *Pinus brutia* forests and *Sarcopoterietalia spinosae*), (b) *Quercetea cerris oromediterranea orientalia* (incl. *Pinus nigra* forest).
5 Mediterranean subalpine forest of *Cedretea libani* (including *Abies cilicica* and *Juniperus excelsa* forests of the Taurus, Amanus and Lebanon mountains).
6 a. Mediterranean steppe-maquis.
b. *Ballotetalia undulatae, also includes areas marked with* —).
7 Mediterranean coastal sand vegetation (*Retametalia raetami palaestina* and *Ammophiletalia arenariae orientalia*).
8 Xero-Euxinian steppe-forest (*Querco-Artemisietea anatolica; b not marked in map*).

IV. Kurdo-Zagrosian and other Iranian steppe-forest climaxes

9 Xerophilous deciduous steppe-forest of *Quercetea brantii* (actual).
10 Supposed climax area of the latter.
11 *Pistacia-Amygdalus* steppe forest (actual).
12 Supposed climax area of the latter.
13 *Juniperus polycarpos* steppe-forest remnants (actual).
14 Supposed climax area of the latter.

V. Irano-Turanian steppe and desert vegetation

15 Central Anatolian dwarf-shrub steppes of *Artemisietea fragrantis anatolica*.
16 Mosaics of Anatolian *Artemisietea fragrantis armeniaca* and Sub-Euxinian oak forest remnants.
17 Iranian steppes of the *Artemisietea herbae-albae iranica*.
18 Mosaics of N. W. Iranian *Artemisietea fragrantis* high steppe and *Quercetea brantii* remnants.
19 Mesopotamian steppes of the *Artemisietea herbae-albae mesopotamica*.
20 Irano-Turanian psammophilous vegetation, including: (a) saxual forests of *Haloxylon persicum*, (b) sand vegetation of *Stipagrostis pennata*).

VI. Saharo-Arabian desert vegetation

21 Saharo-Arabian desert vegetation of the *Anabasetea articulatae*.
22 Saharo-Arabian coastal sand vegetation of *Stipagrosto-Retametalia raetami sinaica*.
23 Saharo-Arabian interior sand desert vegetation of the *Haloxylo-Retametalia raetami* (including *Haloxylion persici arabicum*).

VII. Sudanian and Sub-Sudanian vegetation (Tropical deserts, savanna and forests)

24 Sub-Sudanian desert vegetation of *Hammadetea salicornici* or of the latter intermixed with *Acacietea tortilis*.
25 Mosaics of *Haloxylotea salicornici* and *Suaedetea deserti* (mostly along coasts); or the above interrupted by *stands of Acacietea tortilis sub-sudanica* scattered in depressions.
26 Desert and hot desert vegetation of *Haloxylotea salicornici*, *Acacietea tortilis sub-sudanica* and *Anabasetea articulatae* (undifferentiated).
27 Oases and riverine hydro-halophytic vegetation with Sub-Sudanian fragments.
28 *Acacietea tortilis sub-sudanica*.
29 *Acacietea flavae iranica* and Nubo-Sindian classes (e.g. *Euphorbietea larinae*, etc.).
30 Empty deserts with very sporadic occurrence of the latter.
31 Savanna of *Acacietea sudano-arabica* (mainly *Acacia-Commiphora* scrub).
32 Tropical mountain forest mainly of *Oleeta africanae* and *Podocarpeta* in lower, and of *Junipereta procerae* in higher altitudes.

VIII. Halo- and hydrophytic vegetation

33 Littoral saltland vegetation of *Salicornietea europaeae* and Irano-Turanian saltland vegetation of *Halocnemetea strobilacei* and Saharo-Arabian saltland vegetation of *Suaedetea deserta*.
34 Mosaics of hydro- and halophytic vegetation partly on sandy ground.
35 Tropical mangrove vegetation of *Avicennietea* (in some places the corresponding colour has been left white with a black triangle).

Figure 3.3: Map of the phytogeographical zones of the Middle East established by Zohary (1973: Map 7).

3.2.2 The Irano-Turanian region

The Irano-Turanian region, which is one of the regions that concerns our study, covers parts of the Sinai Peninsula, northern Iraq, most of Iran, and the high plateau of North Africa between the Mediterranean and the Saharo-Arabian regions (Zohary 1973: 88; Willcox 1992: 2). Zohary (1973: 89-92) divides this region into a western and an eastern subregion. The Western Irano-Turanian subregion includes several provinces such as: the Mesopotamian Province, which includes some highlands of the Sinai, northern Iraq up to the foothills of the Kurdistan Mounts, and some areas in Khuzestan in south-western Iran; the Irano-Anatolian Province including the Kurdistan and Zagros mountain ranges, the Iranian central plateau, and the eastern and southern slopes of the Elburz mountains; and the Turanian Province comprising the Northern-East of Iran (Zohary 1973: 89-92). The Irano-Turanian region encompasses a few genera and species suitable for boatbuilding such as juniper (Lat. *Juniperus* spp.), black mulberry (Lat. *Morus nigra* L.), Turkish pine (Lat. *Pinus brutia* Tenore), oak (Lat. *Quercus* spp.), tamarisk (Lat. *Tamarix* spp.), and elm (Lat. *Ulmus* spp.) (Zohary 1973: 90-91, 582; Willcox 1992: 2). All these species have a substantial history of being used in the western Indian Ocean since antiquity, in planking and structure for boatbuilding, as will be demonstrated in this thesis in Chapters 6 and 7.

3.2.3 The Saharo-Sindian region

This region constitutes a belt of sub-tropical desert steppe extending from west Africa, Egypt, Arabia, southern Iraq, to northwest India (Zohary 1973: 92-94, 216; Willcox 1992: 2). It is an extremely arid and hot region which renders the growth of vegetation quite difficult. Still, there are quite a few tree species which form "an open forest savannah relying on ground water and deep rooting systems" (Willcox 1992: 2). Many of the tree species of the Saharo-Arabian region are derivatives of Mediterranean, Irano-Turanian and Sudanian genera (Zohary 1973: 92). The main species suitable for boatbuilding located in Saharo-sindian areas are *Acacia* spp., *Salvadora persica* L., *Tamarix* spp., and *Zizyphus spina-christi* L. (Willcox 1992: 2). A few species that used to populate certain areas in ancient times have now disappeared from the present landscape like in southern Iraq (Willcox 1992: 2). We might then suggest that perhaps a wider spectrum of tree species were available to boatbuilders in the region in the past. For example: species of *Quercus*, *Juniperus*, and *Pinus* used to occupy northern and central Sahara in prehistoric times, and have disappeared since, due to the desiccation processes the Sahara has endured since the Neolithic (Zohary 197: 93).

3.2.4 The Sudano-Deccanian region[16]

This region forms a belt of tropical vegetation running parallel to but to the south of the Saharo-Sindian zone (Zohary 1973: 96). Zohary (ibid: 97, 240, 589) divides the eastern part of the Sudanian region into an Eritreo-Arabian province and a Nubo-Sindian one. The Sudanian region mainly includes south-west Arabia, Hijaz, Asir, Oman, southern Iran, and south-western Pakistan (Zohary 1973: 96, 240, 589). It has a rich diversity of tree genera and species. The trees which most concern us here are the following: species of the genus *Acacia* spp. such as *Acacia tortilis* Forssk. and *A. raddiana* Savi, *Avicennia marina* (Forssk.) Vierh., *Balanites aegyptiaca* (L.) Delile, *Dalbergia* spp., *Ficus* spp., *Moringa* spp., and *Salvadora persica* L. (Zohary 1973: 96-97, 241, 590; Willcox 1992: 2). These species are distributed among savannah-like vegetation in wadis and depressions, and could have been utilised for the structural components of vessels.

[16] For more on this region check Zohary (1973: 95-97).

3.2.5 The Indian Region

The phytogeographical region named the Indian Region (Zohary 1973: 81) is divided into nine local phytogeographical areas (Chatterjee 1939) (Figure 3.4), including:

1. The western Himalayas, which comprise north and south Kashmir, part of Punjab and Kumaon, and is divided into three zones (Submontane, Temperate, and Alpine).

2. The eastern Himalayas, extending from east of Nepal up to Arunachal and following the Western Himalayas subdivisions.

3. The North-eastern region, comprising the Assam region.

4. The Gangetic plain, covering part of Delhi, Uttar Pradesh, Bihar, West Bengal and part of Orissa.

5. The Indus plain, encompassing a part of Punjab, Delhi, Rajasthan, a part of Gujarat and Cutch.

6. The central India, which groups part of Orissa, Madhya Pradesh, Vindhyan region (included in the Eastern Ghats on the map).

7. The Deccan, covering southern Peninsular India from southern Madhya Pradesh up to Kanyakumari excluding the Western Ghats (The Eastern Ghats on the map).

8. The Western coast of Malabar, from Gujarat to Kanyakumari along Western Ghats.

9. The Andaman and Nicobar Islands.

Such phytogeographical diversity supports vegetation which chiefly consists of five main types of forest with the number of plant species estimated at 30,000 (Chaturvedi 1956: 456) (Figure 3.5,Figure 3.6). The species of our concern here are the ones which were exploited locally for boatbuilding, and/or might have been exported to the Red Sea and Persian Gulf areas for their nautical timber. Such genera and species include: *Acacia* spp., *Albizia* spp., *Artocarpus* spp., *Avicennia marina*, *Azadirachta indica*, *Balanites roxburghii*, *Bambusa* spp., *Calophyllum* spp., *Casuarina* spp., *Cupressus* spp., *Dalbergia* spp., *Diospyros* spp., *Fraxinus micrantha*, *Hopea* spp., *Lagerstroemia lanceolata*, *Mangifera indica*, *Populus* spp., *Quercus* spp., *Rhizophora* spp., *Shorea* spp., *Tamarix* spp., *Tectona grandis*, *Terminalia* spp., and *Ziziphus* spp. (Chaturvedi 1956: 459-474).

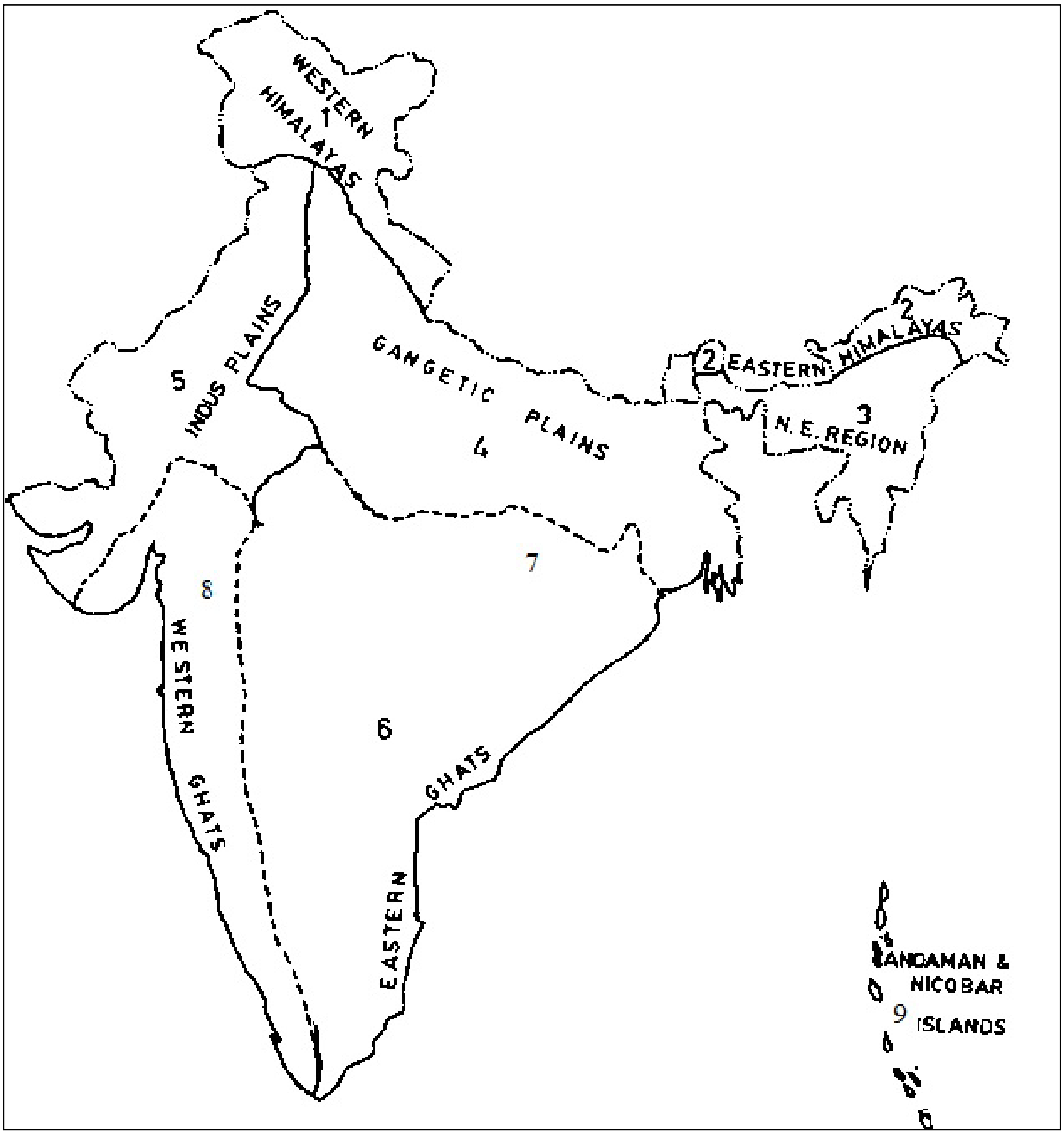


Figure 3.4: Phytogeographical regions of India (Modified from Paroda & Arora 1991: Figure 1).

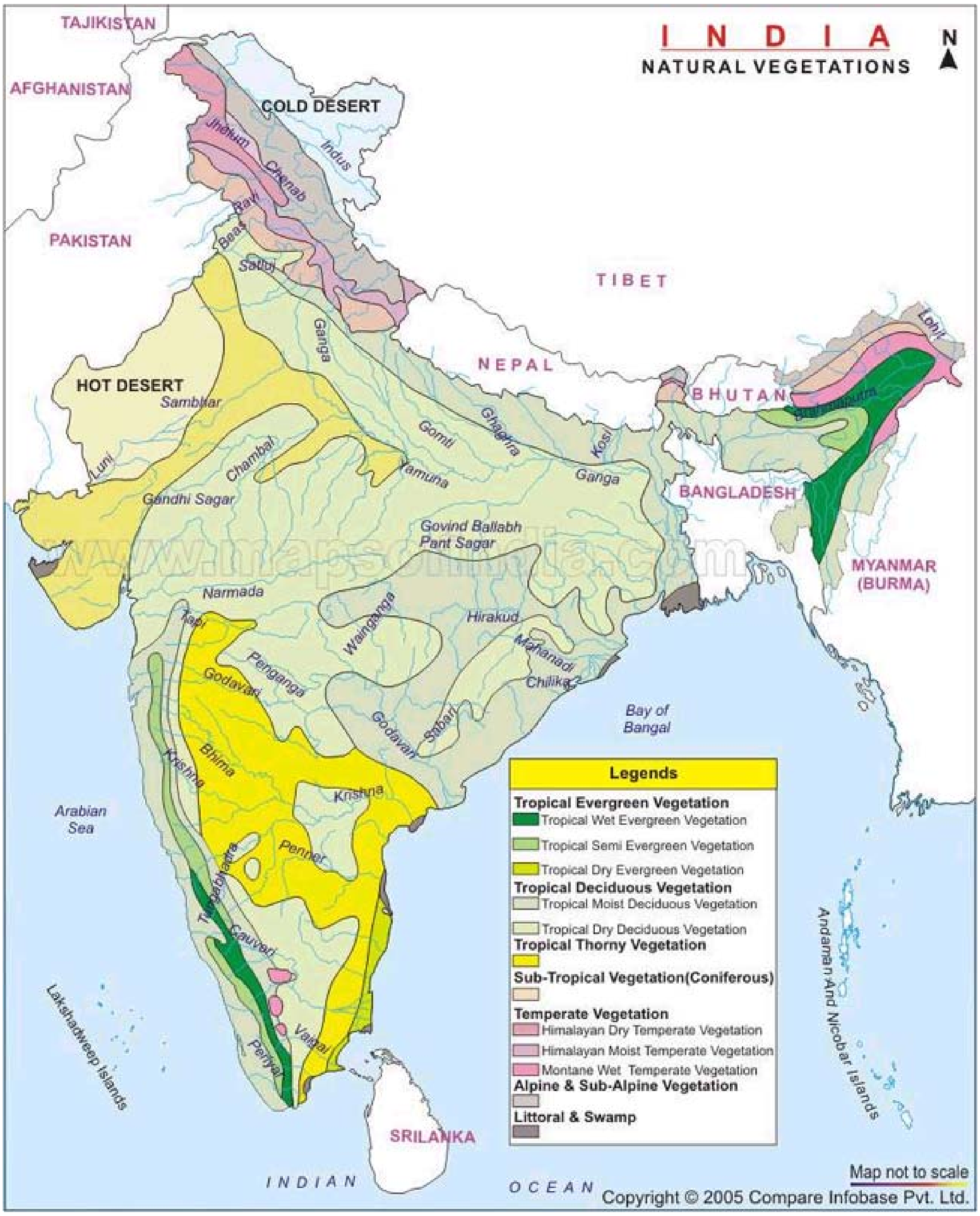


Figure 3.5: The vegetation distribution in India (Anon 2008).

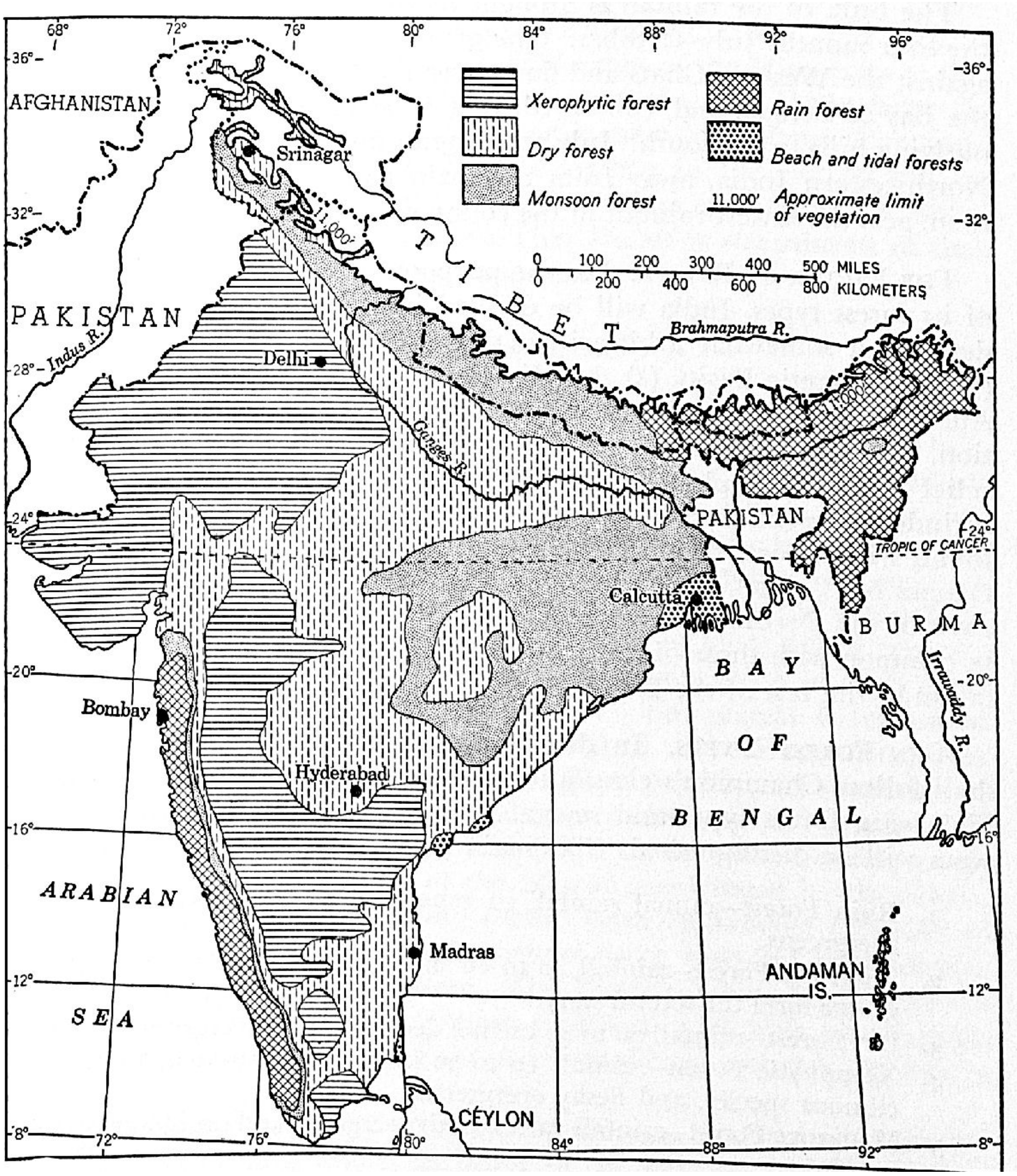


Figure 3.6: Types of forests in India(Chaturvedi 1956: 457, Figure 2).

3.3 Physical settings and arboreal cover of fieldwork areas

Subsequent to looking at areas which might have acted as timber providers for boatbuilders of the Red Sea, this section highlights more specifically the arboreal cover of countries surrounding the Red Sea, i.e. where Dionisius A. Agius, the MARES Project, and I undertook ethnographic research on wood use in traditional boatbuilding. The areas concerned are: Egypt, Sudan, Eritrea, Djibouti, on the western Red Sea coast; and Saudi Arabia and Yemen on the eastern coast (Figure 3.7). Thus, an in-depth look at arboreal covers of these regions will demonstrate that exploitation of local wooden resources for boatbuilding is possible. The species studied here are genera and species mentioned in historical sources, present in the archaeological and ethnographic records of this thesis (See 12.3.7 Table 7).

Figure 3.7: Arial image of concerned countries (Modified from Google Earth).

Considering the concept of relic forests (Zohary 1973: 506-507; Al-Hubaishi & Müller-Hohenstein 1984: 24; Willcox 1992), it is safe to infer that the present-day arboreal cover, albeit less dense, of these countries, are reminiscent of ancient practices related to timber acquisition for boatbuilding. Indeed, Zohary (1973: 404-405, 506-507, 653) explains that due to climate change, deforestation and other anthropogenic activities, and due also to soil erosion, presently barren areas in the Middle East might have been more favourable for tree life in the past. Willcox (1992: 3) argues that the maximum extent of forest cover in the Middle East was reached in the early Bronze Age, with timber resources more available then than at any time since. Since then, he adds, "there is some evidence of decline, but this is variable from area to area and it is not clear whether this was due to climatic factors or to deforestation by man, through over-exploitation. When one examines the vegetation of the Middle East today, there is little doubt that much is highly degraded. But it is not easy to establish when this deterioration began. Indeed it is probable that the degradation of the vegetation occurred at different times in different places depending on population pressure".

Below, the phytogeographical areas specific for each modern state are given whenever possible, along with the distribution of plants in their different habitats. This provides insights as to which regions were sought out for their timber-producing trees.

3.3.1 Egypt [17]

Egypt is divided into four physiogeographic regions (Figure 3.8): the Western Desert, the Nile Valley and the Delta region, the Eastern Desert and Sinai (EEAA 2008: 128; El-Nahrawy 2011: 5, 11). The western Desert is a plateau rising to a mean 300 metres, with some escarpments and deep depressions. The Nile flows through the large flat plain of the Nile Valley to the Mediterranean, where it forms the Delta, which includes brackish lagoons and lakes. The Nile valley also comprises the Fayyum Depression and several oases. Between the Nile valley and the Red Sea lies the mountainous Eastern Desert, with numerous transecting wadis. Sinai forms a triangular-shaped plateau rising to the south, ending in high mountains which descends into the Red Sea and the Gulf of Aqaba (Zohary 1973: 8; El-Nahrawy 2011: 5, 11-12). There are also four main bioclimatic zones in Egypt: the rainy coastal belt along the Mediterranean Sea, where rainfall sustains a semi-steppe vegetation; the sub-coastal belt and the wetlands comprising the Nile Delta and the Nile Valley; and the deserts and the Sinai regions, which are hyper-arid with mild winters, hot summers, and scarce rainfall. Exceptionally, the high mountain massif of southern Sinai receives high precipitation as rain and snow which sustains vegetation of trees and shrubs. Also, the catchment areas of a few wadis sustain important moisture levels and thus are lavishly vegetated (Zohary 1973: 20-21, 66; EEAA 2008: 128-129; El-Nahrawy 2011: 5, 15).

[17] For a detailed descriptions on botanical families and genera in Egypt see Zohary (1973: 66-67), Täckholm (1974), and Boulos (1999, 2000, 2002, 2005).

Figure 3.8: Topographical map of Egypt(Modified from Google Earth).

Egypt reflects the main phytogeographical divisions set by Zohary (1973) (See 3.2), but also has phytogeographical subdivisions local to the country (Täckholm 1974; Boulos 1999- 2005). Each of these subdivisions refers to a phytogeographical area designated by a letter or two, as seen in Figure 3.9. Thus, I will use these codes in the below description of Egypt's flora.

Phytogeographical regions

N: The Nile region including the delta, valley and Faiyum.

O: The oases of the Western Desert: Wadi Natrun, Siwa, Farafra, Bahariya, Kharga, Dakhla, Kurkur, Dungul and Uweinat.

M: The Mediterranean coastal strip from the border with Libya near Sollum to Port Said.

D: All the deserts of Egypt except that of Sinai.

De: Desert east of the Nile except that of Sinai.

Dw: Desert west of the Nile.

R: The Red Sea coastal strip.

GE: Gebel Elba and the surrounding mountainous region.

S: The entire Sinai peninsula including the coastal Mediterranean strip and El-Tih Desert east of Suez Canal.

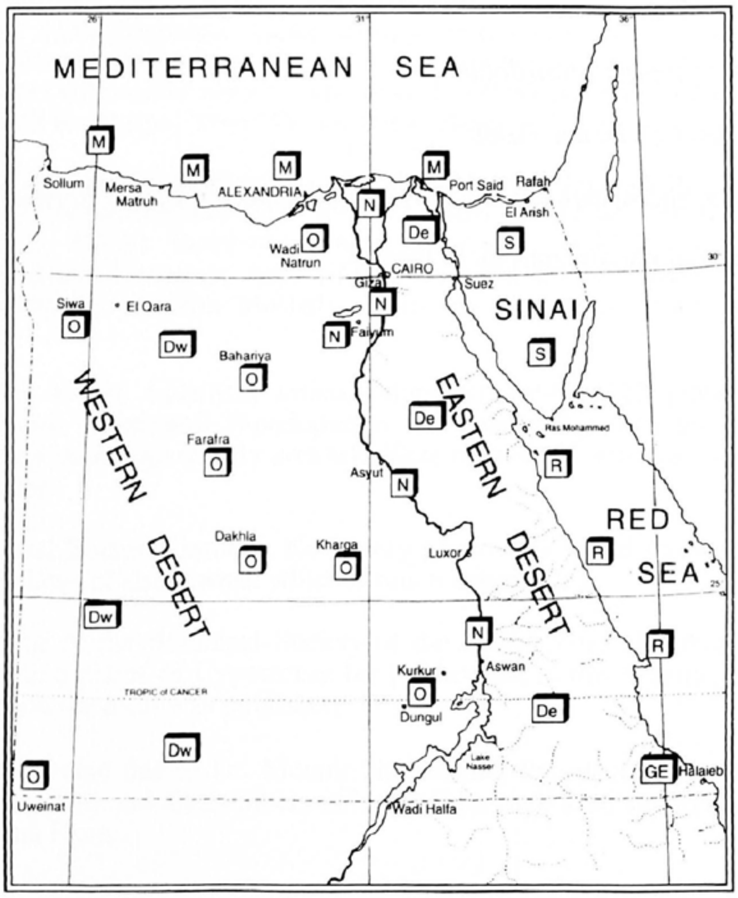


Figure 3.9: Phytogeographical regions of Egypt (Boulos 1999).

The Sudanian territory in Egypt is located in the south-eastern part of the Eastern Desert (Zohary 1973: 243; Figure 3.3). The Sudanian flora of Egypt holds several tree species

(Zohary 1973: 242-243), among which are acacia, fig, the toothbrush tree, mangrove, balanites, juniper, moringa, olive, poplar, willow, tamarisk, and sidr.

Acacias are distributed all around the country (De, Dw, R, GE, N, D, S) in several habitats such as rocky hillsides; sandy and stony plains; desert wadis; volcanic soils; open scrubland; and Nile and canal banks (Zohary 1973: 243; Täckholm 1974: 286-291; Boulos 1999: 364-372). The wonderboom fig (Lat. *Ficus salicifolia* Vahl.), the wild fig (Lat. *F. palmata* Forssk.), and the common fig (Lat. *F. carica* L.) are located respectively in O and GE, on rocky slopes in Uweinat; in De, GE and S, on rocky cliffs and wadi sides; and cultivated in N, O, M, D and S (Täckholm 1974: 54-55; Boulos 1999: 14-16). The toothbrush tree (Lat. *Salvadora persica* L.) is distributed in desert wadis, and coastal and inland sandy plains of N, O, D, R, GE, and S (Osborn 1968: 171, Täckholm 1974: 341-343; Boulos 2000: 82). The Sudanian territory also includes mangrove vegetation such as *Avicennia marina* and *Rhizophora mucronata* Lam. growing on muddy flats along the Red Sea coast and the Gulf of Suez (Zohary 1973: 244, 458, 472; Täckholm 1974: 454; Boulos 2000: 148; 2002: 5). These mangrove are another source for nautical timber as they were employed in boat frames, as will be demonstrated in this thesis. *Balanites aegyptiaca* grow in desert wadis and plains in N, O, GE, and S. (Täckholm 1974: 313; Boulos 2000: 31). The Phoenician Juniper (Lat. *Juniperus phoenicea* L.) is distributed in S on rocky ridges of the Yelleq, Halal, and Maghara mountains (Täckholm 1974: 50; Boulos 1999: 10). *Moringa peregrina* is distributed on rocky slopes and wadis of S, and De (Osborn 1968: 173; Täckholm 1974: 211; Boulos 1999: 238). Wild olive trees (Lat. *Olea europaea* L.) are widely cultivated in Egypt especially in oases, the Nile delta and on the Mediterranean coast in N, O, M, D, and S (Boulos 2000: 204). The Euphrates Poplar (Lat. *Populus euphratica* Oliv.) grows in O on sand dunes in Siwa (Täckholm 1974: 54; Boulos 1999: 14). Willow (Lat. *Salix mucronata* Thunb. and *S. tetrasperma* Roxb.) is found by canals and river banks in N, O, M, De, and S (Täckholm 1974: 51-54; Boulos 1999: 13). There are six species of *Tamarix* (*T. aphylla*, *T. tetragyna*, *T. nilotica*, *T. amplexicaulis*, *T. passerinoides*, *T. macrocarpa*) growing in different habitats such as saline sandy soils; desert wadis; sandy plains; swamps; edges of salt marshes; and Nile banks; in N, O, M, D, R, GE, and S, depending on the species (Täckholm 1974: 366-367; Boulos 2000: 126-130). There are three *Ziziphus* species (*Z. spina-christi*, *Z. nummularia*, and *Z. lotus*) growing widely in various regions in N, O, M, D, R, GE, and S in desert wadis, plains, and mountains (Täckholm 1974: 345; Boulos 2000: 84-86).

The above-mentioned species show that Egypt holds a wide variety of endemic timbers that are suitable for boatbuilding (See Gale et al. 2000; Ward 2000).

There are also several timber-producing genera and species introduced to Egypt since at least the 19th century such as *Casuarina* spp. and *Eucalyptus* spp. from South Asia and Australia, as will be demonstrated in the ethnography section. One example is Indian Rosewood (Lat. *Dalbergia sissoo* Roxb. ex. DC.), which was introduced to Egypt by Ibrahim Pasha in the era of Muḥammad ᶜAli (1805-1848) (Shaltout & Keshta 2011). Due to their durability, strength, length and girth, these trees would be suitable for hull planks and keels. Also, if they are mentioned in textual sources, or found in archaeological contexts related with boatbuilding, this would indicate import rather than local exploitation. As for areas of exploitation, some species are located close to potential boatbuilding or boat repairing sites on the Red Sea coast.

3.3.2 Sudan

Sudan lies in the subtropical arid zone of Africa (Warrag et al. 2002) (Figure 3.10). Its main topography comprises flat or undulating plains and low-lying plateaux which are punctuated by small rocky hills in the central part of the country. Some of these hills form massive mountains that can reach more than 3000 metres in height. The Red Sea coast is 20 to 50 kilometres wide, bordered to the west by the Red Sea Hills followed by a 1000 metre-high plateau. Western Sudan is high volcanic area with a suitable climate for forestry (Bégué 1958: 4; Zaroug 2006: 7). The diverse topography reflects in the range of climatic systems throughout the country: the north is arid; the Red Sea coast is arid Mediterranean; the central parts are tropical arid and semi-arid with a short summer rainy season; and the south and south west are tropical sub-humid with a gradually longer rainy season (Bégué 1958: 4-7; Zaroug 2006: 8). The River Nile and its tributaries, as well as a large number of seasonal rivers and water courses, flow through the country and variously influence the vegetation. There is also a vast resource of groundwater (Zaroug 2006: 5). As is the case in other Red Sea countries studied here, Sudanese vegetation is under threat from human, animal and climatic factors, and has dwindled to 17% of forest land in 2000 (Bégué 1958: 14-15; Warrag *et al.* 2002: 49; Dawelbait *et al.* 2006).

Figure 3.10: Topographical map of Sudan (Maps.com n.d., Accessed 21th April 2014). It represents Sudan's territory before it split into two countries (Sudan and South Sudan) in July 2011.

There are seven main phytogeographical zones in Sudan (Gorashi 2001: 6-7),[18] which can be further subdivided as in Figure 3.11, from north to south:

1. Zone 1: Desert
2. Zone 2: Semi-desert
3. Zone 3: Rainfall woodland savannah on clay soil
4. Zone 4: Low rainfall woodland savannah on sand
5. Zone 5: High rainfall woodland savannah
6. Zone 6: Special forests

[18] Bégué (1958) recognises six vegetation divisions while Harrison & Jackson (1958) argue for five. I have adopted Gorashi divisions since they are the most recent studies. However I could not find a map by Gorashi and only the one figured below (Figure 3.11). In Figure 3.11 Zone 3 is comprised within Zone 4 and figures as "Low rainfall savannah woodland".

7. Zone 7: The montane forests

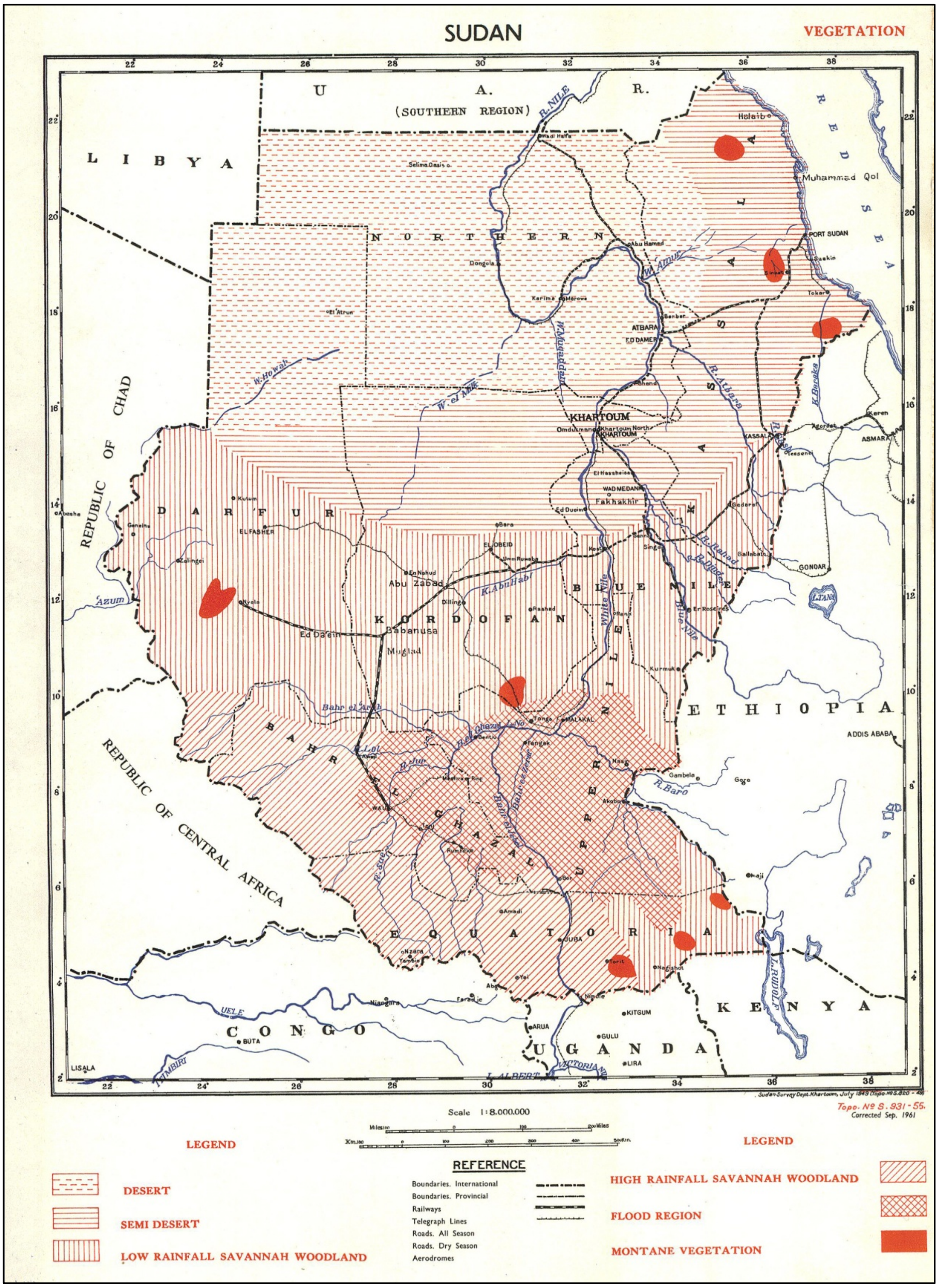


Figure 3.11: Map of the phytogeographical areas of Sudan (Sudan Survey Department, Khartoum, 1949, Topo No. S.820-49, Corrected in September 1961, Topo No. S.931-55) .

Zone 1: Desert

This zone embraces vast areas of northern Sudan. There are several species of *Acacia* (*Acacia albida*, *A. ehrenbergiana*, *A. nilotica*, *A. seyal*, *A. tortilis*), *Salvadora persica*, *Tamarix* spp., and *Ziziphus spina-christi* are the main arboreal resources growing around the Nile banks and seasonal watercourses (Bent 1896: 342, 349, 350; Bégué 1958: 8; El Amin 1990: 61-62, 148-167, 287, 291-295; Gorashi 2001: 6). *Acacia nilotica* produces sawn timber (Warrag *et al.* 2002: 49).

Zone 2: Semi-desert

Seven species of *Acacia* are dominant here (*Acacia etbaica*, *A. glaucophylla*, *A. mellifera*, *A. orfota*, *A. radiana*¸ *A. senegal*, *A. tortilis*) along with *Balanites aegyptiaca*, *Moringa* peregrina, *Salix* spp., *Salvadora persica*, and *Ziziphus spina-christi*. (Bégué 1958: 8-9; El Amin 1990: 42, 154-167, 249-251, 287, 291-295, 299-301; Gorashi 2001: 6-7). Along the Red Sea coast there are mangrove stands of *Avicennia marina* and *Rhizophora mucronata* (Bégué 1958: 9; El Amin 1990: 98, 435-437).

Zone 3: Rainfall woodland savannah on clay soil

A. mellifera, *Acacia seyal*, *Balanites aegyptiaca*, *Dalbergia melanoxylon*, *Tamarix aphylla*, and *T. nilotica* are the main species in this region (Bégué 1958: 9; El Amin 1990: 61-62, 159, 163, 229, 299-301; Gorashi 2001: 6-7)

Zone 4: Low rainfall woodland savannah on sand

Acacia albida, *A. raddiana*, *A. senegal*, *Albizia* spp., *Dalbergia melanoxylon*, and *Terminalia* spp. are the main species here (Bégué 1958: 9; El Amin 1990: 149, 163, 169-177; Gorashi 2001: 6-7).

Zone 5: High rainfall woodland savannah

Acacia campylacantha A. Rich, *Acacia sieberiana* DC., *Afzelia africana* Sm., *Albizia sericocephala*, African mahogany (Lat. *Khaya senegalensis* (Desr.) A. Juss. with K. *anthoteca* C. DC and *K. grandifolia* C. DC.), African ebony (Lat. *Diospyros mespiliformis* Hochst. ex A. DC.), *Ficus* spp., *Morus* spp., *Pterocarpus lucens* Guill & Perr., and *Terminalia* spp. are the main species of this region (Bégué 1958: 10; El Amin 1990: 93-95, 165, 191, 243, 261-275, 313-317, 351; Gorashi 2001: 6-7).

Zone 6: Special forests

The most important species are *Acacia albida*, *A. nilotica*, and *Ziziphus spina-christi*. These forest types lie within the low-rainfall savannah or even the semi-desert areas. They are mainly around the rivers and seasonal watercourses (El Amin 1990: 149, 160, 291-295; Gorashi 2001: 6-7).

Zone 7: The montane forests (Figure 3.12)

The Red Sea Hills in the east, Jebel Marra in the west, and Imatong and Didinga mountains in the south are the four main mountain masses in the Sudan (Gorashi 2001: 6-7). There are stands of *Juniperus procera*, *Diospyros mespiliformis*, and *Olea chrysophylla* in the Red Hills; *Acacia albida*, *A. arabica*, *A. seyal*, *Balanites aegyptiaca*, *Ficus* spp., *Khaya senegalensis*, *Salix* spp., and *Terminalia brownii* in Jebel Marra; and *Acacia* spp., *Albizia* spp., *Juniperus procera*, *Olea* spp., and *Terminalia* spp. in Imatong and Didinga (Bégué 1958: 11-12; El Amin 1990: 1-2, 149, 163, 249-251, 261-275, 315, 351).

In recent years, two eucalyptus species (Lat. *Eucalyptus camaldulensis* and *E. microtheca*), as well as *Azadirachta indica*, *Tectona grandis*, *Conocarpus lancifolius*, and five *Morus* species have been introduced: respectively in 1915, 1932, 1950, 1955, and 1995 as part of forest management schemes (Bégué 1958: 17-18; El Amin 1990: 71-74, 89, 311, 442; Warrag *et al.* 2002: 48). The dates of other introductions are not known such as *Dalbergia* sissoo from India planted on banks of rivers on sandy soil in central Sudan, *Casuarina equisetifolia* from Australia planted in central and south Sudan as garden and shade tree, *Melia azedarach* grown in Khartoum and Darfur (El Amin 1990: 231, 247-249, 317). These species are often used in traditional boatbuilding, but we do not know whether this is the case in Sudan.

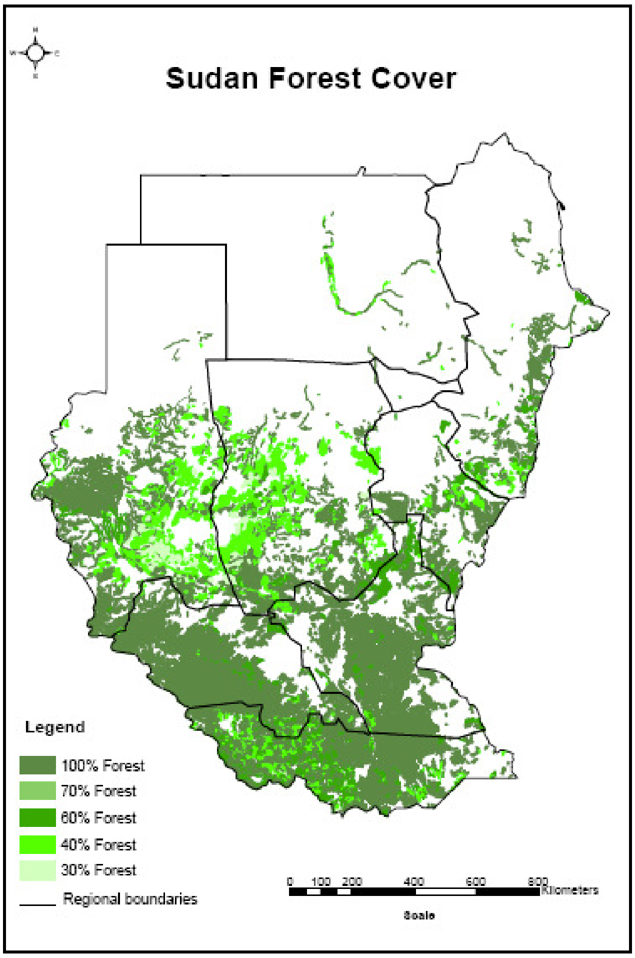


Figure 3.12: Sudan's forest cover (Dawelbait *et al.* 2006: 12).

3.3.3 Djibouti

Djibouti's topography consist of a 350-kilometre Red Sea coastline, which is separated from a plateau by eight mountain ranges varying from 500 metres to 2010 metres in altitude. The south of the country is partly occupied by the Grand Bara Desert (Robleh 2007: 12) (Figure 3.13). The climate is relatively hot all year long with winter rainfall; it varies from arid in the north-eastern coastal areas to semiarid in the central, northern, western and southern parts of the country. However, low-to-freezing winter temperatures are attained in the highlands (Saboureau 1975: 4; Robleh 2007: 14). Rainfall conditions the presence of vegetation, which is more widespread on the highlands of the maritime facade, for example (Robleh 2007: 18). The latter region holds relics of forests with Mediterranean and Ethiopian affinities (Robleh 2007: 7). Several endemic species are present in Djibouti that might have been exploited in wooden boatbuilding in the past as well as present times. However, most of Djibouti's forests have been decimated due to timber exploitation for construction, grazing, and firewood in the past, resulting in the desertification of some regions, especially in the southwest (Saboureau 1975: 6-7; Ford 2006; Robleh 2007).

Mangrove vegetation of *Avicennia marina* and *Rhizophora mucronata* occupies the coastal area, mainly in the northwest of the country in the District of Obock, and on the islands of Musha and Maskali (Lebrun *et al.* 1989: 86, 225; Robleh 2007: 21). Broadleaved forests such as *Acacia* (Lat. *Acacia etbaica*, *A. mellifera*), olive (Lat. *Olea europaea* L. subsp. *africana* Mill.), and *Terminalia brownii*, and conifers such as African juniper (Lat. *Juniperus procera* Hochst. ex Endl.) grow in mountains, especially in Mount Goda and Mabla (Duplaquet 1953: 347; Saboureau 1975: 5; Lebrun *et al.* 1989: 153; Ford 2006). *Acacia mellifera*, *A. etbaica* Schweinf. and *A. tortilis* are present as highland bushes; while *Acacia tortilis*, *A. asak*, *A. ehrenbergiana* and *A. nilotica* are found in some of the wadis, and plains such as Magdoul, Andabba and Ginni-Bad, as well as in the coastal desert region (Lebrun *et al.* 1989: 113-115; Robleh 2007: 20). They are often associated with *Balanites aegyptiaca*, *Moringa peregrina* (Forssk.) Fiori, *Salvadora persica*, *Tamarix aphylla* L., and *Tamarix nilotica* Ehrenb. (Lebrun *et al.* 1989: 51, 79, 97, 136; Ford 2006; Robleh 2007: 7, 18).

Figure 3.13: Topographical map of Djibouti (Ezilon Maps 2009a).

Forests of *Juniperus procera* used to occupy larger areas than at present and grow to a height of 15 to 20 metres at an altitude of 800-1,600 metres (Lebrun *et al.* 1989: 37; Robleh 2007: 19). The *Terminalia brownii* forests of Mounts Goda and Mabla grow at altitudes of between 370 and 1250 metres, with trees reaching 6 to 10 metres high (Ford 2006). They are often associated with stands of *Acacia mellifera*, *A. seyal* and *A. etbaica* (Lebrun *et al.* 1989: 85, 130; Robleh 2007: 20). Riparian forests consist of eleven fig species and four jujube species (Lebrun *et al.* 1989: 131-133, 137-138; Ford 2006). Neem trees (Lat. *Azadirachta indica* A. Juss.) are widespread in Djibouti, and can reach 15 to 30 metres in height (Lebrun *et al.* 1989: 146; Anon 2009) and thus could easily serve for large boat components. *Conocarpus lancifolius*, and *Albizia lebbek* L. Benth., also employed in boatbuilding, are probably an introduction of the late 1940s as ornamental trees (Duplaquet 1953: 347; Saboureau 1975: 3; Lebrun *et al.* 1989: 84-85, 116). *Casuarina* (Lat. *Casuarina equisetifolia* L.), Mango (Lat. *Mangifera indica* L.), and Persian lilac (Lat. *Melia azedarach* L.), are also species introduced and cultivated in Djibouti at an unknown date (Lebrun *et al.* 1989: 38, 147, 148), and widely used in traditional boatbuilding in India (See Chapter 8); so they could also serve local boatbuilders.

The arboreal flora of Djibouti, even if presently degraded, must have been larger in antiquity. Thus, boatbuilders could have made use of local genera such as *Avicennia* and *Rhizophora*, *Acacia*, *Balanites*, *Ficus* and *Ziziphus* for structural element of boats, and *Azadirachta*, *Juniperus* and *Terminalia* for hull planking and other tall planks.

3.3.4 Eritrea

The coastal plains of Eritrea, rise westwards to 3000 metres in a dramatic escarpment that gives way to high, rugged, and bisected plateaus that dominate the topography. The diverse landscape offer a variety of ecosystems from deserts and savannas to montane forests (Figure 3.14). The climate is hot and arid in the lowlands, while the highlands enjoy cooler weather, which might reach freezing temperatures in winter, and higher rainfall levels (FOSA 2001, Introduction section).

Figure 3.14: Topographical map of Eritrea (Ezilon Maps 2009b).

Forests in Eritrea faced the threat of extensive exploitation for timber during the Italian colonial period (1890-1941), along with the lasting negative impact of overgrazing, cultivation, the need for fuel wood and timber, and frequent droughts. In the 20th century, the percentage of forest cover dropped from 30% to 10% resulting in a total ban on cutting live trees (FOSA 2001). The types of forests can be divided into six main categories, as per the 2001 FOSA Country Report for Eritrea (FOSA 2001):

- Highland Forests: These are composed of a mixture of coniferous species (*Juniperus procera*), and broad-leaved species (*Olea africana*) and other associated species.

- Mixed woodlands of *Acacia* and associated species occurring mainly in the southern part of the Western Lowlands, but also in restricted areas elsewhere in the country.

- Bush or shrub vegetation, which is dominant cover in Eritrea.

- Grassland to wooded grassland, which occurs in many parts of the country.

- Riverine forests composed especially of tamarisks *(Tamarix aphylla)* and doum palm (*Hyphaene thebaica*) which are common in the Western Lowlands and are frequent in the Eastern Lowlands.

- Mangroves occurring in many spots along the coast and concentrated mainly around the port of Assab and between Tio and the port of Massawa.

The main species that might be employed for boatbuilding in Eritrea are listed below, with their distribution patterns (Figure 3.15).[19] Of these, there are several endemic species: Mangrove swamps of *Rhizophora mucronata* Lam. occupy the Eritrean Red Sea coast in the Eritrea East (EE) region (ibid: 133). Twenty-five *Acacia* species are widespread in Eritrea in the EE and Eritrea West (EW) regions, from an altitude of 400 metres to 2600 metres. *Acacia* shrubs or trees grow up to 10 to 30 metres high in several locations such as wooded grassland, deciduous bushland, dry scrub, wadi bottoms, on rocky ground and by water courses: *A. senegal* (L.) Wild., *A. asak* (Forssk.) Willd, *A. oliveri* Vatke, *A. mellifera* (Vahl) Benth., *A. laeta* R. Br. ex Benth., *A. venosa* Hochst. ex Benth., *A. polyacantha* Wild., *A. becatophylla* Steud. ex *A.* Rich., *A. albida* Del., *A. lahai* Steud. & Hochst. ex Benth., *A. seyal* Del., *A. ehrenbergiana* Hayne., *A. amythethopbylla* Steud. ex *A.* Rich., *A. nilotica* (L.) Willd. ex Del., *A. tortilis* (Forssk.) Hayne, *A. etbaica* Schweinf., *A. abyssinica* Hochst. a Benth., *A. sieberiana* DC., *A. origena* Hunde, *A. bavazzanoi* Pic.-Serm., *A. dealbata* Link, *A. decurrens* Wild., *A. cyclops* A. Cunn. ex G. Don, *A. cultriformis* A. Cunn. ex G. Don, and *A. retinodes* Schlechtend (Hedberg & Edwards 1989: 78, 80-84, 85-93). *Albizia* is a tree growing in the EW region in Eritrea at an altitude between 500 metres to 2400 metres and is found in wooded grasslands, planted in streets and gardens, in woodlands, bushlands, and dry scrub: *A. malacophylla* Var. *malacophylla* (*A.* Rich.) Walp., *A. lebbeck* (L.) Benth., *A. anthelmintica* (*A.* Rich.) Brogn., *A. amara* (Roxb.) Boiv., and *A. isenbergiana* (A. Rich.) Foum. (Hedberg & Edwards 1989: 93-96). *Balanites aegyptiaca* (L.) Del. grows at 8 metres tall, in the EE and EW regions at an altitude 700-1,800 metres on dry savannah and *Acacia* woodland (Hedberg & Edwards 1989: 433).

[19] The map shows the floristic regions of both Ethiopia and Eritrea. The regions of concern here are the EE and EW dividing Eritrea in two floristic regions.

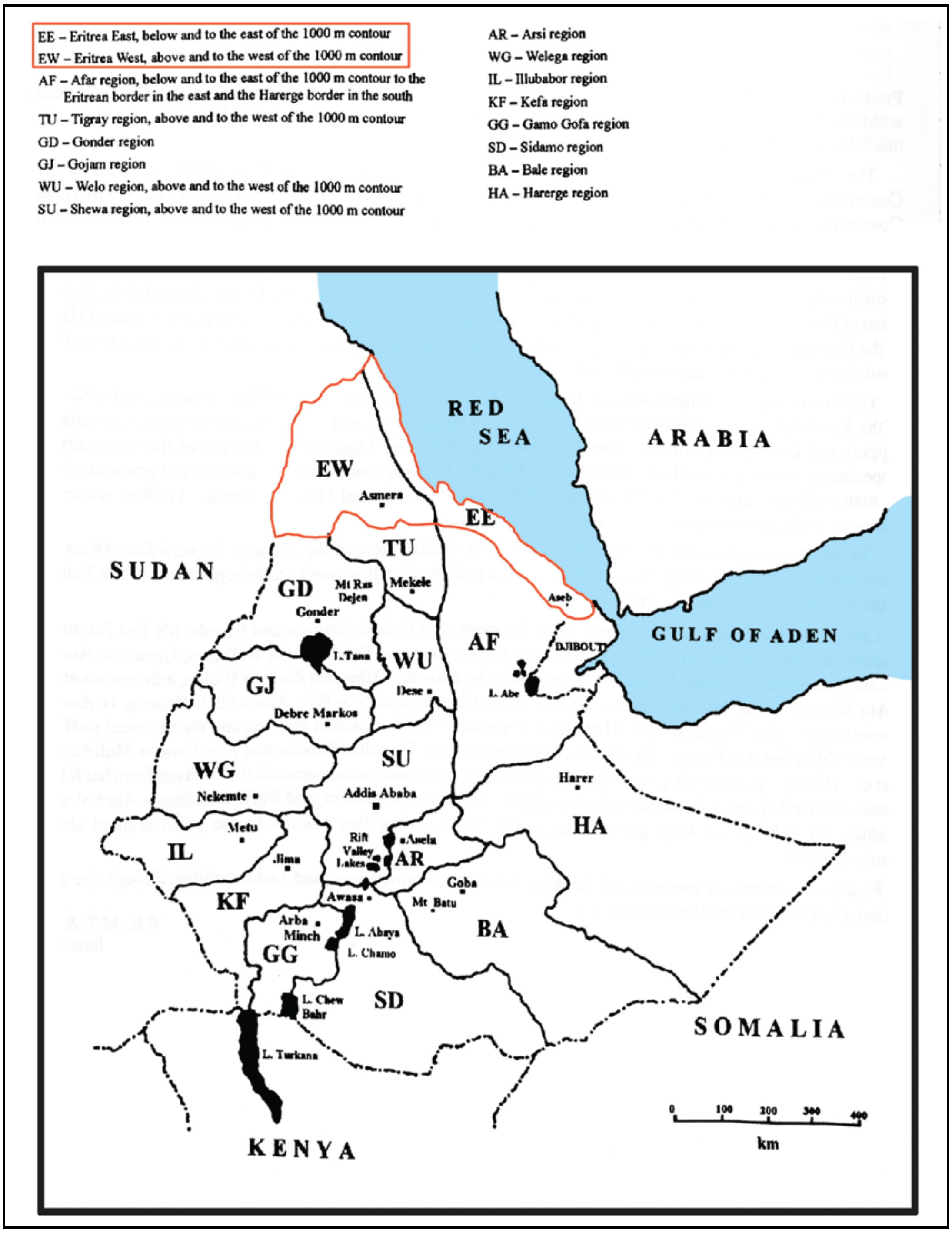


Figure 3.15: Map of the floristic regions of Ethiopia and Eritrea. The borders of Eritrea are drawn in red (Modified from Edwards *et al.* 2000).

Conocarpus lancifolius Engl. & Diels is a ten to 30 metres high tree and is used in boatbuilding in Somalia (Edwards *et al.* 1995: 130). Fourteen fig species are located in the EW and EE regional, growing to 30 metres tall depending on the species, at an altitude of 500-2,600 metres in riverine forest, single trees in farmland or villages, open woodland, on rock, boulder sand rocky slopes, in deciduous woodland or bushland, evergreen woodland, long wadis, forest edges: *Ficus carica* L., *F. palmata* Forssk., *F.*

capreaefolia Del., *F. sycomorus* L., *F. sur* Forssk., *F. vallis-choudae* Del., *F. salicifolia* Vahl., *F. ingens* Miq., *F. ovala* Vahl, *F. glumosa* Del., *F. populifolia* Yahl, *F. vasta* Forssk., *F. thonningii* Blume, and *F. hochstetteri* (Miq.) A. Rich (Hedberg & Edwards 1989: 280-299). *Moringa peregrina* grows in the EE area, between 100-850 metres, in lava rock slopes, ravines and dry rocky gullies in semi-desert, and banks of large seasonal water-courses (Edwards *et al.* 2000: 157). African blackwood (Lat. *Dalbergia melanoxylon* Guill. & Pm) is a 5-12-metre-tall shrub or tree, growing at 600-1,900 metres of altitude in EW, in deciduous woodlands, wooded grasslands or bushlands, often in rocky places or valleys (Hedberg & Edwards 1989: 106). Barwood (Lat. *Pterocarpus lucens* Guill. & Perro) is a deciduous tree, up to 7.5-18 metres tall, that forms wooded grassland, particularly on rocky hills in the EW area, at an altitude of 550-1,520 metres (Hedberg & Edwards 1989: 105) (Figure 12.59). Willow (Lat. *Salix subserrata* Willd.) grows up to 10 metres high, in region EW at 1,250-2,850 metres of altitude, beside rivers and streams (Hedberg & Edwards 1989: 258). Toothbrush tree grows up to 6 metres tall from the coast to 1,300 metres of altitude in the EE region on saline and sandy soils (Lat. *Salvadora persica* L.) (Hedberg & Edwards 1989: 354-355). Two species of tamarisks grow in Eritrea (Edwards *et al.* 1995: 3-5): *T. aphylla* grows in the EE region on sandy-salty banks of wadis and rivers, and in dry deciduous scrubland or woodland; *T. nilotica* in the EW region between 300-1,750 metres of altitude, in riverine woodland, and on alluvial soils at the bottom of river valleys. *Terminalia brownii* Fresen. grows at an altitude of 300-2,000 metres in the EE and EW regions, to 10-15 metres high, in woodlands, wooded grassland and bushland, river banks, dry riverine forests, and is a relic tree in agricultural land (Edwards *et al.* 1995: 128). Three jujube species reaching 6-15 metres tall, grow in regions EE and EW, at 100-2,400 metres, and are often present in *Acacia-Terminalia*, *Acacia-Balanites* woodland and bushland, *Acacia* woodland on alluvial soils, dry riverine forest and thicket, wooded grassland, in and along dry riverbeds, edges of cultivation and gardens: *Ziziphus mucronata* Willd, *Z. spina-christi* (L.) Desf., and *Z. abyssinica* Hochst ex. A. Rich. (Hedberg & Edwards 1989: 393-369).

A few species are not endemic to Eritrea and were introduced in the past few centuries. Thus, such species might have been employed in modern traditional boatbuilding, and thus would not have been used in antiquity and/or medieval times. Edwards *et al.* (1995: 80) say that in the 19th century, the *Eucalyptus* genus was introduced from Australia by

Italian colonists to the area of Asmara. Some thirteen *Eucalyptus* species are presently distributed in the EW region, and are cultivated in plots from 1,700 metres to 2,400 metres of altitude: *E. patens* Benth., *E. diversicolor* F. Muell., *E. saligna* Smith, *E. botryoides* Smith, *E. resinifera* Smith, *E. comuta* Labill., *E. salubris* F. Muell, *E. cladocalyx* F. Muell., *E. tereticomis* Smith, *E. camaldulensis* Dehnh., *E. globulus* Labill., *E. largiflorens* F. Muell., and *E. leucoxylon* F. Muell. (Edwards *et al.* 1995: 88, 90-98, 100, 104-105). These tall trees, varying from 15 to 90 metres high, produce strong and durable timber suitable for keels and long planks; as is the practice in Egypt (See Chapter 8). Another example is *Casuarina* (Lat. *Casuarina equisetifolia* L.), a cultivated tree growing at 1,000-1,400 metres of altitude in region EW, that was introduced from Australia (Hedberg & Edwards 1989: 262). Neem (Lat. *Azadirachta indica* A. Juss.) was introduced from India or Burma, and is planted in the EE and EW regions below 1,550 metres (Hedberg & Edwards 1989: 485). Probably another introduced tree are the oak (Lat. *Quercus robur* L. and *Q. ilex* L.) and the white mulberry (Lat. *Morus alba* L.) cultivated in region EW at 1,800-2,400 metres and 1,500-2,300 metres respectively (Hedberg & Edwards 1989: 265, 272).

3.3.5 Saudi Arabia

In Saudi Arabia, there is a wide range of arboreal species which are suitable for boatbuilding. These are species of acacia, balanites, fig, juniper, tamarisk, moringa, toothbrush, terminalia and sidr. These are distributed in several distinct physiogeographic regions in the country (Al-Nafie 2008: 160) (Figure 3.16).

These topographical areas are: In the west, the narrow coastal plains extend along the Red Sea, and gives way to the western mountain ranges that rise steeply to a maximum of 3,015 metres and drop gradually towards the central plateau. The latter consists of a highland terrain including the Pediplain Najd, Hisma Plateau, and Hijaz-Asir Plateau, and is transected by wadis which flow easterly and are sometimes buried under the central sand dunes. The precense of these wadis indicate a former wetter climate in the area. Central Saudi Arabia is occupied by the cuesta region composed of a "parallel sequence of several prominent crescent-shaped north-south escarpments. These west-facing escarpments extend along the eastern margins of the Crystalline Shield between Ad Dahna sand dunes in the east and the central plateau region in the west" (Al-Nafie 2008: 160). Finally, the sand dune regions comprise: the Rub Al Khali (Empty Quarter) including Nafud Al Jafurah; the Great Nafud; Ad Dahna; and a series of sand dunes extending along the western side of Tuwayq Escarpment. Between the Ad Dahna and the Arabian Gulf coastal region there is As Summan Plateau of hard rocky plains. The Arabian Gulf coast is irregular with marshes, salt flats and narrow sandy plains (Vesey-Fitzgerald 1957: 780; Al-Nafie idem: 160).

Figure 3.16: Topographical map of Saudi Arabia (Ezilon Maps 2009c).

Saudi Arabia's climate (Figure 3.17) is generally mild in the winter and dry and hot in the summer. Temperatures can range from 50°C during summer to sub-zero at night inland. Rainfall is less than 100 mm per year in most regions in winter, and decreases from north to south and from west to east. The west and south-western mountains are subject to continental rain in winter and monsoon rain in summer (Assaeed n.d.: 2-3; Vesey-Fitzgerald 1955: 477; Al-Nafie 2008: 160-161). This climate sustains a variety of arboreal resources which might be used in boatbuilding. The deterioration of vegetation during the last century has been caused by human and animal activities such as livestock grazing, fuel-wood cutting and land cultivation (Assaeed n.d; Aref & El-Juhany 1992).

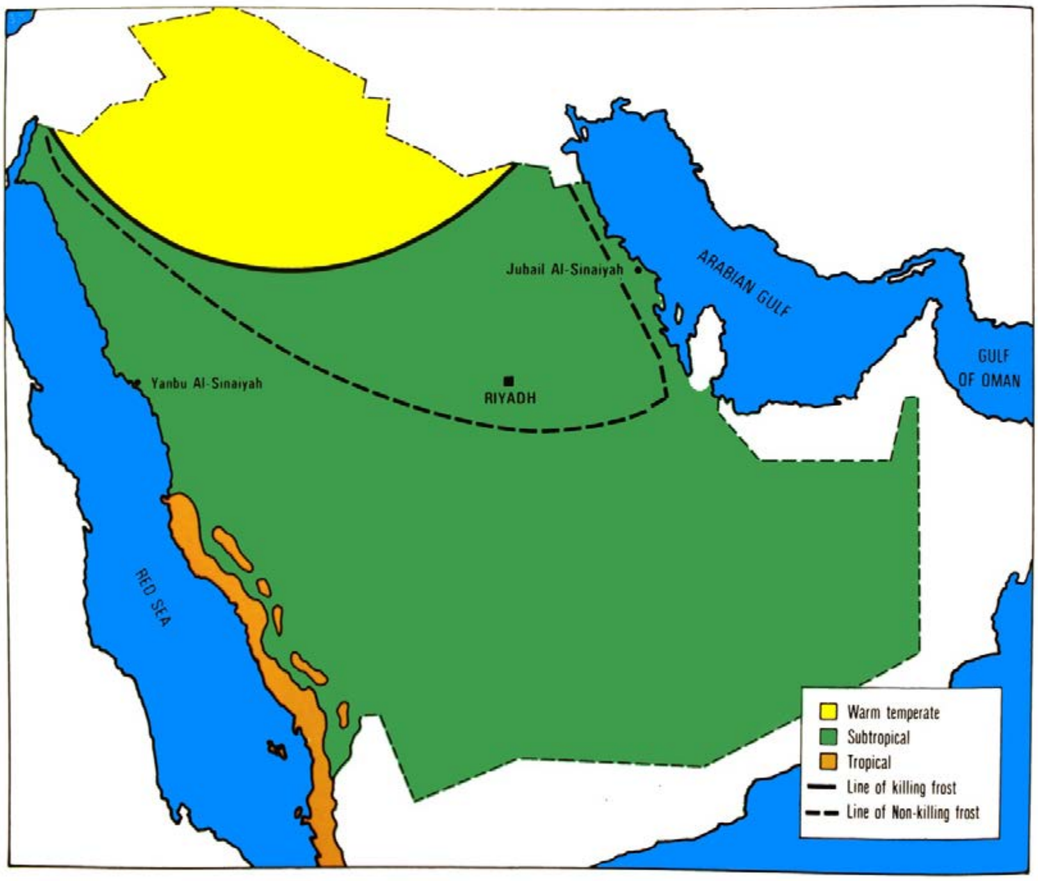


Figure 3.17: Climate map of Saudi (RCJY 1990: 12).

Al-Nafie (2008) following Zohary (1973) suggest that the Arabian Peninsula consists of two main phytogeographical regions[20]: the Saharo-Arabian Region[21] and the Sudanian Region.[22] The Sudanian region comprises the Eritreo-Arabian and the Nubo-Sudanian subprovinces (Zohary 1973); while areas above 1,800 metres are called "Afromontane archipelago-like regional centre of endemism" which includes the Afro-alpine archipelago-like region above 2,800 metres of altitude (Al-Nafie 2008: 163) (Figure 3.18, Figure 3.19).

[20] He also reviews all the different phytogeographical divisions for the country by different authors.

[21] This region is also called the Saharo-Sindian Region or the Saharo-Sindian-Regional Zone.

[22] This region is also known as the Sudano-Zambezian Region or the Sudano-Zambezo-Sindian Region.

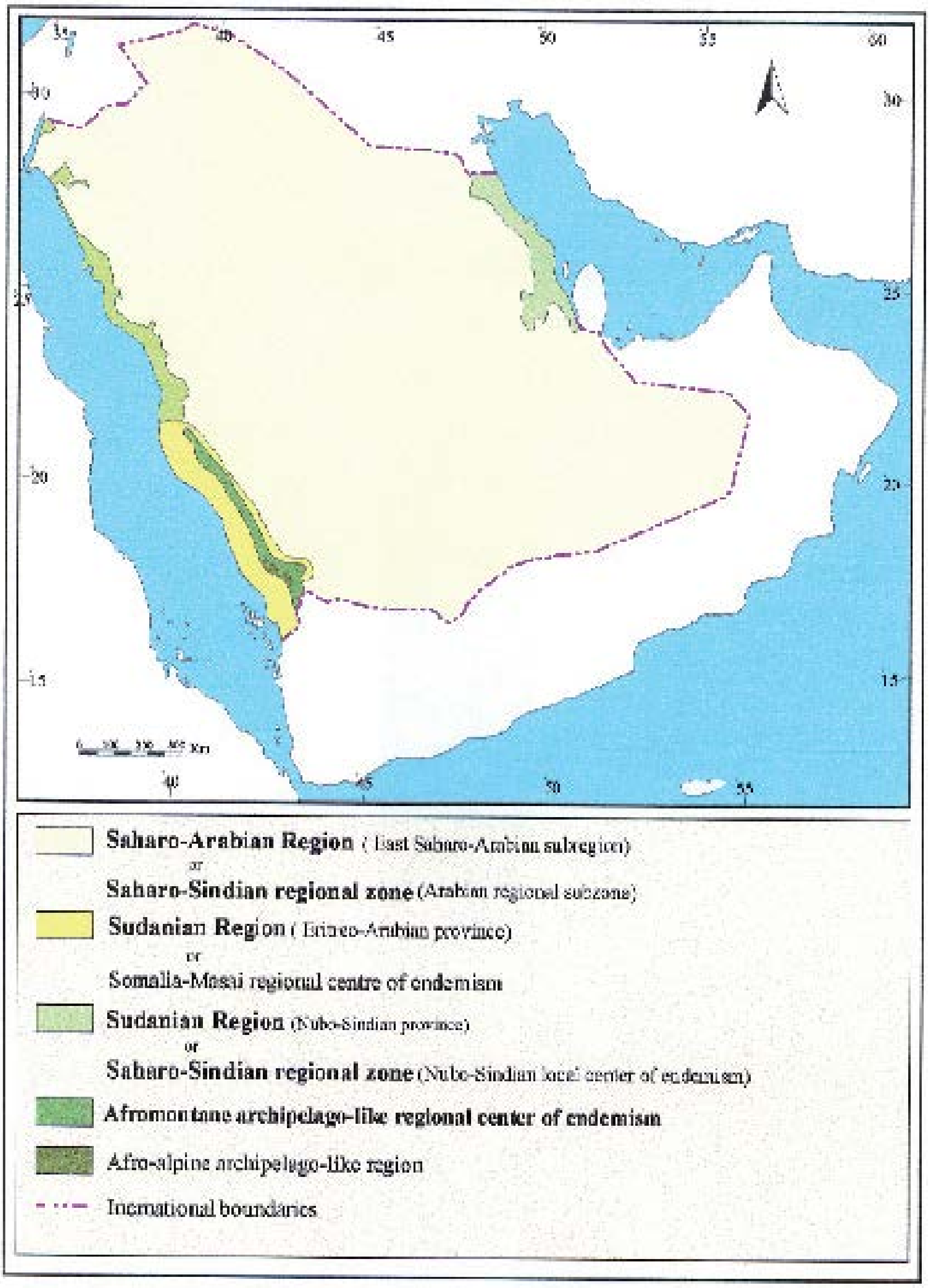


Figure 3.18: Phytogeographical regions of Saudi Arabia (Al Nafie 2008: 174, Figure 7).

The Saharo-Arabian Region has one species of tamarisk (*Tamarix nilotica*) (Al-Nafie 2008: 166 Table 2) which might serve in boatbuilding. The region is quite scarce in trees due to its aridity, caused by animal and human exploitation (Al-Nafie 2008: 167).

The Sudanian territory in Arabia is also represented by the Eritreo-Arabian province extending in the southern and south-western parts of Arabia, and the Nubo-Sindian province. The latter province is widely distributed and comprises continuous patches interrupted by arid deserts stretching along the coastal belts of the peninsula, but also several plains, plateaus, depressions and slightly elevated hills, far from the coast (Zohary 1973: 244). The arboreal flora comprises around twenty species of *Acacia*, *Balanites aegyptiaca*, ten species of fig, African juniper (Lat. *Juniperus procera* Hochst. ex Endl.), *Moringa peregrina*, *Salvadora persica*, tamarisk (Lat. *Tamarix aphylla* (L.) Karst.), *Terminalia brownii,* and three *Ziziphus* species (Zohary 1973: 379, 244-246; Wood 1997: 48, 49; Al-Nafie 2008: 169).

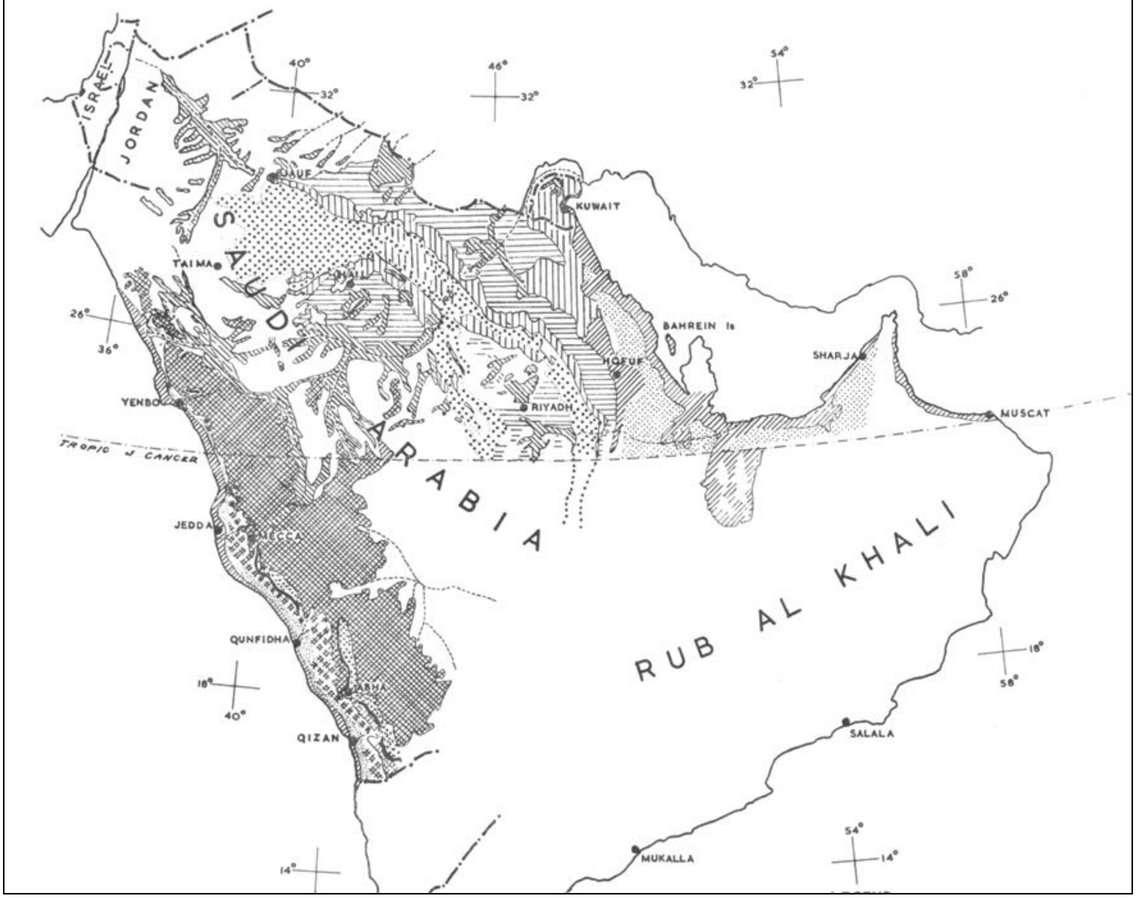


Figure 3.19: Vegetation map of Saudi Arabia (Vesey-Fitzgerald 1957: Figure 2).

Acacia species are generally distributed between 500 metres and 1,500 metres above sea level (Zohary 1973: 246; Al-Nafie 2008: 169), but are also present on the coastal plain of the Red Sea (Vesey-Fitzgerald 1955: 484, 485) (Figure 3.20, Figure 3.21). Acacias are commonly found in the Jeddah- Mecca areas, the Ghallah area along with *Tamarix* stands, the Hijaz, Asir and Rub al Khali, the Red Sea coast north of Jeddah, and the north-eastern gorges (Vesey-Fitzgerald 1957: 787; Zohary 1973: 247; Migahid & Hammouda 1974: 167-172). Several species of acacia include: *Acacia tortilis* which grows in wadis, on gentle slopes and rocky and gravely soils (Assaeed n.d: 4); *Acacia asak* and *A. etbaica* present on hillsides and plateaus between 1,000-1,500 metres (Assaeed n.d: 4; Vesey-Fitzgerald 1955: 480; Aref & El-Juhany 1992); *Acacia mellifera*, *A. etbaica*, *A. asak*, *A. tortilis*, *A. ehrenbergiana*, *A. nubica,* and *A. hamulosa* which are common on stony slopes between 500-1,000 metres of altitude (Vesey-Fitzgerald 1955: 480-481). Below 500 metres, *Acacia ehrenbergiana* is the dominant species growing in the valleys often associated with *Salvadora persica* (ibid: 481). *Balanites aegyptiaca* trees are concentrated in the southern Hijaz (Migahid & Hammouda 1974: 95-97). *Avicennia marina* and *Rhizophora mucronata* populate the muddy soils near the Red Sea and Persian Gulf coasts of the country (Assaeed n.d: 4; Vesey-Fitzgerald 1955: 488-489; Migahid & Hammouda 1974: 199, 260; RCJY 1990: 31). Fig trees such as the sycomore fig (Lat. *Ficus sycomorus* L.) and the willow-leaved fig (Lat. *Ficus salicifolia* Vahl.) are commonly distributed near water courses in the southern Hijaz, the southern and eastern Najd, at altitudes of 1,000-1,500 metres (Vesey-Fitzgerald 1955: 480; Zohary 1973: 246; Migahid & Hammouda 1974: 115). *Moringa peregrina* is found in the Hijaz area, usually near watercourses (Vesey-Fitzgerald 1955: 487; Migahid & Hammouda 1974: 40-41). *Morus nigra* is found in the Hijaz and the western Najd (ibid: 116).

Forests of African juniper are located in montane forests that run parallel to the coast of Arabia around an altitude of 2,000-3,000 metres (Zohary 1973: 246; Assaeed n.d: 4; Aref & El-Juhany 1992; Fisher 1997; Al-Nafie 2008: 168), thus consisting of a remote area that is difficult to access for the seekers of wood, but not impossible. Indeed Vesey-Fitzgerald (1955: 479) noted the exploitation and clearing for cultivation of juniper stands at high altitudes. Forests of African olive (Lat. *Olea chrysophylla* Lam.) and wild olive (Lat. *Olea europaea* L.) are located at a more accessible lower altitude of 1,500 metres and below in the northern Hijaz and the south (Zohary 1973: 246; Migahid & Hammouda 1974: 220-221). *Terminalia brownii* trees are found in fragmentary savannas around the peninsula (Al Nafie 2008: 169). Tamarisks consist of five species (*Tamarix aphylla*, *T. amplexicaulis* Ehrenb., *T. nilotica*, *T. microcarpa*, and *T. mannifera*) which are widely distributed in the country from north to south, in the Hijaz, Najd and the eastern part of the country (Migahid & Hammouda 1974: 74-75) (Figure

3.22). *Ziziphus* species with *Z. spina-christi* being the most common are often located in drainage valleys in all parts of the country (Vesey-Fitzgerald 1955: 481; Vesey-Fitzgerald 1957: 787; Zohary 1973: 246) (Figure 3.23).

Introduced species growing in Saudi Arabia include Neem (Lat. *Azadirachta indica*) brought in early to mid-20th century from the Indo-Pakistan subcontinent and cultivated in the southern Hijaz and Najd (Ahmed *et al.* 1989: 35-36; Migahid & Hammouda 1974: 107). *Albizia lebbek* is cultivated in the Najd area (Migahid & Hammouda 1974: 172); but the introduction date is unknown.

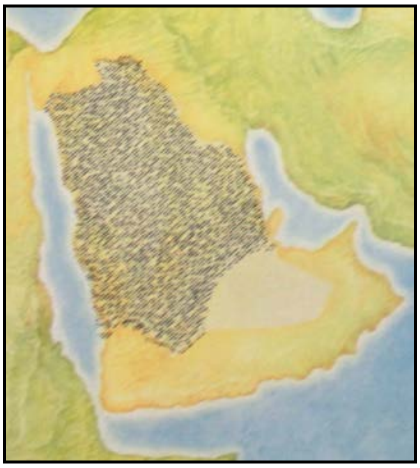


Figure 3.20: ***Acacia tortilis*** **(RCJY 1990: 100).**

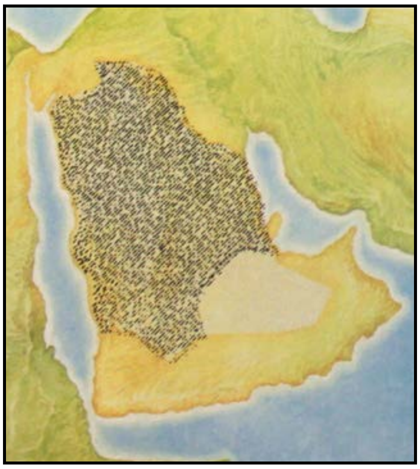


Figure 3.21: ***Acacia ehrenbergiana*** **(RCJY 1990: 102).**

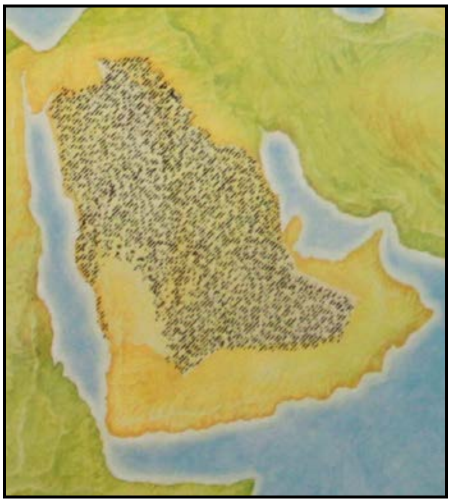


Figure 3.22: ***Tamarix aphylla*** **(RCJY 1990: 36).**

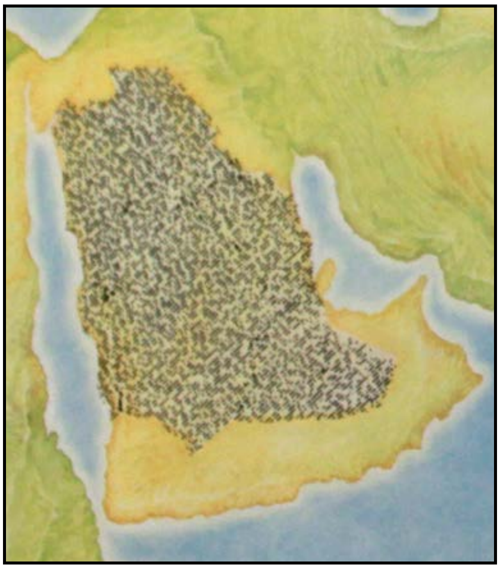


Figure 3.23: ***Ziziphus spina-christi*** **(RCJY 1990: 50).**

3.3.6 Yemen

Yemen comprises five major topographical regions: the Tihama, the Escarpment, the High Plateau, the Mashriq, and the Sands (Wood 1997: 9).[23] These offer a varied source of endemic arboreal resources (Hepper n.d.; Wood 1997) that might serve in boatbuilding (Figure 3.24). Plant distribution in these regions are directly influenced by the climate (rainfall, temperature and altitude, hours of sunshine and mist), the nature of soils, and human and animal interference (clearance, grazing, agriculture, and introductions of new tree species) (Al-Hubaishi & Müller-Hohenstein 1984: 25-39;

[23] These are the most common divisions among botanists. However, Al-Hubaishi & Müller-Hohenstein (1984) consider other divisions which I have tried to correlate to the ones I considered following Wood (1997).

Wood 1997: 17-24). There is a general consensus among botanists who studied the flora of Yemen that the country was more densely vegetated and green in the past than at present, due to increasing climatic aridity and on-going exploitation of wood resources for building, fuel, and grazing (Hepper & Wood 1979: 65; Wood 1997: 25; Munro & Wilkinson 2007: 27).

The Tihama forms the Red Sea coastal plain of Yemen that extends some 20-50 kilometres eastwards, where it rises to 400-500 metres from sea level (Hepper n.d.: 309-311; Wood 1997: 9). The hot and humid climate sustains agriculture along the various wadis that cut through the region (Al-Hubaishi & Müller-Hohenstein 1984: 42, 49-51; Wood 1997: 9). During prehistoric and early historic times, the Tihamah had forest stands of *Acacia* such as *Acacia tortilis* and *Acacia ehrenbergiana*, of *Balanites aegyptiaca*, *Tamarix aphylla*, and *Ziziphus spina-christi*; as well as coastal mangrove stands of *Avicennia marina* and *Rhizophora mucronata* (Hepper n.d.: 310; Hepper & Wood 1979: 65-66; Al-Hubaishi & Müller-Hohenstein 1984: 51-55; Munro & Wilkinson 2007: 15). Most of these species are still present in the landscape along with *Salvadora persica*, growing on silt deposits near the coast, and *Ficus sycomorus* in the silt plains of the Tihama (Hepper n.d.: 310; Wood 1997: 25-28; Zohary 1973: 472). The latter species must have also existed in earlier times since they are endemic to Yemen.

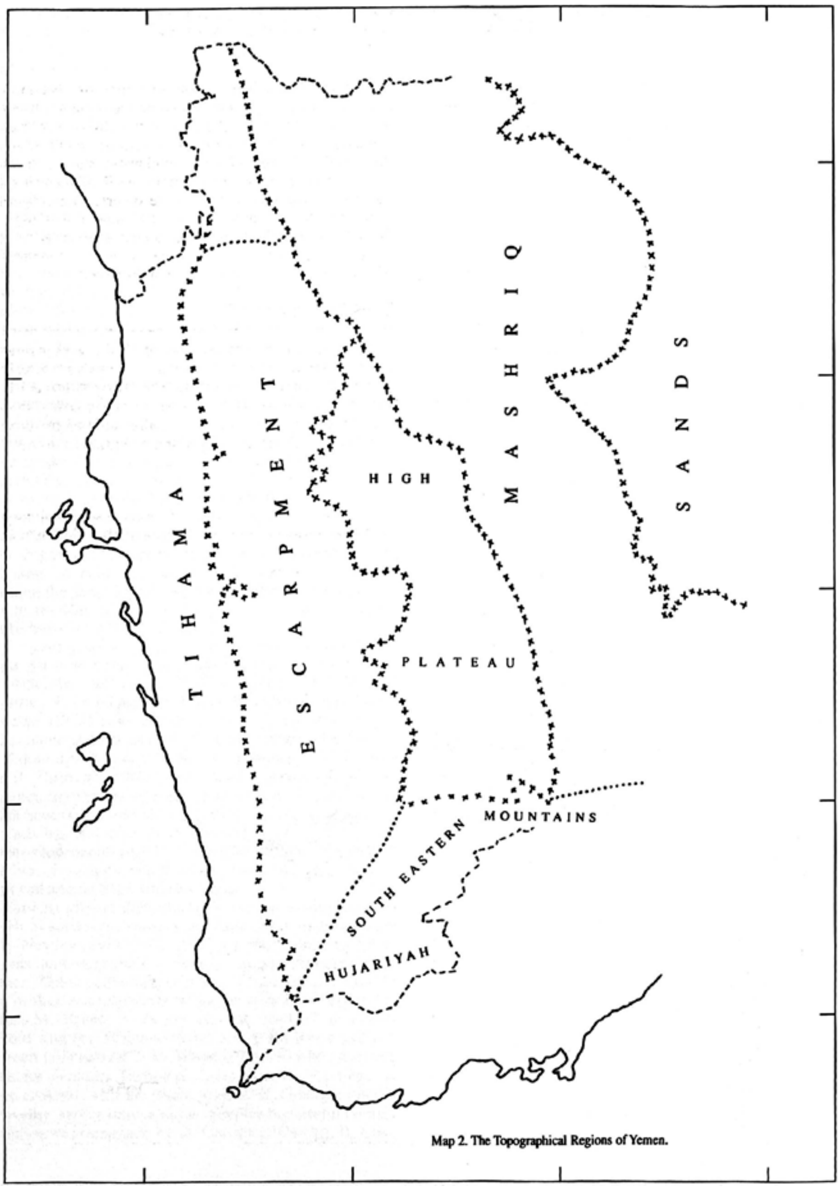


Figure 3.24: Topographical map of Yemen (Wood 1997: 8, Map 2).

The Escarpment runs parallel to and east of the Tihama, and encompasses the 100-kilometre-wide western mountains of Yemen along with their associated valleys and plains. They range between a height of 500 metres in the west and 2,400 metres to the east with a few peaks at 3,000 metres from sea-level (Al-Hubaishi & Müller-Hohenstein 1984: 69-70, 77-78; Wood 1997: 9-10). The fertile soils and high humidity rates are suitable for vegetation growth (ibid: 10). Species of *Acacia* (Lat. *Acacia mellifera*, *A. asak*, *A. tortilis*) associated with *Salvadora persica* form bushlands from 500-1,600 metres in altitude, in the central and southwest escarpment, the wadis in the lower areas between 500-1,000 metres (Al-Hubaishi & Müller-Hohenstein 1984: 64, 70; Hepper n.d.: 311; Wood 1997: 29-39). *Acacia origena* Hunde appears in permanent flowing wadis at 2,400-2,500 metres, but also forms highland forests extending from 2,000-

3,000 metres high which have been existent since prehistoric times (Wood 1997: 33, 38). Several species of fig (*Ficus populifolia*, *F. salicifolia*, *F. sycomorus*, *F. vasta*) are also widely distributed in different place of the escarpment such as drainage valleys located between 500-2,000 metres and permanent flowing wadis at 500-1,000 metres and 1,200-1,500 metres (Hepper n.d.: 311; Hepper & Wood 1979: 66; Al-Hubaishi & Müller-Hohenstein 1984: 65, 74, 82; Wood 1997: 29, 32, 33-34, 39). *Ziziphus spina-christi* is quite common in drainage wadis, in bushland zones between 500-1,600 metres, in gullies of the southeast mountains, and with *Z. mucronata* Willd. in valley forests in the central escarpment (Hepper n.d.: 311; Wood 1997: 29, 34). Tamarisks (Lat. *Tamarix aphylla*, *T. arabica* Bunge/*Tamarix nilotica* (Ehrenb.) Bunge) and willows are less common and are located in permanently flowing wadis at 2,400-2,500 metres (Wood 1997: 33). Scattered tall trees of *Terminalia brownii* Fresen. are present in and around cultivated terraces located on exposed hillsides in the central escarpment at 1000-1800 metres (Hepper & Wood 1979: 66; Wood 1997: 35). *Juniperus procera* and *Olea europaea* L. exist as relict highland forests at 200-2,800 metres, and were much denser in antiquity (Hepper n.d.: 313; Hepper & Wood 1979: 66-67; Wood 1997: 39).

The 50-kilometre-wide high plateau is formed of elevated fertile plains between 200 and 3,000 metres cut through by high mountain chains. The moderate temperatures, rainfall and substantial underground water encourage the growth of vegetation as well as agriculture practices and human settlements (Al-Hubaishi & Müller-Hohenstein 1984: 43, 85-86; Wood 1997: 11). The consequences of the latter might have caused the present-day denuded aspect of the plateau, except for relic patches of acacia, tamarisk, and Christ's Thorn Jujube in protected valleys and in montane plains, which might have been thicker in antiquity (Hepper n.d.: 316; Hepper & Wood 1979: 67; Al-Hubaishi & Müller-Hohenstein 1984: 87, 90, 91; Wood 1997: 40, 41).

The Mashriq is the name given to the eastern mountains of Yemen stretching for "100 kilometres from the eastern edge of the high plateau to the edge of the Great Arabian Desert and from southern Yemen north to the Saudi Arabian border" (Wood 1997: 11). These mountains are often separated by uneven plains and present an average height of 2,000 metres in the west and 1,000 metres in the east (Al-Hubaishi & Müller-Hohenstein 1984: 93-94; Wood 1997: 13). The Mashriq is arid with low humidity rates and rainfall, with hot days and cold nights. *Acacia* trees such as the umbrella thorn

Acacia (Lat. *Acacia tortilis*) are commonly found in sandy and gravelly wadis of the Marib area, east of Sanaa (Al-Hubaishi & Müller-Hohenstein 1984: 96; Zohary 1973: 247). Relics of four species of *Acacia* form bushlands on the exposed mountains above 1,800 metres might have been exploited in antiquity despite this area being difficult of access (Wood 1997: 43). *Ficus salicifolia* occupies cliffs above 1,800 metres, while *Tamarix* spp. and *Ziziphus spina-christi* are distributed in alluvial plains at 1,200-1,900 metres, along dry wadis at 1,100-1,900 metres with occasional *Acacia*s and *Salvadora persica*. *Tamarix arabica* and *T. aphylla* occupy wetland habitats in the Mashriq (Al-Hubaishi & Müller-Hohenstein 1984: 96; Wood 1997: 44).

The Sands, also known as the Great Arabian Desert, lie at the eastern border of Yemen and extend across Arabia to Oman. The topography is made of vast stretches of sand interrupted by a few rocky outcrops and ridges. The climate is quite arid with high temperatures, low humidity and rainfall, thus sustains rare vegetation (Al-Hubaishi & Müller-Hohenstein 1984: 44; Wood 1997: 16). *Salvadora persica* forms perennial shrubs of sand dunes (Wood 1997: 45).

In conclusion of this chapter, the countries boarding the Red Sea and Persian Gulf as well as India display a wide area of local wooden resources that might have been exploited in boatbuilding since antiquity. Arboreal resources of the Red Sea and the Persian Gulf include coniferous tree genera and species such as *Abies*, *Pinus*, *Cupressus sempervirens* and *Juniperus*; non- rosaceous broad-leaved trees such as *Fagus*, *Olea*, *Quercus*, *Tilia*, and *Ulmus*; hydrophilous trees such as *Albizia julibrissin* Durazz., *Alnus*, *Populus*, and *Salix*; Tropical vegetation trees such as *Acacia*, *Moringa peregrina*, *Salvadora persica*, *Ziziphus*; tree species of steppes, deserts and salines such as *Balanites* and *Tamarix*; coastal salines trees such as the mangrove vegetation (Zohary 1973: 341-397, 458, 472, 602). The several habitats in the area under study hold association of species that might have offered the timber seeker an array of choices in one place.

Endemic species indicate that timber from such trees must have been locally exploited in ancient times; while introduced species which were naturalised in areas of the Red Sea are found in the ethnographic record as locally exploited species. The finest trees i.e. those producing long straight planks, must have been highly prized and first targeted for their timber for boatbuilding and other constructions in ancient times. The relics of past forested areas are witnesses of this phenomenon. The diversity and local availability of the above-mentioned species demonstrate the ability of boatbuilders to rely on endemic species for structural elements and short planks. This discredits the general consensus that the Red Sea and Persian Gulf areas were completely denuded of forests in the past, and thus imported wood was the only source of nautical timber.

Theory allows the possibility of critique (Hodder 1995: 5)

4 Theoretical framework

Exploring theoretical concepts related to archaeological and anthropological reasoning frames the perspective from which the present thesis examines the use of wood in traditional boatbuilding. The theoretical canon focuses on the Red Sea regions, whilst also drawing on data from the wider western Indian Ocean. A theoretical appreciation of maritime ethnography and archaeology of such regions is starkly absent. The researcher thus faces the challenge to draw on 'Western'-born theories and concepts of both processual and post-processual schools of thought.

In essence, this thesis looks at the fundamental element of boatbuilding that is the material of construction, wood. Such a material is fetched by humans, past and present, in landscapes which hold such a resource. However, the access and use of arboreal resources cannot solely be explained by environmentally deterministic arguments, i.e. how the environment limits and/or enables human responses and behaviours to timber acquirement and use. Hence, considering "ontological and cognitive themes within landscape study" mitigates the issue of "environmental constraint-and-facilitation" (Cooper 2012: 71).

As landscapes are meaningfully constituted, that is, influencing and being influenced by human experience, there is a need to consider issues of meaning and subjectivity to reach an in-depth understanding of present and archaeological landscapes. Moreover, as Cooper (2012: 71) states "much enquiry has [...] gone into the notion of human engagement with the landscape through labour and the insights this can yield into past existence". This is why this thesis addresses the concepts of the dwelling perspective, taskscapes, and affordances. Also, the social aspect of labour needs to be considered as the driving force behind fetching and exploiting local and often far-reaching timber resources. Meanwhile, the notions of sensory perceptions and materiality confer an active role at an individual level for the timber merchant and the boatbuilder in choosing and engaging with the material-wood.

Moreover, as Johnson (2012: 279) argues one cannot consider that: "human beings have experienced landscapes in the same way in all times and in all places". This hints at the fluctuations in the availability of wood species over time and space, and how people dealt with this issue. By extension, it also addresses how one defines traditional practices and societies; the Red Sea communities considered as fixed in time from an orientalist perspective. Thus, this thesis stresses the active engagement of boatbuilders with nautical timber through addressing the notions of craftsmanship and apprenticeship.

Finally, owing to its multi-disciplinary approach, the theoretical context set here frames the archaeological and ethnographic aspects of the thesis, as it studies past and present nautical timber use. It does so through evaluating the validity of an ethnoarchaeological approach in its processual sense; or whether human engagement with timber exploitation through time should be addressed as the intertwining of environmental, socio-cultural and individual factors.

4.1 Living traditional practices

The subject of this thesis being the use of wood in traditional boatbuilding from classical antiquity until present times, draws on a main key concept: The issue of tradition.

The concept of tradition has been widely looked upon in related literature (e.g. Hasslöf 1972; Hobsbawm 1992; Sahlins 1999). It "is that body of practice and belief which is socially transmitted from the past. It is regarded as having authority in the present simply because it comes from the past, and encapsulates the wisdom and experience of the past" (O'Hear 1998: 445). However, tradition, as Hobsbawm (1992) argues, is not what is socially transmitted from the past, but a set of practices which are imagined constructed and formally instituted. These through behavioural repetition automatically imply "continuity with the past" (Hobsbawm 1992: 1). Thus, tradition has a flexible character, that is to say, the means by which it responds "to circumstances of various sorts" (O'Hear 1998: 446). This paradigm echoes the concepts of Hasslöf's 'Living Tradition' (1972), and Said's 'Orientalism' (2003), since it challenges preconceived archetypes of 'Eastern' societies frozen in time, in the case of our study of maritime communities. Reasonably, as Pfaffenberger (1992: 511) explicitly states: "no such thing as a 'traditional society' exists. Every human society is a world in the process of becoming, in which people are engaged in the active technological elaboration, appropriation, and modification of artefacts as the means of coming to know themselves and of coordinating labour to sustain their lives. New resources are unlikely to be ignored if they can be woven into an existing or new activity system". As will be demonstrated in this thesis, what might be perceived as 'traditional' processes of timber exploitation rooted in the past are constantly under transformation and adaptation to new economic and social contexts and other variables.

4.2 Filling in the gaps: an ethnoarchaeological approach?

The bulk of this thesis draws on an ethnographic case study of the use of wood in traditional boatbuilding in the Red Sea. It also looks at archaeological material and related issues on this subject. This section explores how the potential of ethnography can colour archaeological interpretation. Since, as Ransley (2009: 10) advocates, "the idea of studying one culture with the express intention of using it as a mechanism to understand the past is […] methodologically flawed"[24] Thus, a reflection upon ethnoarchaeology and its inherent concept of analogy is analyzed here. Noteworthy is that most of the examples below relate to the wider study of boats, rather than the specific issue of nautical timber, due to the lack of studies on such subject.

Ethnoarchaeology is defined as "the study of material culture in the present by archaeologists" (Johnson 1999: 52). During its development in the early 20th century, ethnoarchaeological research gained momentum with the emergence of processual archaeology, which relied on a scientific positivist approach to the archaeological record. Subsequently, post-processual archaeology expanded the scope of ethnoarchaeology, with its focus on intangible material culture and varying human behaviour vis-à-vis historical and environmental contexts. Independently of their theoretical perspectives, ethnoarchaeological studies primarily focused on non-maritime contexts, practices and communities (e.g. Binford 1978; Gould 1978; Kramer 1979a; Hodder 1982; Gould & Yellen 1987; David & Kramer 2001). In the Middle East, ethnoarchaeological research was done from a processual perspective, and concentrated on 'traditional' villages mainly in Iran and Jordan (e.g. Watson 1979a; Kramer 1982); on material culture in Iraq (e.g. Ochsenschlager 1993) and Jordan (e.g. McQuitty 1984);

[24] Quoting Ransley (2009: 10): "There are after all dangers in constructing an ethnographic study around an archaeological question, particularly one that focuses on a particular task or manufacturing process, on functions or systems – since it will be shaped by an already established conceptual framework, one understanding of the world, rather than being open to observing an alternative. There is a sense in which the researcher believes they already know what the questions are before they enter the field".

experimental research on flint tools from sites in Anatolia and Iraq (Anderson 1994); and bone tools from the Zagros and the Levant (Campana 1989).

It is only in the past two decades that maritime ethnoarchaeology has started attracting the attention of scholars (e.g. Prins 1986). Recent scholarship in the study of Western Indian maritime material culture have emphasised the importance of ethnography, mainly to record vanishing 'traditional' practices, but also its implications for understanding the archaeological record (McGrail 1996; Vosmer 1999; MGrail *et al.* 2003). Noteworthy is Belcher's (1999) research on the ethnoarchaeology of fishing in a Baluch village, Pakistan; as well as other ethnoarchaeological studies focused on nautical aspects such as Pomey's (2011, 2012) comparative study of sewn boats of the Mediterranean and the western Indian Ocean; and Blue *et al.*'s (1997) investigation of Orissa's *patia* fishing boats and Tamil Nadu's *vattai* fishing boats (Blue 2002). Although, the latter studies integrated issues beyond a mere technological description, in-depth case-studies focusing on social contexts — such as the ones done in anthropological research — remain scarce in boat studies (See Ransley 2009; Fuquen 2014). Indeed, mainstream boat studies "perceive the application of particular, contemporary, technical analogies as the connection between excavated boat remains and traditional boats. Both address boats solely as technology, as functional objects, and neither are able to demonstrate effectively how traditional boat studies could contribute to maritime archaeologies beyond providing analogies for specific aspects of boat reconstruction. In this version of ethnoarchaeology, the relationship between material culture, social meaning and place remains largely unexplored" (Ransley 2009: 8). Moreover, almost none concerns the use of wood in boatbuilding. It is therefore a challenging task to adapt the subject of the present thesis — that is the nautical timber use in the past and present — to an ethnoarchaeological framework, or have a comparative approach to previous similar studies on the topic, which are non-existent. This is also applicable to the issue of timber trade, since ethnoarchaeological literature on trade in general lacks in quantity (David & Kramer 2001: 377). But these are not the only limitations as to why an ethnoarchaeological approach might provide an incomplete vision of our subject.

This thesis attempts to analyse and evaluate what might be suitable analogical parallels between past and present practices of nautical wood exploitation. As Blue (2003) argues, maritime ethnoarchaeology aims at interpreting the archaeological material related to maritime aspects of culture through analogous applications. Analogy is defined as the "selective transportation of information from source to subject on the basis of a comparison that, fully developed, specifies how the 'terms' compared are similar, different, or of unknown likeness" (Wylie 1985: 28). By using information derived from one context, which is the present, to aid the explanation of data found in another context, which is the past (Johnson 1999: 48), analogous application of ethnographical research to the archaeological record links these two temporal entities. Analogy, ubiquitous to ethnoarchaeology, was adopted and criticised by both processual and post-processual authors alike (e.g. Belcher 1999: 24-25; Gould 1978; Wylie 1985; Stahl 1993; Verhoeven 2005; Fewster 2006; Normark 2009). Processual analogies rely on archetypal model building and phenomena-testing to explain the archaeological material (Binford 1967; Watson 1979; Kramer 1979a). For example, Belcher (1999: 24) considers analogy as "the most important tool that archaeologists like other historical scientists, use to understand and interpret the past". Most of the maritime ethnoarchaeological studies cited above (e.g. Prins and McGrail) are quite close to a processual approach since they rely on the use of technical analogies from contemporary boats in archaeological context. As McGrail says: "Ethnographic studies can make the archaeologist aware of a range of solutions to general problems. […] Using such ethnographic analogies […] the archaeologist can […] propose hypothetical reconstructions of incomplete objects or structures, suggest the possible function of enigmatic structural elements and describe in some detail how an object or structure was made" (McGrail 1984: 149-150). Marlier-Saboureau (in Pomey 2011: 138-139) and Pomey (2012: 122-123, 127) found several analogies in sewing technique, for assembling hull planks, between the 6th century BC sewn boats of the Archaic Greek period and contemporary sewn vessels from the western Indian Ocean, including the southern Red Sea, East Africa and the Persian Gulf. These analogies are valid in their own right but remain at a functional and technical level, by adopting what Ransley (2009: 8) rightfully perceives as an "evolutionary narrative of boats" which reflect "social reductionism". However, few briefly mention social aspects. For example, Pomey (2011: 143-144) states that "a ship is in fact the result of adaptation of a specific function to a distinct environment. It is also the product of a society, with its own organisational structure, resources, and level of technical development".

Another shortcoming of processual analogy is the belief that such analogical inferences are more successful when applied to archaeological cultures that historically relate to present ethnographic groups (Gould 1978a; Schiffer 1978). Watson (1979: 279) states that "the possible rewards resulting from the practice of ethnoarchaeology in a region where cultural continuities are numerous and extraordinarily long-lived". This processual view of analogy is not applicable to the Red Sea area due to the constantly changing parameters and variables of timber exploitation processes as will be demonstrated in Chapter 9. This echoes Stahl's (1993) caution against the use of direct analogy in the interpretation of the past, since people's social conditions are influenced and altered by historical circumstances.

Post-processuals, such as Hodder (1982), argue that "the passage of the systemic into the archaeological involves not merely natural and utilitarian cultural transforms but also symbolic transformations" (David & Kramer 2001: 113-114). They attempted to move beyond the functional, behavioural and ecological focus of processual analogical inference, by recognising a relational analogy, which emphasises a contextual, conceptual and intangible approach to the material cultural variability and to a culture that is meaningfully constituted. This resonates with Ransley's (2009: 10) substantial critique of applying analogy to the study of material culture: "In making analogies between systems of ceramic manufacture, pastoralism or boat construction in contemporary south Asia with prehistoric Europe, these studies often make the implicit assumption that underlying all cultures is a systemic uniformity (a governing social structure or organization), a system of social action which can be deciphered and transferred across time and space". Thus, such deterministic uniformitarianism is avoided in this thesis. Another critique of ethnoarchaeology is put forward by Marshall (2006: 73) who argues that it is an essentially 'ahistoric' undertaking, which cannot aid in understanding cultural change due to the lack of historic context. This could be mitigated, as she recommends, by improving on the "synchronic analogies" through building up a range of contextualised examples (ibid: 74). Recent studies on traditional boat studies (e.g. Blue 2003) explored the problematic issues of analogy in relation with cross-temporal and cultural parallels, but not its social reductionism nor by suggesting alternative perspectives to the studies of boats such, as phenomenological perspectives (e.g. Ransley 2009, 2012). Therefore, ethnographic analogies should not be used as models to fit to or test against the archaeological record but rather they can provide ideas and concepts to think through it (Tilley 2003: 2).

In conclusion, the discussion of ethnoarchaeology and analogy is relevant to the present thesis since maritime ethnoarchaeological research in the Red Sea is quasi non-existent. When few attempts have been made, they are understandably constructed and dominated by 'Western' or 'Western'-formed academics, imbued with concepts and approaches of traditional boat studies. The Red Sea areas where ethnographic data was gathered for this research are situated in a 'modernized' context and present a much more 'modern' way of living with highly urbanised areas, electronic technologies, means of transportation; all embedded in a dynamic physical and social world which contrasts what might have constituted a timeless past of a romantic 'orientalist' perception. Indeed Thomas (2004: 209) shows how modern day gadgets, fashion, and building materials have substantially altered the texture of our existence. I do believe as Tilley (2007: 19) says, that people are "embedded in a material world, immersed within it, and this sensuous world of material things has effects on the way people think and behave, but not in any simple or deterministic sense". Moreover, ordinary life in the Arab world has been constantly shaped, for the past centuries, by "transnational flows of culture, capital, political power, and military force" (Abu-Lughod 1989: 301). As for maritime cultural ethnography and archaeology, "traditional boat studies, and processual ethnoarchaeology, are imbued with the legacies of the early anthropological social evolutionist perspectives, connections with colonial discourses and latterly structural-functionalist conceptions of culture in their understandings of human-object-environment relations", as Ransley (2009: 13) rightfully sums it up. This is why, this thesis explores concepts other than ethnoarchaeology, and attempts to present alternative perspectives of the study of nautical timber, to assess and evaluate how much of an ethnographic analogical approach is applicable. The concepts proposed subsequently encompass intangible perceptions of nautical wood, issues of materiality, temporality, craftsmanship and apprenticeship to explore the interconnectedness of material culture, social meaning and place.

4.3 Intangible perceptions of nautical timber

Alternative perceptions of the use of wood in boatbuilding are explored here, aiming at going beyond functional and structural contexts. These derive from ethnographic data and suggest alternative ways of thinking about past practices without necessarily applying direct analogies to the archaeological record. Explored here are the intangible perception of people and the wood material they work with, and how it imbues their personal dialects and sensory awareness.

4.3.1 Vernacular language

Timber species figure in conversations with informants in their vernacular names which depend on the regional context in which they are mentioned. Even when these names are quite similar, a few personal variants make their way into the ethnographic record, for example: (Ar.) *atl*, *atal*, *atel*, *athal* are all variants designating the tamarisk tree. A few names are used interchangeably such as (Ar.) *ʿilb*, *sidr*, and *nabq*, all designating (Lat.) *Ziziphus spina-christi* (L.) Desf.

Timber names become associated with a certain quality: at one point Hamdi Hasan Lahma, an Egyptian master boatbuilder,[25] describing the hardness and durability of acacia wood (Ar. *Sanṭ*), said to me while holding his hand in a fist: "You should know from its name: *sanṭ*, it means strong". Such a metaphor is perhaps not a common perception among other boatbuilders, nor official to Arabic. But to Lahma, the sound of the name itself imposed a sense of power. Another type of wood used in boatbuilding in Egypt is the pitch pine nicknamed by boatbuilders as (Ar.) *ʿazizi*. This word comes from (Ar.) *ʿaziz* which can mean 'dear', 'darling', 'precious'. It thus reflects how boatbuilders express working with this type of wood, as a pleasure for the senses, they say, due to its beautiful grain and enchanting smell. These metaphors come to show that timber, as a material, does not sustain a random connection with the perception it generates, but the latter emanates from the embodied practical and experiential engagement of human agents with the physical properties of the wood itself (Boivin 2004: 64; Tilley 2004: 22).

Some timber species also take on names of their geographical origin e.g.: (Ar.) *sweydi* indicates a pine species, when literally it is the Arabic equivalent of the English expression 'from Sweden'. The same applies to other examples such as *romāni* i.e. from Romania, *jāwi* i.e. from Java. This does not necessarily imply for example that all *jāwi* timbers are specifically brought from Java, but the term is often loosely used for any

[25] Interviewed on 14th January 2012.

other South Asian source. This does not rule out the fact that people also knew where their timbers came from.

People also use adjectives as names for certain types of wood, e.g.: In Egypt, I was informed by Abd al-Rahman al-Qassas,[26] a master boatbuilder in Lake Burullus, that local wood types used in boatbuilding are called (Ar.) *khashab akhdar*, literally 'green wood'. The colour green is employed here to designate locally cultivated trees, which "grow from Egypt's earth" as al-Qassas says. This also might indicate an allegory to the fertility of Egypt's lands as perceived by its inhabitants who profit from its natural resources.

4.3.2 Sensory perceptions

From a phenomenological perspective — phenomenology being the study of the structures of human experience and consciousness (Johnson 2012: 272) — aspects of human bodily experience are an important area of inquiry (Ingold 2000). It opens up alternative stances about past practices, beyond a functionalist angle. Care should be taken however to avoid standardising human psyche "away from an anthropological understanding of human experiences as being culturally different" (Johnson 2012: 277).

A boatbuilder experiences timber logs not only through manually manipulating them, but through other senses: the shape of the grain, the variation in the colour, the visual perception of porosity, the location of knots in the wood; the smell of the freshly removed bark and the scent of timber while it is being cut; the feel of the surface of the sawn log; the sounds of the axes, adzes, drills, and other mechanical tools that echoes in boatyards, workshops, and open sites of ephemeral repair. An Egyptian boatbuilder called Maaruf,[27] speaking of the past lively activities at the boatyard of Anfushi, compared Anfushi to a "bee comb", so much so that neighbours were constantly complaining of the loud sounds, and the hustle and bustle coming out of the yard, he said. All these sensory perceptions that blend together, also called syneathesia (Tilley 2004: 14), transpired in conversations with Red Sea boatbuilders while they were describing to me the different types of wood they use, or when they were showing me pieces here and there in their working space.

[26] Interviewed on 16th January 2012.

[27] Yusif Ahmad Maaruf, 57 years old, interviewed in Anfushi, Alexandria on 12th January 2012.

When speaking of their crafts, several boatbuilders perceive anthropic characteristics that are embodied in the timbers they use. For example, Lahma beautifully describes the relationship between craftsmen and materials, whether metal or wood: "A plank needs to be comfortable [in its destined place in a boat]. If you force a plank into place, it will not hold and will eventually break if you keep forcing it, because the plank needs to extend its full length and you are hindering it. You cannot make it obey you, you need to deal with it as something that feels what you intentions are. You have to be clement with it, and give it the opportunity to meet your expectations. Every craft starts with understanding the material one is working with. The material does not speak, you are the one that needs to try and understand it". This shows how "the experience of materials has profound effects on people's lives and understanding of the worlds in which they live, and on their actions", as Tilley (2007: 19) says. Consequently, a material-based approach to material culture, argued below, pushes the perception and interpretation of the significance of nautical wood beyond the simplistic functionalist paradigms.

4.4 Materiality

The present thesis incorporates post-processual theoretical frameworks and science-based techniques, drawing on botany, phytogeography, physical properties of timber, and microscopic wood identification.[28] Thus, a discussion on issues of materials and materiality is relevant to the focus of the present thesis, that is, on woods used in boatbuilding, i.e. the material itself, rather than on watercraft. Ingold (2000: 340) rightly noted the lack of interest in materials and their properties in the archaeological and anthropological literature on material culture. And so, as Boivin (2004: 69) beautifully puts it: "we [as archaeologists] must turn our attention, currently fixed on abstract notions and surface meanings, back to the material world, in all its richness, complexity and possibility".

Timber confers a boat component its materiality; it is what gives birth to the tangible from the intangible, that is, the concept of the boatbuilders with all that in entails in terms of savoir-faire, skills, dexterity, and social construct. "The material is the recipient

[28] The identification of wood samples from the ethnographic record gathered by myself and members of the MARES team, was done by Dr. Rainer Gerisch. Whereas the identification of archaeological material was mentioned in this thesis according to the related publications.

of human design", says Thomas (2004: 213). Almost all the boatbuilders and wood merchant I have interviewed, visually and inherently perceive the correspondence between a tree part and its nautical counterpart: a crooked piece of log would be designed for or fashioned into a frame. Conversely, a straight trunk would be used to carve a hull plank (Figure 4.1). This should not be interpreted as a straightforward imposition of mental realities upon material ones (Ingold 2007). However, the form of a boat component comes into being from the mutual engagement of people and materials, emerging through a pattern of skilled movement (see Ingold 2000: 342, 345-346, 352-354), whether it is felling a tree or carving a boat component. Indeed, "action has an emergent quality which results from the continual feedback from external events to internal representations and from the internal representations back to enactment" (Keller & Keller 1991: 2 in Pfaffenberger 1992: 508).

Figure 4.1: Visualising boat components as tree parts (Garry & Philippe 2009: 41).

There is much to gain in focusing on the social meaning of the material to define the concept of materiality, and to investigate the significance of materials and their properties in relation to different social, cultural, historical and experiential contexts i.e. to people and their worlds (e.g. Boivin 2004; Jones 2004; Knapett 2007; Tilley 2007). Jones (2004: 335) says that the critical question is to investigate "the interaction between the properties of material and the way in which they are socialised". As such, the physical properties of timber such as durability, strength, density, grain, colour, and shape are essential to issues of materiality, as these influence on a primary level how and where timber is employed in a watercraft. Especially pertinent to the choice of timber for boatbuilding purposes is the question of durability i.e. the ability for a timber component to endure mechanically, biologically, and chemically damaging effects. As seen from the archaeological and ethnographic investigation in this thesis, highly durable timbers such as teak were often used in keels which are subject to all sorts of stress. This practice does not only reflect utilitarian and functional aspects but is also indicative of the way these timber species are valued, used and exchanged. In other words how they are 'socially meaningful' (Jones 2003: 335). Ibrahim Bilgaith, a Saudi master boatbuilder, jealously keeps a teak keel in his boatyard at al-Hafa in Jizan, which he claims to have used over and over in different boats; being from teak, a wood that he values as gold, he says. Having outlived the boats it was a part of, this keel reflects how durability plays in the "temporal relationship between artefacts and persons" (ibid: 335).

Moreover Boivin (2004: 64) states that a material is significant though "the interaction with it by human agents, which is in turn enabled and limited by the capacities and potentialities of the human body". Material properties of things influence human behaviour by enabling and constraining people's activities. This stresses the importance of the materiality of the affordances given by things to people (Godsen 1994: 77; Jones 2004: 330; Tilley 2007: 19). The properties of materials have implications for the way they are embedded in social schemes; thus, these properties influence and contribute to the nature and constitution of these schemes (Boivin 2004: 66). A recent development in the traditional boatbuilding industry in the Red Sea has been the substitution of wood with fibreglass as it gradually became the material of choice for fishing boats. This transition has shaped new ways of social and economic practice in the way people venture out at sea. Using these fibreglass boats implied that fishermen started travelling faster, further, thus reaching distant fishing grounds, which are becoming rare and can just meet the needs of a growing population (Agius et al. 2010). Fibreglass boats are also sturdy, require less time, effort and cost to repair, and less frequent maintenance (Agius et al. 2010), they can also sustain longer immersion time than wooden vessels. Thus, these changes mean that particular agencies and skills related with wooden boatbuilding are rapidly disappearing, and with them "traditional patterns of social organization and interaction" (Boivin 2004: 66). The concepts of bodily engagement and materiality are interwoven and incorporated in social and cultural developments throughout time, as both humans and their material world are mutually shaping and creating each other (Ingold 2000: 87; Boivin 2004: 69; Jones 2004: 330-331). Another technological advent that has changed wooden boatbuilding practices in Egypt is the use of epoxy to glue together horizontal layers of mahogany wood to fashion a keel, which is by itself an alteration in human skills and a complete different practice of carving out a keel from a single log.

In conclusion, the concept of materiality is indeed crucial to the present thesis. As Jones (2004: 336) suggests: "If we assume that a focus on materiality places the material qualities of artefacts at the centre of a web that ties together questions relating to social relations, symbolization, physical interactions with the environment and subsistence, then we have an extremely powerful analytical tool". What follows looks at the concepts of craftsmanship and apprenticeship through which humans are transformed and grow via their daily practice and contact with the material being worked.

4.5 Craftsmanship and Apprenticeship

Crafting should not be viewed as a mere passive action by which an artisan creates an object through a preconceived design, but as an active process through which he/she, among other things, expresses identity. The sociological aspects of material culture (Appadurai 1986) confer it an active and dynamic nature provided by artisans who are perceived as a creators and not fabricators (Costin 1998: 4). Fabricators only execute the will of others, while artisans "actively create or capture social meaning and make it manifest in the objects they create" (Costin 1998: 5). They are social actors with diverse skills, knowledge, experience, politico-economic background, social status, aims and aspirations, i.e. with a life context, through which they perceive the significance of their world, art, and craft. Therefore, craft production should not only focus on issues of technology and organization but also on aspects of 'social labour' (Costin 1998: 4) by which components of social identity, such as gender, kinship, class and ethnicity, dictate the division of labour in craft production in terms of task allocations, responsibilities, and roles. Tasks related to wood use in boatbuilding activities observed in the Red Sea were gender-specific, with male wood providers, boatbuilders and owners. Generally speaking, women were/are not directly involved in boatbuilding practices (Flatman 2003), except indirectly, in spinning coir for ship ropes in the Indian Ocean (Ibn Baṭṭūṭa [d.779/1377] 1962: II.388; Risseeuw 1980). All the boatbuilders I interviewed were male. A large number of them were Muslims and our interviews were often organised around the call to prayer. Otherwise, I made sure my visit to wood importers near

Alexandria did not fall on a Sunday, since they are Christian Copts. Most of the identity of boatbuilders is an inherited one: they learnt their craftsmanship from their fathers who did so from theirs and so on, and in their turn they are passing the torch to their male offspring, so much so that in certain cases the very last name of a boatbuilder is indicative of his crafting. It is the case for example of Ibrahim Ali Musa al-Najjar, [29] an Egyptian boatbuilder in his eighties, perpetuates his father's and ancestors' trade: Najjar in Arabic is the word for carpenter. In terms of the status of Red Sea boatbuilders, I have not had enough time to explore this issue in an in-depth manner. However, I have encountered an interesting example of how the status of boatbuilders is intrinsically related with both the quality of the woods they procure, and by extension, to the boats they build, and with the status of their customer. As an example: in virtue of their professional craftsmanship and the high quality timbers they use, the Lahma brothers who belong to a renowned Egyptian family of boatbuilders were commissioned by leading maritime archaeologist Cheryl Ward (2012) to partake in *Min of the Desert*, an experimental archaeological project to reconstruct an ancient Egyptian ship (See Section 5.3.2).

There is a wealth of ethnographic literature on apprenticeship and its implications for social theory (e.g. Jenkins 1994; Bourdieu 1977; Ingold 2000). My stance in this thesis is to voice indigenous Red Sea narratives on boatbuilding practice, and assess to what extent they are informed by Western theories. Due to the logistical limitations regarding ethnographic fieldwork, outlined in Section 5.3.2, I have not had the chance to thoroughly observe what happens in boatbuilding apprenticeships in the Red Sea. For example, the in depth-work of Simpson (2006a, 2006b) and Ransley (2009, 2012) in India encompass issues of social hierarchy and ethnicity which I did not comprehensively pursue. Still a few impressions transpire from my personal observations in boatyards in Egypt and at al-Hafa in Jizan, Saudi Arabia. Most of the boatyards are family-owned business where craftsmanship was passed on from the forefathers of the present owner, or owners in the case of a brotherly ownership. Wood merchants also fall under this category. Sometimes neighbouring shipyards are owned by relatives of the same family, as is the case in Lake Burullus, Egypt. Thus, the owners of the boatyards are master boatbuilders keen on perpetuating wooden craft traditions, but also on answering the demands of a growing and economically-driven leisure-boat

[29] Interviewed on 24th January 2012.

industry with the use of new materials such as metal and fibreglass. A master boatbuilder usually delegates tasks of administration and supervision to his offspring whereas more tedious tasks appertain to workers who are non relatives. These usually originate from the town or the province where the boatyard is, but others migrate from further afar and even from other countries. However, all master builders said they experienced the entirety of potential tasks under their fathers' supervision, of whom they always spoke highly, and with whom they built a respectful and obedient relationship. Indeed, such personal relationship in shipyard apprenticeship is often related to its inherent cultural and religious background (Simpson 2006a, 2006b). The master builders I spoke with told me that back when they were still apprentices, they were deemed fit to start partaking in boatbuilding tasks, after a period of only observing and/or fetching tools and nails for other more experienced carpenters including their fathers. They acquired a 'non-verbal knowledge' (Jenkins 1994: 439), where the verbalised technical knowledge "represents only the tip of the iceberg" (Pfaffenberger 1992: 508), "through their joint immersion in the settings of activity" (Ingold 2000: 193). As such, when I asked how exactly boatbuilders learnt to saw and convert a timber plank, most replied that this is how it should be done, this is how it is. Like Ingold (2011: 57) argues: "The skilled practitioner is like an accomplished storyteller whose tales are told in the practice of his craft rather than in words". Hamdi Lahma told me that he has a (Ar.) *maʿrifa* meaning his personal knowledge gained from experience, which can compete with and win over any naval architect's (Ar.) *ʿilm* i.e. formal education. It is in this inherited knowledge that most master builders find their pride. Much of the practice in question is also transmitted, learned, and employed through 'mimesis' (Bourdieu 1977: 2, 116). However, learning a skill is not only a cognitive process, involving observation and imitation, but is grounded in contexts of practice, personal involvement and bodily engagement of a novice to attain the rhythmic fluency of an experienced practitioner (Pálsson 1994: 920; Ingold 2000: 353, 356-358, 372). Thus with time, skills grow with the performing body impacting its anatomy, and are as much biological as cultural (Ingold 2000: 360). Boatbuilders through their apprenticeship develop what Pálsson (1994) describes as enskilment, a process of "immersion in the practical world [...] and not [...] the mechanistic internalization and application of a mental script, a stock of knowledge or a 'cultural model'" (Pálsson 1994: 901). They interact with the wood while carving it, feeling it, listening to it, guided by an intimate awareness of the material and tools, and by their internalised skills and personal experience. Tools become assimilated as part of their bodies, whereby technical practices become embodied practices expressed in a social context.

Thus, techniques, material culture and social organization of labour all shape human adaptation to the environment in what Pfaffenberger (1992: 497) defines as a 'sociotechnical system' or an 'activity system' which is "a domain of purposive, goal-oriented action in which knowledge and behaviour are reciprocally constituted by social, individual, and material phenomena" (idem: 508). Further in-depth research is needed in other areas of the Red Sea to investigate social labour relations, to avoid falling in technological determinism, which Pfaffenberger (1992: 510) rightly refutes when he states that "not just because there is only one way to make a material artefact, that every culture that adopts it will be forced to develop the same social and labour relations". Thus, in the following section I will investigate the different networks and interrelations woven around timber procurement and use for boatbuilding.

4.6 Timber connection

The timber exploitation processes investigated in the present thesis (Chapter 9) places the material wood into a network of intertwining activities, agencies, and people. Several actors from cultivators to famers, timber agents, boatbuilders and their apprentices, boat owners, whether these are fishermen or merchants, come in contact to negotiate acquisition, prices, transportation and other arrangements. All these relationship networks are enabled by a need for timber to build boats. Indeed, acquiring and crafting wood for boats not only involves economic parameters but underlies social relationships. Likewise, Costin (1998) has stressed the importance of recognising social actors, identities, relationships, processes and behaviours in the discourse on the organisation of production of craft objects. When analysing and interpreting the social processes of the timber trade in the Red Sea, I realised that certain parameters explaining the concept of trade in general were, for example, overlooked in processual ethnoarchaeology. David and Kramer (2001: 360) state that: "Exchange and trade distribute raw materials and artefacts across space through a variety of physical and institutional mechanisms". These authors fail to include, for example, issues of interpersonal choices that are deeply enmeshed in relationships of cooperation, complementarity, mutual trust, respect, and familiarity between boatbuilders and wood merchants (See Section 9.2).

Also, timber procurement for boatbuilding requires people to move and travel across the landscape. A few Egyptian boatbuilders I spoke to usually acquire their timber from local providers but some others pay a visit to cultivation grounds in order to personally estimate and choose suitable timber-producing trees for felling. Local wood merchants often personally undertake the trip to suitable tree stands, and act as lumberjacks as well. When it comes to imported wood, the movement takes on a larger dimension with long-distance travel, whether to fetch South Asian timber or seek European providers in Romania, Russia, and Scandinavia (see Section 9.2.2). Thus, ways of experiencing such places and landscapes is structured by the physicality of these peoples' bodies (Tilley 2004: 4). As such, during my fieldwork in Egypt, I visited Atef Matar a local wood merchant.[30] He took my assistant and I on a tour around the cultivated fields in Birket al-Sabeᶜ, to indicate types of tree growing there, which he sells to boatbuilders. Whilst we were diligently following him and recording his every word and move, our sense of direction, not having been there before, was somehow reduced to null. This was not the case for Matar. Having grown up in and around these fields, he was orienting himself accordingly, having acquired 'cognitive maps' of these places, that is, 'internalized representations' of them which "become articulated through a somatic nexus" (Tilley 2004: 9). This goes to show the difference between our outsider's situated knowledge and Matar's embodied knowledge of space gained by experience, by moving through his lands. The next section explores the concept of temporality as an additional hermeneutic tool through which we can view and relate past and present practices of exploiting timber in boatbuilding; as well as the significance of temporality for the changing narrative of a timber's life cycle.

4.7 Temporality

This section explores the paradigms with which we can interpret and compare past and present practices, as well as exploring the temporal development of the material itself.

4.7.1 The dwelling perspective, taskscapes and affordances

Boatbuilders in the Red Sea areas depended greatly in the past on wood resources to build watercraft. They still do in very few regions where wooden boats are still being built such as in Egypt, Dahlak Kebir in Eritrea and Yemen. The relationship that land

[30] Interviewed on 28th January 2012.

owners, wood merchants, and boatbuilders sustain with the environment they live and operate in is explored here though three concepts: the dwelling perspective, taskscapes and affordances.

Through the concept of the temporality of the landscape, Ingold (1993, 2000) attempted to unite archaeological and anthropological perspectives. A concept he coined as a 'dwelling perspective'. It transcends the division between a naturalistic Cartesian view of a landscape, perceived as a passive external backdrop to human activities, and a culturalistic view whereby a landscape is a symbolic ordering of space. Thus, to Ingold (1993: 153, 2000: 189) a landscape "is constituted as an enduring record (sic) of [...] the lives and works of past generations who have dwelt within it, and in so doing, have left there something of themselves". Acts of dwelling are constituted by what Ingold (1993: 158, 2000: 194-195) calls a 'taskscape', that is "activities carried out by a skilled agent in an environment" as part of his/hers daily life. The temporality of a taskscape is thus socially constructed, since each task is meaningful in relation to others, performed by a network of people working together (Ingold: ibid).

On the other hand, environments provide a series of 'affordances', following Gibson's (1986) term, that is, the possibilities which it offers or furnishes, either for good or ill. Affordance is "equally a fact of the environment and a fact of behaviour. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and the observer" (Gibson 1986: 129). Such a perspective argues for the interconnectedness of people and their environment through practical activities (Tilley 2004: 24). By attending to the environment in which they live, people change what it affords them (Gibson 1986: 130).

Thus, taking into account that a taskscape amounts to human activities imbued in a landscape, and affordances are what an environment offers humans, then taskscapes use and modify affordances, which in turn instigate a set of taskscapes. As Ingold (1993: 155, 2000: 192) explains: "A place owes its character to the experiences it affords to those who spend time there [...]. And these, in turn, depend on the kinds of activities in which its inhabitants engage. It is from this relational context of people's engagement with the world, in the business of dwelling, that each place draws its unique significance". What follows next explores how these three concepts colour interpretations of past practices for the exploitation of nautical wood.

4.7.2 Links to past practices

Nautical timber can be seen as a representation of a material linking present-day cultural practices to ancient ones through the continuity of use of certain species: acacia, tamarisk, etc. In broad terms, from antiquity and throughout medieval times and until the present, three main geographical entities acted as main timber providers to the Red Sea areas: the Mediterranean and wider Europe, East Africa and South Asia. This however, should not be considered as constant, since sources and types of local and imported woods were under constant change with time. Indeed, from medieval times, new species such as the eucalyptus tree for example have been introduced to Red Sea areas, which modified the landscape, and thus what the landscape affords as resources for wooden boatbuilding. Also, new centres of import figure in recent decades due to travel, political and socio-economic variables (See Chapter 10). Thus, experience of place and landscapes is temporally coloured and constituted because "things, people and places are not static entities but constantly changing and altering their nature" (Tilley 2004: 12).

Change in the use of timber species in boatbuilding has also been experiential. For example, the use of sycomore fig attested in Egyptian Pharaonic nautical contexts, is discarded by modern Egyptian boatbuilders who deem it porous and weak. This is an example of how the material itself testifies to history and change. Boatbuilders, through their activity, carry past experiences forward: "Any moment of lived experience is thus orientated by and toward the past, a fusion of the two. Past and present fold in upon each other. The past influences the present and the present rearticulates the past" (Tilley 2004: 12).

In applying analogical reasoning to the ethnographic wood species used in boatbuilding and their archaeological counterpart, several similar species are used in both contexts. However, the element of idiosyncratic variability at an individual level i.e. the personal choice of a boatbuilder cannot be simply inferred as similar to the past. For example, both acacia and tamarisk are suitable for structural boat components. However, some boatbuilders I spoke to in Quseir said that one boatbuilder they know uses tamarisk for frames to make profit since tamarisk is cheaper but is not as durable as acacia. Therefore, they estimate that the latter does not have high ethical standards because he is delivering a lesser quality to the boat owner who commissioned him. This also reflects how the reputation and status of an artisan is extrinsically reflected in the value of the end-product (Costin 1998: 9) and can be tarnished if the boatbuilder is deemed as greedy.

Such idiosyncratic variability, whether at a cultural or individual level, also counters the argument of environmental determinism (Binford 1962; Gould 1980) i.e. the biophysical limitations of human response.[31] Since people are not passive receptors of information and knowledge about the world but are actively involved with "practical projects, values, needs, desires and interests" (Tilley 2004: 30). Equally, landscapes are not static entities but social products constantly in process of being and becoming, both constituted and constitutive, linked with agency and meaning (Tilley 1994; Tilley 2006: 7). Forests and tree stands have been constantly modified and exploited for boatbuilding and other uses by anthropic interference, thus causing an alteration of tree landscapes throughout history. The latter were also modified through the introduction of non-endemic arboreal species, also used in boatbuilding, to Red Sea countries at different periods. *Morus nigra* originating in Asia Minor, Caucasus and Armenia was introduced to Egypt during the Hellenistic period (Germer 1985: 23-24). Whereas *Morus alba*, originating in Mongolia was introduced to Egypt during the Early Islamic Period for silk worm breeding (ibid: 24). Other species such as mango and eucalyptus were introduced to Egypt and other areas of the Red Sea in modern times (Bégué 1958; Watson 1983; Mikhail 2011). Presently, we can think of the Red Sea landscape as "actively created by ordinary people, and its form and appearance today are the result of their agency over thousands of years" (Johnson 2007: 147). In turn, this shift in the arboreal landscape altered boatbuilding practices as new species were introduced and new networks of procurement explored. This exemplifies again the mutual embeddedness of people and their world which are constantly bringing each other into being (Ingold 2000: 87). "The world is active in constituting social relationships, just as people are active in shaping the form of the environment that they inhabit", so says

[31] McPherson (1993: 5) advocates this paradigm when speaking about the Indian Ocean maritime trade. He adopts Braudel's concept of the *longue durée* whereby the long-term natural and human environment set the rhythms of human activity such as "basic social attitudes towards food, clothing, architecture and trade", independently of the short-term political and natural events. He sees the peoples, cultures and economies of the Indian Ocean region "as a distinctive world until it was integrated into a global economy in the eighteenth and nineteenth centuries".

Jones (2004: 333). Thus, the variety of endemic and non-endemic timber species employed for watercraft offers a great variation of interpretation ancient and contemporary wood use. Drawing on Rackham's (1990 in Johnson 2007: 144) example of the timber from a house, to show the interconnectedness of practice and environment, a boat plank unveils "a complex system of timber management, starting with the management of woodland over decades and even centuries" which indicates not "a determinism of nature over culture, but [...] a deep and complex understanding of the mutual construction of both". However, such generalization is not always valid. Indeed, in certain cases timber merchants acquire wood from forests in an unsustainable manner contributing to deforestation in countries such as Malaysia, Indonesia and East Africa. Such a globalised trade is money-driven, where boatbuilders are almost entirely disconnected from timber management policies.

4.7.3 The life cycle of a wooden boat component

From both archaeological and ethnographic contexts, it appears that wooden boat components have a life cycle with two main phases: a first phase preceding use in watercraft whereby parts of trees are rendered into boats; and a second phase where components are used and then discarded or recycled. However, such a division is not that clear-cut. From the moment it is born from a tree, a piece of wood undergoes continuous changes as a result of conversion, treatment, environmental strain, and use.

The metamorphosis of a tree log into a boat component draws on a "series of operations which transforms a substance from a raw material into a manufactured product" also known as the *chaîne opératoire* (van der Leeuw 1993: 239-40). A description of this process has been detailed in Chapter 9: from selecting suitable trees, felling them, transporting them to the yard, stripping the bark, seasoning the timber and converting it. The *chaîne opératoire* is quite relevant in ethnoarchaeological approaches (David & Kramer 2001: 13), since such series of operations observed in an ethnographic context could inform on related past practices. Rather than considering this concept in its processual sense, there is a need to contextualise such practices temporally and socio-culturally. Moreover, it is a process coloured by the bodily engagement between the tool, the material and the practitioner, which results from "the intimate coupling of perception and action" (Ingold 2011: 56-58).

Once a boat is afloat, its wooden components are exposed to stress, water, teredo, sun, and wind, facing biological physical and chemical degradation. When the material cannot sustain these factors, it is discarded and replaced (Figures 4.2 and Figure 4.3). Its life can be prolonged if recycled into buildings; the remains of which are attested by archaeological evidence in the Roman site of Berenike, Egypt, and the Islamic sites of Quseir al-Qadim, Egypt and al-Balid, Oman (Chapter 7); or sold for charcoal (Section 9.2.1).

Figure 4.2: Replacing the garboard strake on a *zaʿīma* in Tuwalet, Massawa, Eritrea (Photograph: John P. Cooper).

Figure 4.3: Discarded planks with sawdust at al-Hafa shipyard, Jizan, Saudi Arabia (Photograph: author).

In conclusion, apprehending wood use in boatbuilding from an analytical perspective has the potential to inform the archaeologist and ethnographer about alternative ways of thinking, beyond a functionalist and deterministic approach. By integrating material analyses with social questions, we reach a more interesting analytical paradigm. This is one of the reasons why an ethnoarchaeological approach in its processual sense, i.e. by applying direct analogy, is not valid. The materiality of things is experienced in divergent ways in various historical and social contexts, places and landscapes as it is a relationship embedded between people, places and things, including the dynamics between sets of taskscapes and affordances. Transforming a log into a boat component as practice involves embodied technical skills, internalised knowledge, personal experience, and sensory engagements between the material and the boatbuilder; skills that are acquired through a process of enskilment, that is the bodily engagement in the practical world, and an interaction calling on all senses — feeling the wood, smelling it, observing it and listening to it through the tools at hand. As Tilley (2004: 2) says: "We experience and perceive the world because we live in that world and are intertwined within it. We are part of it, and it is part of us". Looking at how craftsmanship operates within the human experience and daily life indicates how carving a tree log or a boat component is not only a mere transcription of a prior design onto raw material. As Ingold (2000: 372) argued, the forms of things come into being "through the unfolding of a system of relations comprised by the presence of the artisan in a richly structured environment that could include other persons, other examples of artefacts of the kind that it is desired to make, a selection of materials, and a range of tools and supporting surfaces". These parameters need to be taken into consideration not only when interpreting ethnographic examples but also the archaeological record. Moreover, in terms of inferring implications of social identities and craft production from an ethnographic record and applying it to the archaeological record, one needs to bear in mind that crafting is a social construct which may be "idiosyncratic, culturally-specific, and historically contingent" (Costin 1998: 7). Carving planks and building boats is transmitted through apprenticeship from generation to generation, but in the form of a template preceding the construction or practical process. As Ingold (2000: 372) argues: "Form-making involves a precise co-ordination of perception and action that is learned through copying the movements of experienced practitioners in socially scaffolded contexts". Finally, the concept of temporality applied to wood as a material, and to the landscape which affords timber, shows that both are constantly modified and transformed by human physical and conceptual engagement; and in return they shape people. The embeddedness of the social and the material world is central to a more comprehensive approach of human-material-environment relations in the present thesis.

5 Methodology

The methodology adopted in the present thesis is a mutli-disciplinary approach to the study of the use of wood in boatbuilding in the western Indian Ocean, with the Red Sea as a case study, from classical times until the present. It involves a critical and interpretative analysis of classical and medieval primary sources; with an investigation of the archaeological datasets evidencing the nautical use of several timber species and their significance in terms of provenance and trade patterns; the multi-sited ethnography addressed the recording of a rapidly disappearing aspect of maritime tangible and intangible cultural heritage, and a comparative framework between past and present practices of using wood in boatbuilding. Meanwhile, the scientific identification of wood samples allowed the verification of vernacular names with their scientific counterparts.

5.1 Primary sources

5.1.1 Type of sources

The chronological scope of the present thesis covers two main periods: classical antiquity (8^{th} century BC- 7^{th} century AD) and the medieval Islamic period (7^{th} century AD-15^{th} century AD). For the classical period, this thesis draws upon works of Greek and Roman botanists, historians, and geographers, written in Greek and Latin. This author thus reported their original terminology for wood, as well as the edited English translation to mitigate her limited knowledge of these ancient languages. The medieval Islamic authors, whether these were Arab, Persian, Kurdish, or Andalusian, of several disciplines such as historians, geographers, lexicographers, and travellers, all wrote in Classical Arabic. It was the lingua franca of the time irrespective of race, religion and politics. Also, Arabic being this author's mother tongue, these edited primary works were read and studied as such.

5.1.2 A critical appraisal of textual sources

A critical approach need to be adopted by researchers when analysing primary sources, which is not a mere description of the views of different ancient and medieval scholars on a certain issue (Caulley 1992). A critical approach and document analysis should compare relevant issues, identify areas of controversy, and analyse the context, the intent and the purpose of a text. External criticism is another tool to examine the content of a text for consistencies or the lack thereof with established facts from secondary sources. The researcher needs to investigate the significance of the evidence provided to aid the interpretation of the subject at hand. Critical thinking through describing, contextualising and establishing relevance of the source material is a substantial process necessary to assess and interpret data from primary sources.

The primary methodological concern when looking at ancient tree names is the accuracy of species identification and terminology. As Moorey (1994: 347) sums it up: "The ancient terminology for timbers [...] is fraught with uncertainties since it may not be assumed that the ancient categories are our categories nor that terms were constant across space and through time. Nor would scribes have recorded timber with quite the same precision that comes naturally to expert timber merchants, foresters, or carpenters". Moorey was concerned with Ancient Mesopotamia but his statement could well apply to classical and medieval sources. Stanley Pease (1952: 51) argues that one should be aware that a secure identification between the trees mentioned by the classical authors and those of today is very hard to achieve.[32] This is due to the problematic botanical identification of the species designated by the different authors whether in Greek or in Latin. Indeed, these names were given to different trees and plants by these ancient authors long before the establishment of the universal binomial system. The latter system generates an international code of botanical nomenclature made of two names in Latin form. It ensures that no two species share the same name, and that this same name is internationally used. It was introduced in the 18th century by the Swedish naturalist Carl Linnaeus (Raven 2000: 23). Before this, classical authors did not possess technical terms and used popular one-word names already designating certain plants. Indeed, Theophrastus (d. 287 BC) taught his students that most cultivated plants had commonly known names, but wild species were rarely known and some nameless (Anon 1918: 186). These generic names, some of which are used once by authors such as Theophrastus, need nowadays to be followed by an epithet precisely designating one single type of plant or tree. Even in the case of Theophrastus, where the latter uses a single name for a single type of plant, this does not solve the problem, since many

[32] Stanley Pease (1952: 51) suggests that this problem could be mitigated by "collecting very fully the reference in ancient works, in noting modern names which may be the lineal descendants of ancient, in gathering and comparing folk-uses, ancient and modern, and in gaining greater familiarity in the field in the countries occupied or explored by the Greeks and Romans".

popular flora names encompass an extensive diversity among what are today considered separate species (Raven 2000: 23). As Raven (ibid) states: "The result is, of course, that many plants names and even some of those described by Theophrastus, like the prickly crocus, are forever impossible to identify by anything more than a hazardous guess". Indeed, the study of ancient plant names requires the combined knowledge of "the scholar, the historian, the ethnologist and the naturalist", something which is rarely achieved (Anon 1918: 186). Indeed, even with modern technology, wood species identification by botanists is still quite challenging (Van der Veen 2011: 206). Sometimes tree genera comprise not only species but also subspecies, and this was one of the developments of modern botanical analysis. Thus, it is highly doubtful that ancient and medieval classification of trees was that accurate or refined. This might have led to the use of a single word by ancient and medieval authors to actually indicate many species or even encompass trees of diverse types (Moorey 1994: 347).

Another interesting possibility to consider is that the terminology has been erroneously considered as consistent through the ages (Moorey 1994: 352). It is clear from botanical works that classifications and names of species are constantly reappraised due to taxonomic advances (See Mabberley 1998). For example: *Acacia albida* Delile formerly included in the genus *Acacia* is now known as *Faidherbia albida* (Delile) A.Chev. and included in the genus *Faidherbia*. The Delile suffix represents the 18th century French botanist Alire Raffeneau Delile who first identified this species; while A.Chev. stands for the 20th century French botanist Auguste Jean Baptiste Chevalier responsible for this shift. Additionally, Graeco-Roman writers erroneously conferred the term cedar to tree species that were in fact junipers (Lucas 1989: 492). This confusion of nomenclature entailed that the term cedar has been most probably used in a loose manner, and it is now often unclear in the classical sources whether a particular wood so called was truly cedar (Lucas 1989: 492). Moreover, the Arabic word *sāj*, which indicates teak, is also an Indian vernacular name for this species but also for *Terminalia tormentosa* (Roxb.) Wight & Arn. (syn. *T. alata* Heyne ex Roth) which is widely used in boatbuilding in India (Gamble 1902: 342-343). Considering these arguments, it can be inferred that medieval Islamic sources also might have loosely used the term (Ar.) *sāj* to indicate species that were in fact not. Confusion of species might arise from the physical resemblance of certain types of timber, in the absence of scientific verification though microscopic wood identification. Hence, Moorey (1994: 352) argues that it is possible for "the fine, expensive dark woods of eastern origin, sissoo and ebony" to have been often "confused with cheaper types of dark wood, which might be used for many of the same purposes". For example, several medieval Islamic authors, speak of the use of teak in boatbuilding (see Section 6.2). The heartwood of teak is a medium brown, darkening with time. It can easily be mistaken with other types of tropical woods such as certain species of the *Shorea* genus (Lincoln 1986), and Iroko (Eng. African teak, Lat. *Milicia excelsa* (Welw.) C.C. Berg) (Meier 2007) both commonly used in boatbuilding. Most likely, boatbuilders and timber merchants would empirically know the difference between species. This is was not necessarily the case of classical and medieval historians, geographers and travellers. This can be hard to exemplify as it is conjectural, but still a plausible hypothesis.

When investigating species identification in ancient texts through secondary sources, it seems clear that some of these authors fail to report the citation as is, and use it to support their personal interpretation. For example, when Theophrastus (V.4.7) speaks of a durable type of wood, he does not specify a certain species. Despite this, countless amount of literature has taken for granted that Theophrastus speaks of teak (see Section 6.1.1).

Another issue that deserves attention is the contemporaneity of sources to the events they are reporting. For example, a few medieval Islamic authors such as Maqrīzī copied facts describing the use of teak in construction from his predecessor historians. We need to consider if the wood identity was lost or confused with another in the process, or transmitted as-is with no verification.

Another factor to consider is that sources are often eclectic in their scope, and thus information is lacking on the use of timber in more common vessels. Medieval authors when reporting types of timber used in boatbuilding often relate to major naval endeavours of the royal elite. Thus, we know less about timber which was employed in fishing or cargo boats.

Searching for the slightest hints on the use of nautical wood in primary sources was a painstaking, slow and time-consuming process, as most editions did not hold any relevant indexes. This has therefore limited my ability to cover a wider array of ancient and medieval sources, considering time limitations and the multi-disciplinary scope of the present thesis, which also draws on areas of archaeological and ethnographical investigation as well.

Finally, care should be taken when referring to ancient and medieval sources for identification of tree species. The information thus provided needs to be supplemented with secondary sources and cross-checked with archaeological evidence if and when possible.

5.2 Archaeological evidence for nautical timber

5.2.1 Significance of archaeological evidence

Archaeology allows the validation or refutation of practices related with ancient use of nautical woods as reported by ancient literature, and adds a time-depth to contemporary practices of wood exploitation. It enriches our understanding of past timber exploitation patterns by offering tangible evidence for ancient and medieval timber use in boatbuilding in the western Indian Ocean.

5.2.2 Type of data and wood analysis

Archaeological data sets evidencing the use of wood in boatbuilding in antiquity and medieval times in the western Indian Ocean are quite scarce — even more so than what the textual sources have to offer. Reasons for this go beyond the scope of the present thesis but the poor number of excavations in regions of the western Indian Ocean, or perhaps the fragile preservation of wooden artefacts, might be the two main causes.

The breadth of the archaeological material investigated in this thesis draws on nautical findings in wide maritime archaeological contexts encompassing both land-sites and shipwrecks in Egypt, Oman, West India and Indonesia. Even, if Indonesia is not included in the geographical context of this thesis, the 9th century Belitung wreck is considered as a western Indian Ocean vessel. These archaeological data sets stem from reports and publications of recent scholarship on the aforementioned sites (Raban 1971;Vermeeren 2000; Ward 2000; Flecker 2000, 2008; Belfioretti & Vosmer 2010; Peacock & Blue 2011; Fabre 2011; Van der Veen 2011). Thus, this author has not examined the material first-hand.

Wood samples from these above-mentioned sites were analysed by archaeobotanists to answer questions of provenance of the different timbers, of the vessels they are a part of, and the timber trade and transportation patterns that might have existed in the past. However, wood identification and its various implications is a challenging task which Van der Veen (2011: 206), who studied Quseir's timbers, explains as follows: "Wood structure is rarely sufficiently diagnostic to enable identification to species level. Sometimes differences in vessel size or the cellular distribution of the axial parenchyma (or other tissues) may suggest individual species/groups of species, for example in *Acacia* spp., but cell size and distribution are strongly influenced by edaphic factors (climate, topography, soil conditions, etc.), by the maturity of the wood and by the part of the tree (trunk, branch, root). Consequently, wood structure can vary significantly within a single tree and reliance on such features can be misleading. In addition, naming to species level can be particularly risky when only small fragments of wood are available for examination, especially when these originate from degraded archaeological material. Accordingly, in most instances identification to genus level is all that can be achieved". Hence, the more degraded the wood, the harder it is to section and examine. The identification to genus level would then provide a wider phytogeographical scope for the related trees, and thus renders the task of pin-pointing sources of exploitation quite complex.

5.2.3 Evidence of provenance: long distance timber import or local exploitation?

When analysing the origin of the timber used in boatbuilding to determine where the boat was built or repaired, attention should be given to the origin of the wood in question. If the timber-producing tree is endemic to the locality, it most probably indicates local exploitation. Conversely, distinction needs to be drawn between imported timber and species introduced for cultivation. As Willcox (1992: 27) argues, it is quite challenging to discern import from introduction. In the case of Mesopotamia, he adds, archaeological finds of *Pinus*, *Morus*, and *Juglans* could be either. Thus, referring to ancient textual sources might resolve the issue. Consulting botanical manuals such as Mabberley (2008) and other country-specific flora books, phytogeography (Zohary 1973b), historical phytogeography or paleochorology (Krutzsch 1989), and environmental history (Mikhail 2011) publications is also crucial. When a non-endemic species, employed in boatbuilding, relates to a well-defined and dated archaeological context, this author has compared the context date with the introduction date of the related species in order to determinate whether it was an introduction or import. Any date prior to the introduction indicates timber import, or reused foreign species while any subsequent date most probably indicates local timber exploitation of introduced species.

Investigating the archaeological evidence for the ancient and medieval use of wood in boatbuilding can shed light on several research questions regarding practices of ancient related communities: The means by which ancient and medieval boatbuilders in the western Indian Ocean access wood resources, especially in the Red Sea and the Persian Gulf, commonly viewed by modern scholars as wood-poor regions of the world; whether the exploitation of nautical wood types in a given period reflect the political geography and economic networks of the day; the ways in which geopolitics and economics influenced the types of wood exploited; and if changes did occur, then how wood merchants and boatbuilders have responded to changing wood availability over time.? However the scarcity of archaeological datasets may not always provide an in-depth understanding of such issues at all periods and in all areas, since they are quite dispersed in time and space. Thus, there still are large chronological and geographical gaps that can only be filled by the discovery of more related archaeological material.

Published studies on wooden nautical archaeological material, pre-dating the classical period, such as related to Pharaonic Egypt, were also looked at by this author to provide a deeper chronological understanding of past activities (Ward 2000a; Ward & Zazzaro 2010; Pomey 2012). As Skoglund (2012: 2) argues: "Archaeology can contribute to a more pluralistic understanding of humans' use of trees in a historic perspective". Thus, a comparative approach with the ancient and medieval literature, as well as with ethnographic practices, allows the scholar to draw an exploitation timeline and patterns for different timber species.

5.3 Ethnographic approach

5.3.1 Aims and objectives

Prominent scholars in the sphere of maritime ethnography constantly warn of the disappearance of traditional wooden boatbuilding in South Asia (McGrail *et al.* 2003; Pham *et al.* 2010), the western Indian Ocean (Chittick 1980; Swamy 1999; Rajamanickam 2004), and more particularly in the Red Sea (Prados 1996; Agius *et al.*

2010). Traditional wooden boats and their building practices *per se* are not the subject of this thesis, but timber, the inherent element of these watercraft, is. Thus, if they disappear, the use of nautical timber, its exploitation patterns and trading networks, undergo the same fate; along with the skills of wood merchants and boatbuilders. McGrail *et al.* (2003: 17) explain the importance of documenting and recording traditional wooden boats, so "that a way of life, and a technology that is fast disappearing, will be recorded. The traditional wooden boat, propelled by wind or by muscle power, is being replaced by metal or plastic boats with engines. The traditional log raft is also being phased out. By recording the building and use of such craft, we preserve evidence of these skills for posterity". Thus, this is one of the essential aims of the ethnographic approach I adopted in this thesis. As fibreglass is rapidly replacing timber as the prime material used by once traditional boatbuilders, extensive research into the exploitation of timber species and their socio-economic implications becomes urgent.

Recording the use of wood in traditional boatbuilding in the Red Sea is also significant from a historical and an archaeological perspective. The scarcity of literary and archaeological evidence related to the subject could be mitigated by contemporary practices of timber use, which might indicate examples of 'living traditions'. The documentation of nautical timber use in ethnographic contexts can provide "a baseline and a launch pad for historical research backwards from today" (McGrail *et al.* 2003: 18). Analogies or dissimilarities between ancient and contemporary practices can be delineated through the use of ethnoarchaeology. But these might be problematic when applied over space and time, and need to be considered cautiously (Wylie 1985; Belcher 1999: 24-25; Blue 2003; McGrail *et al.* 2003: 18; Ray 2003: 2). Still, in the absence of excavated evidence, ethnography offers perspectives with which we can think the use of wood in boatbuilding in earlier times. Examples of these are provided in Chapters 9 and 10.

Ethnographic practice, through participant observation with the involved communities, provides answers that archaeology, by its nature, cannot. The choices made by boatbuilders and wood merchants, their empirical knowledge, how they envision and relate to the material they work with — in other words the intangible aspect of material culture — are all questions that remain either unanswered, or highly speculative when dealing with archaeological wood datasets. Moreover, recording the use of modern species can help determine past use when such an issue is not clear from the archaeological record, for example with regard to the functionality of certain boat components. It can also suggest the ancient use of types of species observed in contemporary boatbuilding, that were present in the ancient landscape but not found as archaeological nautical material.

Comprised within the above-mentioned aims were the following objectives: to produce a corpus of tree species used in wooden boatbuilding in the Red Sea; to understand the incentives that lie behind the exploitation of nautical timber such as environmental, functional, political and socio-economic parameters; and to establish the processes underlying such exploitation. Finally, through interviews with informants, I have established a corpus of vernacular Arabic names of timber-producing trees used in boatbuilding. I have therefore drawn linguistic parallels with earlier terminologies such as the ones that figure in the medieval Islamic sources. A more sophisticated linguistic approach has been undertaken for boatbuilding and maritime terminology by Vosmer (1999) and Agius (2002, 2008). The vernacular names provided by informants are considered as variants of dialectal and idiolect features. This is a more general approach since a dialect is specific to a region or a social group, while idiolect is a variety of a language unique to an individual. We could also suggest that people in the past had several terminologies and dialects/idiolects to designate timber species.

5.3.2 The fieldwork

"Mutli-sited or mobile ethnography invokes a sense of voyage, where the ethnographer traces clues by travelling along pathways, spatially, temporally, virtually or bodily" (Ina Maria 2002 in O'Reilly 2009: 146). The MARES Project members and I conducted multi-sited ethnographic research in Egypt, Eritrea and Djibouti on the western coast of the Red Sea, and in Saudi Arabia and Yemen on its eastern coast. The selection of the various locations mainly corresponded to the research interests of MARES, that being the maritime culture of the Red Sea and the Gulf of Aden. Another factor is the political instability and precarious security situation in certain countries of the southern Red Sea. In the case of Saudi Arabia and Eritrea, MARES obliged the official invitation to undertake research in these countries. More specifically, the Red Sea regions are a crucial research area regarding the use of wood in boatbuilding due to several factors. To name a few, these include the rich maritime history due to the Red Sea being a meeting point of different cultures; good climatic conditions for the preservation of timber; surviving ethnographic resources; and tapping into a subject that has been hitherto widely understudied.

The fieldwork seasons were generally spread over two to three weeks in each location during a period extending from 2009 to 2012. Academic commitments of the MARES team members and myself, financial and time constraints, dictated the duration of the different fieldwork seasons. To me, this was beneficial since it allowed me to assess and reflect upon the data related to timber species and use collected by the MARES project prior to my joining the team in October 2009. Thus, I could adopt a more targeted approach, and pursue lines of enquiry and research questions directly relevant to my thesis. However, both MARES and I, whether working together or separately, followed Townsley's *Rapid appraisal methods for coastal communities* (1993). This method proved its efficiency in mitigating all the above-mentioned issues that have limited our ethnographic research in the Red Sea, as well as providing us with the ability to record an endangered aspect of maritime material culture.

Working together under the umbrella of MARES meant that we participated in what is called in ethnographic research 'team fieldwork' (Erickson & Stull 1997; O'Reilly 2009). Thus, issues of project planning, logistics, financial resources and schedule were established in collaboration with the MARES team members; I was solely responsible for organising the Egypt fieldwork season. MARES members shared a common interest in maritime material and intangible culture of the Red Sea, with each team member having particular focus interests, as well as disciplinary and personal perspectives which all fit perfectly into the overall project. The focus of my research was the use of wood in boatbuilding. I was therefore able to collect evidence from three types of sources: first-hand observations from my fieldwork in Egypt in January 2012, and my participation in the Saudi Arabia fieldwork in May 2010; data from MARES team members' field notes and interviews;[33] as well as the ones of Agius during his past fieldwork in Egypt (2002-2004), Sudan (2004), and Saudi Arabia (2007). As O'Reilly (2009: 204) beautifully puts it: "A team becomes a team [...] by sharing and discussing fieldnotes".

Seventy-nine people in six different countries (Figure 3.7) provided us with data on the use of wood in boatbuilding, out of the total number of people interviewed. Agius

[33] Essentially from Prof. Dionisius A. Agius and Dr. John P. Cooper.

interviewed fourteen people during his fieldwork in Egypt in 2002, 2003 and 2004, mainly in Quseir, Quft, and Mersa Alam. He spoke with seven people in Suakin, Sudan in November/December 2004, and only one from Yanbu al-Bahr in Saudi Arabia in May 2007. The first fieldwork season undertaken by MARES members was in Yemen in February 2009, when the team interviewed 16 people and visited Aden, Fuqum, Khor al-Ghoreira, Mocha, Khokha, Hudayda and Salif. In October 2009, MARES went for 20 days to Djibouti, and interviewed nine informants from Djibouti city, Tadjoura, Obock, and Godoria. For three weeks in May 2010, I joined MARES on my first ethnographic fieldwork, where we interviewed seven people in Jizan and the Farasan archipelago. Due to lack of funding, I could not join the subsequent two-week fieldwork in Eritrea between February and March 2011, where MARES interviewed seven people in Massawa, Zula village, and Treter. Then, having secured funding from the Prince Al-Waleed Foundation, I set off for Egypt alone, in January 2012, for a three-week fieldwork season where I interviewed a total of 18 people in Anfushi in Alexandria, Rasheed, and Lake Burullus on the Mediterranean coast; Birket al-Sabeᶜ in Munufiya, north of Cairo; and Suez, Hurghada, Safaga, and Quseir, from north to south respectively on the Red Sea coast.

These informants were all male, with various occupations, mainly: boatbuilders, wood merchants, agriculturists, sea captains, fishermen, pearl divers, historians, and researchers. The oldest person was a sea captain from Suakin born in 1884,[34] and the youngest a 23 year old fisherman from Khor al-Ghoreira in Yemen.[35] The meetings and interviews with informants occurred in various settings, from shipyards, to beaches, workshops, cafes, private homes, courtyards, and hotel lounges.

Discussions were engaged in Arabic as some of the MARES team members speak Levantine Arabic and have a firm command of Modern Standard Arabic. Being an Arabic native speaker, I generally would communicate with my informants in the Lebanese dialect, and would have recourse to standard Arabic whenever my enquiries were not clearly perceived. In Egypt, Mohammad Salama, a student at the University of Alexandria who accompanied me throughout the field trip, would sometimes rephrase

[34] Hussein Abd al-Hamid Abd Allah, sea captain and fisherman interviewed by Agius on the 24th November 2004 in Suakin, Sudan. He was 120 years old at the time of the interview.

[35] Basim Ali Bin Ali, fisherman interviewed by Agius on the 12th February 2009 in Khor al-Ghoreira, Yemen. He was 19 at the time of the interview.

my questions and enquiries in the local dialect, if needed. Overall, my knowledge of Arabic meant I did not need the services of an interpreter. It allowed me to intuitively grasp nuances and personal ways of expressions of my informants. This generally put me in advantage in relation with other ethnographers who either do not speak Arabic or have basic command of the language having learnt it later in life (Love & Ansaldo 2010). On a more personal note, I felt that informants warmed to me when learning I was Arab, and this established a relationship of trust and open communication between us.

The ethnographic interviews were open and semi-structured, based on preset questions or paths of enquiry, but the interviewer would not follow these *strictu sensu*. Thus this allowed the interviewee enough freedom to elaborate on certain aspects more than others, and/or to suggest new ideas and subjects that might have been overlooked by the interviewer. This technique provided new horizons for discussion that went beyond the potential limits of the initial research questions. The conversations thus flowed and progressed in an organic way. As O'Reilly (2009: 128) argues: in unstructured or semi-structured interviews "the respondent is able to offer his or her own insights to guide the research in directions he or she thinks appropriate and to wander off the subject when and where it suits. The interviews should be relaxed and enjoyable, not forced into a framework determined by the interviewer". Indeed, the generosity, patience, endurance and in-depth explanations of the people interviewed was remarkable. Listening back to the recordings and watching the videos of the interviews at hand in the months following the fieldwork made me realise even more the immense and priceless contribution they offer to our understanding of the uses of wood in boatbuilding — even if, at times, the narratives provided by older informants were inexact, perhaps due to their failing memory. At others, good-willing informants would spontaneously give doubtful information. Such distortions of indigenous accounts were looked at by Hasslöf (1972), Jenkins (1994) and Simpson (2006). This could partially be mitigated through direct observation, since I could sometimes compare the narratives to observations I made in the field. More specifically, any information on the physical characteristics of timber could be subsequently contrasted with scientific wood manuals for example (Hoadley 2000; USDA 2010). I could therefore establish consistencies or the lack thereof between narrative understandings and scientific statements. At other times, I could not.

Some people were very expressive and possessed a knowledgeable and analytical discourse, such as 48 year old Hamdi Hasan Lahma a master boatbuilder from Rasheed, Egypt, and Atef Matar a wood merchant in his 50s from Birket al-Sabeᶜ, Egypt. Only one person refused to further pursue the discussion, after I shortly sat with him in a shipyard in Safaga, Egypt. Sometimes, it happened that my informants would answer my questions but take the conversation further away from the subject; this especially happened in Egypt where the post-Mubarak era was conducive to political discussion. I would then delicately reformulate my initial question to bring the issue back to the related research topic. When the answer given was not particularly clear, and I had already reformulated my question, my recourse to this was to draw sketches, or use a boat under construction (if I was in a boatyard) as a model to point out then and there the issue to be clarified.

The main topics I discussed through my interviews covered several issues beyond the straightforward question of nautical exploitation of wood species. Since I was conducting my ethnographic research overtly, I always started the discussion by introducing myself and the nature of my research topic, its aims and significance. Indeed, O'Reilly (2009: 58) argues that: "in contemporary ethnography, research participants should be given as much information as possible in order to ensure their informed consent to our intrusion in their lives". This would almost always work as an ice-breaker, and formed the basis of a mutual trust building; especially in Egypt where people seemed slightly apprehensive at times due to the political turmoil the country had been immersed in since January 2012. Subsequently, I would enquire about personal biographies of interviewees to form a background context, and critically weigh and interpret the information they provided me. Generally, people agreed on their names and narratives being cited as such, in an ethical manner, in the study. Fetterman (1989) has argued the importance in ethnography of an open, honest, communicative and friendly approach, and of a body language with smiling, shaking hands, making eye contact and paying attention to others.

The questions on the types of wood were complemented by questions about assigning boat components to the different wood types and the reasons behind such choices; about the origin of wood and acquiring operations; about felling, conversion and shaping processes; and about analogies with the recent past as to the use of timber species. Adding to that, paths of enquiry encompassed issues related with boatbuilding techniques, boat typology, and development of the wood boatbuilding industry and its future.

Access to maritime communities in Egypt and Saudi Arabia was done through valued gatekeepers. By definition, gatekeepers are people "who smooth access to the group", whether they "grant permission themselves or able to persuade others" (O'Reilly 2009: 132). In Egypt, Dr. Mohamed Mustafa Abd el-Maguid, director of the Alexandria Antiquities department who participated in the reconstruction of *Min of the Desert*, a replica of one of Hatshepsut's ships in 2007-2008 (Ward n.d.: 6), offered me valuable help as to contact details of boatbuilders he knows, and boatbuilding centres he had been to for the Min project. In Quseir, Abd el-Maguid recommended I contact Mohamed Abdallah, an antiquities guard, who kindly introduced me to several boatbuilders from the area. Otherwise, I met boatbuilders on location by word of mouth. In Saudi Arabia, access to al-Hafa boatyard was previously granted to Agius and Cooper during their visit in January 2010 through Dr. Faisal al-Tumaihi. As for the Farasan Islands, Abdo Mohammad Isa Aqili, appointed by the Saudi Commission for Tourism and Antiquities, acted as our guide. Being from Muharraq a village in the archipelago, he was able to introduce us to and assist us in setting meeting with relevant people from the islands' maritime community.

The research methodology adopted during fieldwork was twofold: ethnographic interview and wood sampling. Ethnographic interviews relied on field notes, voice and video recording and still photography. These were taken with the consent of the interviewees as per the ethics code of practice of the University of Exeter. The whole was complemented with descriptive sheets of boats, and measurements of logs and timber planks. Log sheets of interviewees' names, voice, video, and photos records were kept and updated daily, after a day spent on site. In open spaces, such as beaches, and boatyards, special care was taken to find a sheltered place away from the wind, to avoid sound disturbance of the recording. At other times, note taking was challenging when an interviewee, out of excitement, would start immediately walking me though his working space, engaging in conversation and showing me logs of woods lying around and boats under construction. Here, more weight was given to video and voice recording. In addition to the narrative accounts, MARES and I collected wood samples from known logs, planks, and parts of abandoned boats. Where permission was given, these were either taken by manual sawing by Cooper, Zazzaro and myself, or given to us by boatbuilders from their yard or workshop. The samples were photographed and placed in paper envelopes or plastic bags, along with labels detailing the origin and date of the corresponding sample with a permanent marker. The wood samples were sent to Berlin for Dr. Rainer Gerisch to identify (12.3.6 Table 6). Not only do they help in scientifically identifying the wood species used in boatbuilding, but also associating vernacular names to each species; a subject that is still understudied regarding timber used in boatbuilding in the Red Sea regions. Wood sampling also allows corroborating information provided through the ethnographic interviews as to nautical applications of timber. It also gives insights on the use of a particular species for a particular type of boat or boat part, relating to the physical and biological properties of the wood in question.

5.3.3 The setting and background

The ethnographic data of the present thesis is the result of fieldwork seasons in six regions of the Red Sea. However, I can only describe my experience in detail with respect to two of these locations, having participated in the MARES fieldwork in Saudi Arabia over a three-week period in May 2010, and undertaking solo research in Egypt over a three-week period in January 2012. In Saudi Arabia, I followed the MARES itinerary; whilst in Egypt I made the results-oriented decision to visit areas where boatbuilding centres were known to exist.

5.3.3.1 Saudi Arabia season

In May 2010, I joined other MARES team members[36] on a three-week fieldwork in the port town of Jizan, capital of Jazan province, and on the three inhabited islands of the Farasan archipelago (Greater Farasan, Segid, and Qumah). The general ethnographic aim was to gather "information from members of local maritime communities about traditional boat types and their construction, and about seafaring and navigation practices, pearl-diving, maritime trade, and folkloric traditions related to the sea" (Agius *et al.* forthcoming). My input within this framework consisted more specifically of enquiries on the use of timber in boatbuilding, as well as taking wood samples from logs, planks and various boat remains. Agius and Cooper had previously gone to Jizan and the Farasan archipelago in January 2010 on a pilot visit, where they laid the ground

[36] The team members for this fieldwork were Agius, Cooper, Zazzaro and I.

for our visit in May that same year. Through the Saudi Commission for Tourism and Antiquities (SCTA), MARES team members were logistically aided and assisted by Dr. Faisal al-Tumaihi curator of the Sabya Archaeological Museum in Jazan province, and Abdo Isa Aqili the representative of the SCTA on the Farasan Islands.

After meetings with officials at the SCTA headquarters in Riyadh, the MARES team headed southwest to Jizan (Figure 5.1), a port town on the Red Sea coast, where we stayed for two days. Wooden boatbuilding activity there is scarce, and is concentrated in the fishing harbour and only boatyard of al-Hafa, to the north of the modern port of Jizan. Along with Agius, I interviewed Ibrahim Ahmed Bilghaith, a 55-year-old master boatbuilder, and owner of the boatyard[37]– the only surviving one out of six that existed in the past. His hereditary craftsmanship is passed on to his two sons who assist him, Abdo and Majid Bilghaith. He informed us that metal and fibreglass boat construction are taking over wooden boatbuilding. In fact, al-Hafa held a large number of abandoned wooden boats either at anchor or hauled up; some of them falling into decay, while others were being repaired on their bow side or their stern side. Thus, wooden boatbuilding activity at al-Hafa nowadays mainly consists of repair work, in addition to the construction of racing *hūrī*s, whose masts and yards are made with bamboo (Figure 5.2).[38] Bilgaith took us for a tour around the yard among stacks of sawn and recycled planks as well as natural crooks and logs. He indicated each type of wood by its

[37] Interviewed on 11th and 12th May 2010.

[38] The main types of boats the MARES team encountered at al-Hafa were "Egyptian-styled" trawlers built in Jizan some 15 years ago; several traditionally hull-designed fibreglass fishing boats; and several types of *hawārī* (sing. *hūrī*). The first is a Yemeni vessel which the MARES team called "winged *huri*" and which has a transom-stern with an outboard motor; and a stem-post with two protruding "fins" at its quarter deck (Agius *et al.* forthcoming). The second is the small dug-out fishing *hūrī* which was imported from India via Aden or Jeddah. The third is the racing *hūrī* specifically designed by Saudi boatbuilder Bilgaith and his team for festive events. Meanwhile, Bilgaith mentioned a large ocean-going cargo vessel called *zaʿīma* (pl. *zaʿāyim*) which sailed to the Arabian-Persian Gulf, West Indian coast and East Africa. It was characterized by a curved upper part of the bow. Another type is the *ʿobrī*, (pl. *ʿabārī*) a double-ended vessel, featured by a straight, raking prow and a stem-post that terminates at or slightly above the sheer line (Agius *et al.* forthcoming). A third type is the *zaruk* characterised by a "straight but foreshortened stern- and stem-posts, which end approximately two-thirds of the way up the bow" (Agius *et al.* 2010: 77).

vernacular name, and explained the use in a boat by demonstrating on a *zaʿīma* model,[39] and on an Egyptian-style wooden fishing vessel that was hauled out for repair on site (Figure 5.3). Especially dear to his heart was a keel made of teak which Bilgaith claimed to have recycled several times on different boats (Figure 8.22). To him, teak has the value of gold.[40] During our tour, I also observed a few abandoned masts made of pine, relics of a past sailing vessels activity. At the end, Bilgaith generously gave me several samples of wood taken from logs, planks and boat parts.

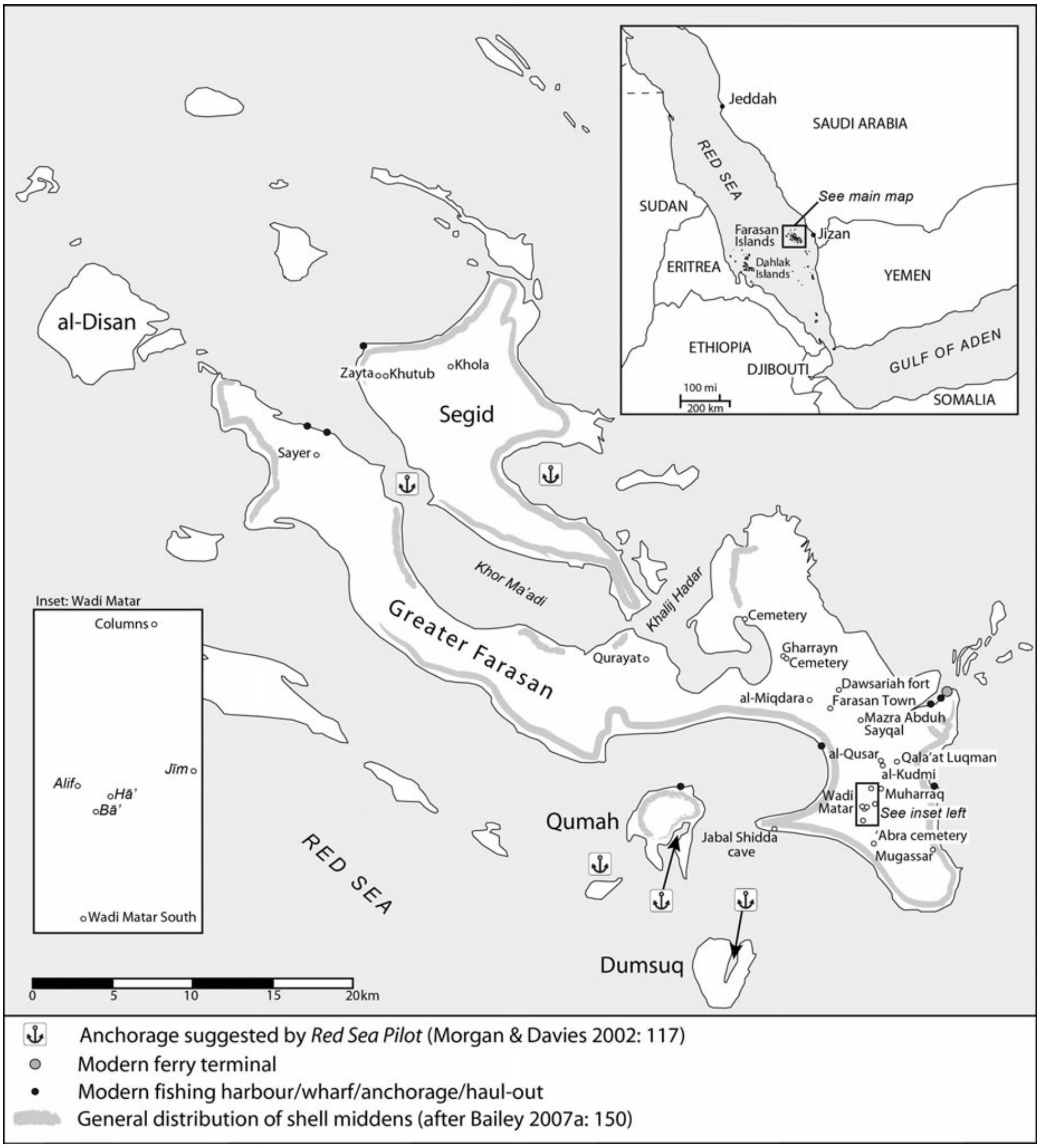


Figure 5.1: A map of the Farasan Islands and the location of Jizan, showing the sites mentioned in the text (Cooper & Zazzaro 2014: 148, Figure 1).

[39] Ibrahim Bilghaith donated this model built by his business partner, and another of a *sanbūq* to MARES, now at the Institute of Arab & Islamic Studies, University of Exeter.

[40] For more on this see Chapter 8, section on teak.

Figure 5.2: A racing *hūrī* with its bamboo mast at al-Hafa, Jizan (Photograph: John P. Cooper).

Figure 5.3: Transom-sterned Egyptian-type fishing vessel under repair at al-Hafa, Jizan (Photograph: John P. Cooper).

Once our ethnographic enquiry was over at al-Hafa, we took a ferry some 50km west of Jizan to the Farasan archipelago, where we spent around two weeks. There, Aqili acted as a valuable gatekeeper, being himself from the village of Muharraq on the Island of Greater Farasan. He arranged most of the interviews, and drove us around the archipelago. We did not observe any boatyards there.

A few days were spent recording the archaeology of the Farasan archipelago (Cooper & Zazzaro 2014), mainly when we could not undertake ethnographic interviews. Our research agenda and schedule did not always match the ones of our informants, thus meetings were sometimes postponed or cancelled. Zazzaro and I were sometimes marginalised, for being women, and were asked to join the reclusive women's quarters, thus missing out on a few of the interviews. This limited my access to potential wider datasets, nevertheless Agius and Cooper kindly included my queries into their interview process.

Local historian Ibrahim Abdallah Muftah[41] informed Agius that "over the past 100 years there were about five known dhow builders in the islands, and that dhows had mostly been built for pearling" (Agius *et al.* forthcoming). With all of these shipwrights now dead, information on wood was obtained through other people from the local maritime community such as historian Ibrahim Abdallah Muftah, former pearl divers Muhammad Uthman Mahmud Hanas and Sheikh Muhammad Isa Muhammad Aqili. Hanas, a 70-year-old retired pearl diver said that that his uncle was a boatbuilder who owned a small workshop in the courtyard in front of the house, in Saer village on the island of Segid, where we were interviewing him. I went out to check the place and all I saw was an open empty space, the floor of which was covered with gravel. Hanas smiled remembering that when he was a young boy, his friend and he would carry the finished *hūrī* over their heads until they reached the sea, some 1.3 km away. The information from Muftah and Aqili were more generic regarding the use of wood in boatbuilding.. Wooden boats are rare and Agius *et al.* (forthcoming) observe that "smaller fishing vessels are of fibreglass, and are called *falūka*; the transition from the traditional wooden dhow to fibreglass was not gradual; it occurred abruptly". The wood samples I collected on the Farasan Islands did not then come from a boatbuilding site like in Jizan, but were taken from abandoned wrecks on the shore mainly at Khutub and Tibta on Greater Farasan, and on the island of Qumah. These were all identified by Rainer Gerisch.[42]

[41] Interviewed on 13th January 2010.

[42] Personal communication by email on 8th January 2012.

5.3.3.2 *Egypt*

Conducting ethnographic research in Egypt became necessary to this research, after I had studied the textual and archaeological evidence related to nautical applications of wood in the Red Sea (Figure 5.4). The majority of ancient and medieval sources held a relative wealth of related information regarding Egypt (See Chapter 6). The same goes for timber archaeological evidence: most of the excavated nautical wood remains, since at least the 3rd millennium BC, are located in Egypt (See Chapter 7). Ethnographic work in Egypt would then prove to be important from both chronological and methodological stands. It allowed me to follow the fluctuations of wood exploitation through time in one geographical area, and engage in a multi-disciplinary approach to my study through comparing and corroborating evidence from texts, archaeology and ethnography.

Figure 5.4: An aerial photograph showing the sites of ethnographic enquiry in Egypt (Google Earth).

Another motivation for my fieldwork season in Egypt in 2012 was the fact that the bulk of my ethnographic data then was from second-hand sources; since I had compiled evidence from Agius and Cooper previous fieldwork data in countries I could not join them for. Although well-intentioned, these datasets did not offer an in-depth look at significant queries I was interested in investigating, such as the timber exploitation processes of selection, acquisition, felling trees, and treatment and conversion. Nor, could I assertively establish political, socio-economic, environmental and technical variables dictating the use of wood in boatbuilding in the Red Sea. Having the freedom in Egypt to set my own itinerary according to my prerogatives, meant I could target a wider range of location types which were not only boatyards but also local wood merchants, wood importers, and agricultural lands where I observed and documented trees in their natural habitats.

Indeed, fieldwork in Egypt was different from my experience in Saudi Arabia mainly regarding gatekeepers, logistic organisation, and number of boatbuilders available. I felt more at ease while travelling and conducting research in Egypt, since I had often travelled there for personal reasons. I also did not experience the cultural shock I felt in Saudi Arabia vis-à-vis of the marginalisation of women and religious conservatism, which somewhat had hindered my ability to conduct fieldwork in certain instances.

I was met at Alexandria's airport on the night of the 9th January by my dear friend and fellow maritime archaeologist Dr. Emad Khalil,[43] and a student of his Mr. Mohammad Salama, who was going to join me in the field. Little did we know then how hectic the times ahead were going to be. The boatyards we visited on the Mediterranean coast of Egypt dealt with wooden fishing boats, as well as leisure and metal cargo boats. This region presents a different picture of boatbuilding activities on the Egyptian Red Sea coast, which is mainly related with repairing fishing boats and building leisure boats for tourism. Boatbuilding centres are not only located directly on the coastline, but also further inland at smaller workshops such as in the coastal towns of Hurghada and Quseir. Boatbuilders also work under commission constructing a boat in its owner's yard, so I observed in Quseir. Kunhali (1993: 56), writing about Kerala, states that the presence of a nearby forest aids in the development of a shipbuilding centre. He exemplifies this by stating that "the rainforests which formed the upper basin of the river [River Chaliyar] enabled an endless supply of timber which helped Beypore to develop as a centre of ship-building". A similar case can be found at Dhofar which enjoys a lush vegetation while the rest of the Arabian-Persian Gulf and Oman does not (Agius 2005: 87-88). The latter situation applies to present-day boatyards in Egypt or the Red Sea regions in general, as the present landscape does not hold such forests.

[43] Currently the director of the Centre for Maritime Archaeology and Underwater Cultural Heritage at Alexandria University.

Thus, timber is always fetched locally from afar, as well as being imported from abroad, as will be argued below.

Mohammad and I started our fieldwork mission by visiting the main boatyard in Anfushi in Alexandria, where we had to endure unstable rainfall (Figure 5.5). We sought shelter when it poured, otherwise went out for photographs, all the way engaging in animated conversations with our informants. We were well received with lots of tea; as would prove to be the case in all the other boatyards we went to. Funnily enough, the tea was often served with tiny wood shavings. Boatbuilder Yusif Ahmad Maaruf, who owned a boatyard in Anfushi, was proud of his hereditary craftsmanship and was nostalgic about the past. He told me that fifteen years ago boatbuilding activity was thriving in Anfushi, so much so that neighbours would always complain about the noises of the tools coming out of the boatyard in the early hours of the morning. His father used exclusively to build fishing boats, but in the early 1980s the industry changed in response to a demand for leisure boats, which Maaruf mainly builds nowadays.

The following day, we had to stay put as the rain had not subsided. January is one of the wettest months on the Mediterranean coast of Egypt. People there call it the *maltam*, a season for wind and storms. Luckily, on the morning of the 14th, we headed to Alexandria's busy central bus station where we waited for the small shuttle taking us to Rasheed (Rosetta) to fill with customers. A bus and a taxi ride later, we were warmly welcomed by Hamdi Hasan Lahma owner, with his three other brothers, of a shipyard they inherited from their father, in Rasheed by the Rosetta Nile branch, some 50 km east of Alexandria (Figure 5.6).

Figure 5.5: A leisure boat built by Yusif Ahmad Maaruf's at his boatyard in Anfushi-Alexandria (Photograph: author).

Figure 5.6: A view of Lahma shipyard in Rasheed, Egypt (Photograph: author).

Speaking with Lahma was very interesting as the topics we discussed ranged from a history of ships from the days of his grandfather, to boat and ship types, to fishing methods, to designing a boat's hull, and boatbuilding processes, to name a few. His insights into nautical applications of timber, on trees' characteristics, and on timber processing ahead of its use, were invaluable. Walking around the shipyard, we could observe a wide variety of fishing boats under construction, as well as metal cargo boats and yachts; in addition to tree logs and planks left to dry in piles or stretched on the ground. All this among noises of electric saws and manual hammers filling the air. Lahma's shipyard possesses its own saw mill where logs are sawn tangentially to the direction of growth rings (Figure 5.7).

Figure 5.7: Saw mill at Lahma shipyard, Rasheed, Egypt. Note the sawing traces on the trunk face. (Photograph: author).

After two fulfilling working days at Rasheed, Mohammad and I headed to Lake Burullus, some 80 km east of Alexandria, also with a small shuttle bus, where we first met Mahmoud Abdel Maguid al-Qassas. The latter preferred to be a boatbuilder rather than a state employee, despite having a diploma in commerce in order to sustain his hereditary craftsmanship. He gave us a tour of abandoned fishing boats, hauled out on a landing place near his shack (Figure 5.8), in which we sat to pursue the conversation, sheltered from the wind. I was pleasantly surprised when he unexpectedly grabbed my notebook and started drawing sketches of traditional fishing boats, naming the wood type employed for each boat component. Mahmoud was not busy building boats at the time of our interview, so he introduced us to his uncle Hajj Ali Abd al-Rahman al-Qassas. The latter possesses a boatyard across from the landing place we initially visited, on another side of the lake (Figure 5.9).

Figure 5.8: Abandoned fishing boats at a landing place at the shore of Lake Burullus (Photograph: author).

Figure 5.9: Hajj Qassas' boatyard across the bridge opposite the landing place, Lake Burullus (Photograph: author).

Hajj Qassas, a very energetic boatbuilder, in his mid-60s, who owns a company specialising in fishing boats, painted a past picture of his boatyard, different from what we see now. In particular, he said that in previous years he had up to 100 workers, and constructed fishing boats for Libya. Even if this number might seem exaggerated, it is reminiscent of a vibrant past boatbuilding activity on site that is no more. He provided us with precious information on environmental factors influencing a boat's timbers whether at sea or at a lake or river.[44] At the time we spoke to him, he was constructing just one fishing boat for an Egyptian fisherman. The boatyard contained a group of 14 large seemingly abandoned fishing vessels, one which was an incomplete fishing boat

[44] This will be discussed further below

abandoned early in the construction process by its owner who could no longer afford to have it built. At the end of the day, on our way back to Alexandria, the road was blocked due to a large demonstration; Mohammad and I, as the rest of the little shuttle bus passengers, had to wait for almost an hour before people agreed to open the road again to traffic.

The next day, we headed to a town some 20 kilometres west of Alexandria, conveniently called "21 kilometres", to meet with one of the biggest wood import companies in Egypt. Just outside the main entrance, across the road, stacks of imported sawn pine lay in the open air (Figure 5.10).

Figure 5.10: Stacks of imported pine sawn timber at the town of "21 kilometres", Egypt (Photograph: author).

We were first met by Samer Khairi, the sales manager at Safwat Moawad & Co. for Wood Import and Trade, and then by one of Mr. Moawad's sons, Mark, who had established a sister company of his father's, called Mark Wood International five years earlier. Supplying boat and shipbuilding yards across Egypt, both companies mainly provide imported sawn pine planks from Scandinavia. Speaking with both people allowed me to corroborate information about wood import centres provided from ethnographic interviews with boatbuilders in Egypt. Unfortunately, Mr. Safwat Moawad was not available for interview at that time. Speaking with him might have informed me about potential changes in wood import centres in the past few decades. Indeed, Mr. Safwat founded his business some thirty years ago; but Mr. Mark said not much had changed regarding import sources and wood species since then, except for the increase in prices.

The following day, Mohammad and I left Alexandria on a seven-hour bus trip to Suez, on the north coast of the Gulf of Suez, on the Red Sea coast. Suez seemed quite a conservative place. Being a woman, it was quite hard for me to find common working spaces with a male colleague and informants. We met with Hajj Adel Faruq, a SCA guardian for Suez, who proved to be a valuable gatekeeper. He took us to Qazaq al-Gamᶜiyya which is the only boatyard in Suez that still produces wooden traditional fishing boats. There are three other boatbuilding sites, Qazaq Ibrahim Marzuq, Qazaq Attaca, and Qazaq al-Modat, that thrive on large leisure yachts and cargo ships made of metal.

Figure 5.11: View of Qazaq al-Gamᶜiyya at Suez. In the background, a yachts building yard (Photograph: author).

The Qazaq al-Gamᶜiyya was modest in size (Figure 5.11) and there were three fishing boats under construction. I spoke with Ibrahim al-Sayyid who comes from a family of boatbuilders originally from Upper Egypt, and whose grandfather used to build Nile boats in Luxor. He says he was destined for this work since every person that grows up next to the sea learns maritime craftsmanship. He was very knowledgeable about wood species and our conversation took place standing on the skeleton of one of the boats he was building. The other boatbuilder Mohammad Abu al-Sayyid Shata also working at Qazaq al-Gamᶜiyya was not present during our visit but he kindly joined us later in the evening, in the hotel lobby for a two-hour conversation. Mr. Shata received his apprenticeship from his father at a very young age, and he especially values this hereditary experience, as he says his father passed on to him secrets of the craftsmanship to ensure its longevity. Mr. Shata's father was drawn to Suez after the Egyptian revolution of 1952, led by Gamal Abdel Nasser (d.1970), as there was a great need of maritime manpower to construct boats and ships, due to its three commercial harbours, the oil refineries, and a boom in fishing. I was able to cover with Mr. Shata as many subjects as I had with Mr. Lahma in Rasheed.

Subsequently, Mohammad and I left Suez and headed some 400 km south to Safaga, a small tourist town on the Red Sea coast. Being there in January, there did not seem to be many tourists around, as the tourism season starts from mid-February to end of October each year.[45] During the day and even at night, the town appeared almost empty. The sea facing the town is dotted with anchorage points, mainly for leisure boats and less so for small fishing boats. It became clear soon enough that on-going traditional boatbuilding activity seemed very limited here, apart from some repair work we observed on an open beach a couple of kilometres south of town. There are two main yards for wooden and metal leisure boats and ships: Qazaq al-Dagaysha and Qazaq Ḥajj Faruq Ḥifni. When we visited the latter's ship yard (Figure 5.12), we were expecting to speak with a boatbuilder, who supposedly had ample knowledge on traditional wooden crafts. However, this person (whom I wish to remain anonymous) said he was too busy to engage in a conversation then and there, and said he would contact us at sunset, which he never did. This was the only time we were refused a meeting. Later, we met two boatbuilders on the open beach south of town, that also acts as a fishermen's anchorage, with around 30 fishing vessels at anchor, and several others beached (Figure 5.13). The first, Hasan Hussein Hammuda, nicknamed Amm Hassun, was caulking a small fisherman's *falūka*. A master boatbuilder now well in his 60s, he had learned the trade from his father after primary school, and passed it on to his sons. He said he does not own a boatyard himself but worked in several ones, where he taught many carpenters. Nowadays, he is just commissioned occasionally for repair works. Ali Ahmad Shirdi was working not very far from Amm Hassun repairing the hull planking of a 12-metre-long fishing boat. Having learnt the trade from his maternal uncles, he worked in several coastal cities such as Port Said – where he is originally from – Damietta and Suez, before coming to Safaga five years ago searching for work. Amm Hassun and Ali Ahmad Shirdi are examples of a fading traditional craftsmanship in Safaga, struggling to make ends meet.

[45] So I was told by Khaled Ali Hsein our driver from Safaga to Hurghada and back.

Figure 5.12: A view of wooden leisure boats at Ḥifni yard, Safaga (Photograph: author).

Figure 5.13: Fishermen's anchorage point, open beach south of town, Safaga (Photograph: author).

From Safaga, Mohammad and I went some 53km north to Hurghada, a famous tourism centre, and the largest city after Suez on the Egyptian Red Sea coast. The road stretched in a straight line before us, amidst a completely arid landscape, bounded by the blue sea to the east, and the Eastern Desert mountain range to the west (Figure 5.14).

Figure 5.14: On the road between Safaga and Hurghada, The Eastern Desert mountain chain in the background (Photograph: author).

Tall, imposing buildings and hotels, either new or still under construction, started appearing on the southern outskirts of town. There were also several schools and two large hospitals; the whole bordered by large, freshly asphalted roads and rows of planted acacia, palm and eucalyptus trees. The closer we got to the city centre, the more modest the houses and neighbourhoods appeared. Hurghada started evolving from a modest fishing village into a substantial tourist hub some 25 to 30 years ago, so I was told by our driver Khaled Ali Hussein who had been involved in the tourism business for quite some time.

Boatbuilding activity in Hurghada is distributed among two main boatyards Qazaq Yeḥya and Qazaq al-Gamᶜiyya; two small workshops for fibreglass *falūkas* and *hūrīs*; and Khalil workshop for traditional wooden fishing vessels. Qazaq Yeḥya produces large leisure boats and is located, across from Qazaq al-Gamᶜiyya on the other side of a newly-built mosque. The latter yard holds a fish market, and is also a fisherman's harbour where most of the boats were from fibreglass (Figure 5.15). The works we observed there are related with repair and not construction. As we sat in a café at Qazaq al-Gamᶜiyya conversing with Mohammad Metwalli, a boatbuilder in his 40s, we were interrupted mid-way as the latter was called upon from outside. Apparently, Egyptian soldiers from the harbour learned about our presence, and ordered us, indirectly through Metwalli, to leave the premises. Our attempts at requesting a meeting with these soldiers, to explain the situation and show our permit were in vain. Therefore, we missed the chance of talking to more people or taking any photographs or recording.[46]

[46] This is why the Qazaq al-Gamᶜiyya does not appear on Figure 5.15, as we did not want to take any risks of coming close to that place again.

Figure 5.15: The newly built mosque in between two boatyards: to the left Qazaq Yeḥya for leisure boats and to the right Qazaq al-Gamᶜiyya not visible), Hurghada (Photograph: author).

Mohammad Metwalli was kind enough to introduce us to Khalil Mohammad Khalil away from the strains of the army. Khalil is a boatbuilder in his late 60s who established himself in Hurghada thirty-five years ago, and owns his own small workshop for building wooden fishing *falūkas* and *hūrīs* (Figure 5.16). At the time of our visit, Khalil had built a small fishing *hūrī* destined to be covered with fibreglass, and that can hold three or four people. He was also building a 4.5-metre-long *falūka* in the open space of the workshop (Figure 5.17). Khalil's activity is indeed a modest one compared to the rest of the above mentioned boatyard of Hurghada.

Our last stop before heading back to our hotel in Safaga, was a quick visit to wood providers in Shāreᶜ as-Salam in al-Dahar area in Hurghada. Mohammad Morsi,[47] the accountant at Sharikat al-Manṣura (Eng. al-Mansura Company), informed me that they acquire imported sawn wood from companies in Alexandria, mainly pine, teak and mahogany. The last two species are used in leisure boats.

[47] Interviewed on 22nd January 2012.

Figure 5.16: Khalil workshop for fishing *falūkas* and *hūrīs*, Hurghada (Photograph: author).

Figure 5.17: A *falūka* in a small open space at Khalil workshop, Hurghada. In the background are Khalil Mohammad Khalil and behind him Mohammad Metwalli (Photograph: author).

Our last stop on the Red Sea coast was some 90 km south of Safaga, at the town of Quseir. Mohamed Abdallah, the antiquities guard for Quseir and surrounding areas, arranged a meeting for us with the eldest boatbuilder there. Ibrahim Ali Musa al-Najjar was also interviewed by Agius exactly ten years ago. Interestingly, al-Najjar had told Agius he was 72 years old back then, and ten years later he still gave me the same age.

Al-Najjar is one of the oldest families in Quseir and the name derives from his craft: *najjar* means carpenter in Arabic. Mr. Ibrahim says the family had at least 200 years of history in maritime carpentry. Perhaps due to his advanced age, his memory failed him at some points during our conversation. He said he used to have a boatyard on the coast in Quseir, where perhaps Agius had interviewed him. Ten years later, all that is left of his heyday is a small annex room outside his house, full of the remains of planks and bits of wood mixed with other abandoned objects and wire. In front of the annex stood a small squared frame *hūrī* he had built, which seemed to have been unused for quite some time (Figure 5.18).

Figure 5.18: Ibrahim al-Najjar and one of his granddaughters, with a *hūrī* in front of the annex room, Quseir (Photograph: author).

The only active boatyard in Quseir at the time of our visit was located further inland in town, in an area called (Ar.) al-Mantaqa al-Sinaᶜiyya (Eng. The Industrial Zone). Of modest size, the yard belongs to Abdo Shata, a 58 year old boatbuilder from Suez who came to Quseir some twenty to twenty-five years ago in search of work. Six fishing *falūkas* were being constructed with wood: Two of them had fully planked-hulls, the other three were as skeletons, and the sixth's hull had half of its planking. All of them were destined to be covered with fibreglass, to resemble the two finished *falūkas* standing on site (Figure 5.19). Shata says he now only has recourse to fibreglass as it is more resistant than wood, all the while showing us three wooden *falūkas* which had fallen into disuse and were abandoned at his boatyard.

Figure 5.19: View of Abdo Shata boatyard with six *falūkas* under construction and two completed, Quseir (Photograph: author).

Abdo Shata was quite busy when we met him, so we could not prolong the discussion further and headed south of town towards the sea. Amongst abandoned *hūrīs* and dilapidated *falūkas*, we met al-Arabi Mohammad al-Shuwwa, a 29-year-old boatbuilder, who does not own a yard and works as a freelancer, the likes of Amm Hassun and Ali Ahmad Shirdi I interviewed in Safaga. Indeed, he has been in Quseir for the past five years after working in Port Said — where he is originally from — Damietta, Hurghada and Safaga. He was very informative as to wood species, their exploitation and methods of acquisition. He asked us to visit him the next day at al-ᶜIwayna al-Gidida an area in Quseir where he was building a *falūka*, with wood and fibreglass, for a fisherman in the courtyard of his house (Figure 5.20). Such a practice of building a boat in an owner's courtyard seems common in the wider Indian Ocean. It was observed in the Arabian-Persian Gulf and Oman by Agius (2005; 2010). In West Bengal at Balagarh, traditional wooden boats are fashioned, among other places, in the courtyards of boat-makers' houses, or in the garden of the client (Bhattacharyya 2006: 244). In Munruthuruthu, Kerala, Ransley (2009: 5) observed how boats are built in and around the village, often in the yard of their owner. Also, in Goa, Shaikh *et al.* (2012: 150) say that "most of the traditional boats are built in temporary yards and sheds erected by carpenters wherever they find suitable places for constructing a boat".

Figure 5.20: A ten-metre long and 2.5 metres wide *falūka* being built in the client's courtyard in Quseir (Photograph: author).

After our visit to Quseir, Mohammad and I returned north to Cairo, from where we took the train to visit Atef Matar, a local wood provider in Birket al-Sabeᶜ. The information Matar provided us with was invaluable and pertained to tree characteristics, felling, cutting, transporting, and exploitation in boatbuilding. He also explained to us the process of acquisition that I will discuss below. Unfortunately, his precious knowledge will fade with him, because none of his children inherited his business. Coming back to Cairo was a real challenge with local transportation, and took three times as long as coming to Birket al-Sabeᶜ. The day after that, I flew back to the UK, filled with exceptional moments I spent with precious skilled people.

5.3.4 Ethical considerations

Participants were recruited voluntarily among coastal communities of the Red Sea areas visited by the MARES project team and myself. Written consent was not sought from the participants for the following reasons. There is no known precedent for the deployment of consent forms in such communities, and the introduction of paper bureaucracy into the interview context may have detrimental outcomes, in that forms may intimidate the interviewees, given the political culture of the states in question. At the same time, the nature of the subject under research means that the information gathered is unlikely to harm, distress or place in danger any of the participants. It is therefore believed that the use of consent forms was unnecessary, and indeed may cause problems. Participants were informed before interview of the nature of the project and research purposes by oral means. Information sheets were not provided to participants for the reasons stated above. On account of anonymity, the names of participants is omitted in gathered data unless express consent is obtained to the contrary. Thus, the nature of participants' occupation is mentioned instead of the personal name. Two certificates of Ethical Approval were obtained from the Ethics Committee of the School of Humanities and Social Sciences at the University of Exeter (Appendix 5).

5.4 Wood analysis and identification

5.4.1 Naming the genera and the species

To stay true to the primary sources and avoid any confusion and translation assumptions, I have, when relevant, kept the original name of species as cited by the related author. At other instances, I have used the binomial name, i.e. the scientific species name in Latin used in taxonomy, to have a more targeted approach. Indeed, using the generic English name for a tree might include all species of this tree, as Willcox (1992: 1-2) explains. For example, ebony, teak, and mahogany constitute generic names which may refer to more than one timber species. The Latin binomial name comprises the genus name and the species name called the "specific epithet" usually written in italics, for example: *Salvadora persica*. The latter is replaced by the abbreviation 'sp.' (or 'spp.' for plural) when the specific epithet cannot be determined. The binomial name also comprises an abbreviation of the botanical authority for this binomial name, at least when the species is first mentioned for example: *Salvadora persica* L. 'L.' stands for the 18th century Swedish botanist Carl Linnaeus who first named and published this species.

When an informant uses a generic term, this usually rather indicates a vernacular term which relates to specific species. I associated vernacular names with their scientific counterparts through botanical literature (See for example Provençal 2010,) and scientific identification of ethnographically identified wood samples.

5.4.2 Shortcomings of wood identification method

The method of preparing and handling the wood samples for their microscopic study to reach a potential identification is detailed by Dr. Rainer Gerisch (See 12.5 Appendix 5), as well pictures of indicative species (See 12.5.6). The wood identification results allowed me to corroborate ethnographic data, as well as identify timber boat elements in the absence of any verbal information during the several fieldwork seasons (See 12.3.6 Table 6 and 12.3.7 Table 7).

However, this method has certain limitations which restrict and confuse assertions made on trade patterns and potential origins of wood, as per Dr. Gerisch explanations: "From the wood anatomical point of view, it is often difficult to make determinations beyond the genus level. In certain cases only the level of the plant family may only be reached. When the identification reaches the species level, it is either because of phytogeographic reasons, or because of a monospecific genus, or that distinct characters are available to distinguish the species from others. Reaching a phytogeographical limit is usually attained through a certain inventory of plants, that is already given by the natural situation of the country or region. This is sometimes difficult in the context of the ship timbers of countries along the Indian Ocean because of the richness of wooden plants in India and the worldwide import of timbers".

In conclusion, the multidisciplinary approach adopted in this thesis covers a broad variety of data sets. It addresses textual, archaeological, ethnographic, linguistic and botanical evidence related to past and present use of nautical wood species, an otherwise understudied subject of enquiry in Red Sea/Indian Ocean boatbuilding research. This unique and broad reaching approach answers the research questions of the present thesis through a critical analysis of primary sources; a re-questioning of archaeological material and its significance; and providing novel ethnographic data of a fast disappearing maritime cultural heritage, which enlightens obscure areas of archaeological enquiry. Thus, it provides an in-depth understanding of the ever-changing and intertwined physical and socio-cultural parameters that influence the use of wood in boatbuilding through time and space; albeit not without a few challenges. These are mainly related to the scarcity of available data-sets and substantial chronological and geographical gaps. These challenges will be thoroughly investigated in the subsequent chapters related to the past exploitation of wood species (Chapters 6 and 7), as well as contemporary practices (Chapters 8, 9, and 10).

6 Historical background of timber trade and timber use

This chapter examines textual evidence from classical antiquity and the medieval Islamic period to investigate how these sources inform us about the timber trade and wood use in boatbuilding mainly in the Red Sea, but also in the wider western Indian Ocean. It does not pretend to offer a comprehensive economic history of these areas, the scope of which goes beyond the present thesis; but it draws upon major political events in such regions and considers the way these influenced timber trade and wood use in boatbuilding.

Broadly speaking, evidence on wooden watercraft in the Red Sea and the wider western Indian Ocean – textual, iconographic, archaeological, and ethnographic – for all periods is scarce (Blue 2009). The current state of research shows that it is even more so on the subject of nautical wood and timber trade. This section draws mainly on historical literary accounts of classical and medieval authors, as well as more recent publications on the historiography of trade in the wider Indian Ocean. The main two historical periods under study here are classical antiquity (8^{th} century BC- 7^{th} century AD) and medieval Islamic times (1^{st}-9^{th}/7^{th}-15^{th} centuries AD) in order to historically contextualise timber trade and use in the Red Sea and the wider western Indian Ocean.

Although the prime focus of this chapter is the classical Graeco-Roman and medieval Islamic periods, tracing the development of earlier maritime wood trade and nautical wood exploitation in the western Indian Ocean is necessary at this stage. Maritime activity in the Indian Ocean dates back a few millennia, "leading to a constant intermingling of cultures, races, religions and trading goods" (McPherson 1993: 4). The availability of raw materials in areas of the western Indian Ocean littoral encouraged the production of processed and manufactured goods (McPherson 1993: 4-5). In some areas rich in woodland, such as India and East Africa, timber can be considered as part of these raw materials that were traded in the western Indian Ocean. It was a necessary, thus crucial, element for monumental architecture and boatbuilding in adjacent regions that lacked tall and sturdy timber resources, such as Egypt, Mesopotamia and the Arabian Peninsula (Ratnagar 1981: 40, 98; Meiggs 1982: 49-87; Hourani 1995: 57).

In the Red Sea during the third millennium BC, the 5th Dynasty pharaohs (2435- 2306^{+25} BC)[48] launched trading expeditions south to the land of Punt, where Egyptian cargo goods such as copperware were exchanged for timber and other resources (Kitchen 2004: 25). The location of Punt has been widely debated: south of Egypt to Sudan and at times to Somalia (Agius 2008: 38 fn. 3); on the East African shore "well south of Egypt, conveniently accessible from the Red Sea's western shores" (Kitchen 2004: 30); and most probably on both sides of the southern Red Sea including northern horn of Africa and the Yemeni Tihama (Bard & Fattovich 2007b). These maritime contacts were sporadically sustained until the second millennium BC (Kitchen 2012). Besides using endemic tree species, Egyptians also tapped the resources of the Lebanon forest for their boatbuilding needs (Meiggs 1982: 49-87). Thus far, there is no textual or archaeological evidence dating from the Pharaonic period that attests to an Indian provenance for nautical wood in the Red Sea (See Gale et al. 2000; Ward 2000). It seems that local species to the Red Sea areas were also used in the first millennium BC. The Book of Kings (I Kings 9.26) states that "King Solomon built a fleet of ships at Ezion-geber (present-day Tell el-Kheleifeh, west of Aqaba, Jordan),[49] which is near Eloth (present-day city of Aqaba; Watchtower 2014) on the shore of the Red Sea, in the land of Edom". Edom was located in the Southern Levant, south of the Wadi Hasa and the Dead Sea all the way to the Gulf of Aqaba (Berchem 1909: 4; Bienkowski 1992). Hourani (1995: 9) suggests that local oak growing in forests of Edom at that time was probably used for planking. Edom also held forests of pine and cypress which equally could have been exploited (Watchtower 2014a, 2014b).

[48] I am using the chronology of Hornung *et al.* (2006) for Egypt's dynasties.

[49] Glueck (1938); Pratico (1985); Hourani (1995: 8).

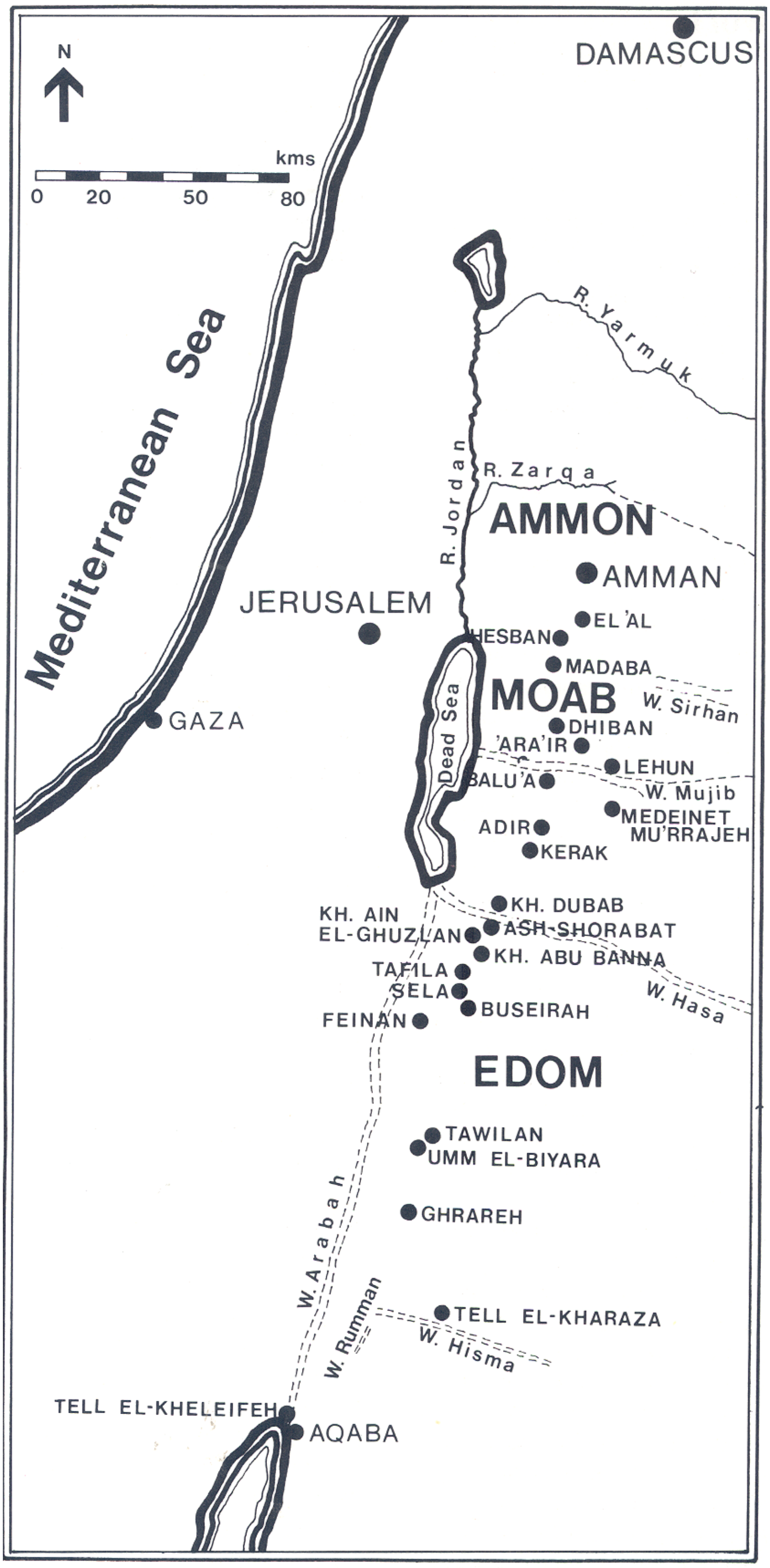


Figure 6.1: Map showing the location of Edom and Tell el-Kheleifeh, the ancient Ezion-geber (Bienkowski 1992: 2, Figure 1.1).

The maritime trade in teak and other hardwoods, from India[50] and the Indus valley[51] destined for the Mesopotamian and South Arabian markets goes back to the third millennium BC, and was conducted on vessels transiting through Oman and Bahrain (Rao 1970: 85, 99, 102, 104; Ratnagar 1981: 70-71, 154; Ray 1994: 12; 2008: 278; Pearson 2003: 50, 54; Agius 2008: 41). Indeed, contemporary literary evidence from the reign of Ur-Nanshe (c. 2500 BC) of Lagash in South Mesopotamia, attest to an import of timber from 'foreign lands' by ships of Dilmun (most probably modern Bahrain)[52] (Ratnagar 1981: 23, 155, 211; Cooper 1986: 22-30; Crawford 1998: 38). Timber for construction, and presumably boatbuilding (Ratnagar 1981: 99), was imported from India (Agius 2008: 39), Oman, south western Iran, and the Indus valley (Crawford 1998: 38). All of these sources, with the exception of Oman, are plausible due to their rich forest resources. Oman's wood varieties do not produce fine timber for boatbuilding (Ratnagar 1981: 40). Mesopotamian literary evidence indicates that wood was also imported from Meluhha (the Indus valley)[53] and Magan (Oman and part of south-east Iran or Baluchistan)[54] (Agius 2008: 41). Some of these species have been identified as teak, benteak, mangrove and rosewood, all useful for boatbuilding (Ratnagar 1981: 39, 41, 70, 100-101, 104; Boxhall 1989: 288; Moorey 1994: 352). However, such statements about ancient timber trade between India and the Persian Gulf need to be questioned. Indeed, some identification of teak found in archaeological contexts in Mesopotamia is highly questionable. Teak found in the palace of Nebuchadnezzar II (r. 605- 562 BC) at ancient Babylon is said to be Indian in origin, and thus testifies to import of this wood in the first millennium BC (Rao 1970: 97). This has not been scientifically verified as other scholars suggest that the wood in question is cedar of Lebanon (Koldewey 1913: 84; Katzenstein 1973: 320). Teak logs were also said to be found at Ur (modern Tell Muqayyar) by early British archaeologist Taylor (1855: 264) in the 6th century temple of the moon god and at the ziggurat of Nabonidus (r. 556-539

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[50] Harappans used to resource wood for their own use, including boatbuilding, and long-distance trade from the Western Ghats in West India, the Jammu Ranges in the north, the Punjab Piedmont in the northwest, the Siwaliks in the Northeast, and Girnar in the Gujarat state (Ratnagar 1981: 65-66, 98-99).

[51] See Ratnagar (1981: 58-59, 98-99) for forest resources for timber production in Punjab and the transportation of logs through the tributaries of the Indus River.

[52] For the identification of Dilmun see Ratnagar (1981: 25), Crawford (1998), McGrail (2001: 59), and Agius (2008: 40).

[53] Agius (2008: 40)

[54] Ratnagar (1981: 38); Agius (2008: 40).

BC). Such identification might have been a judgement by eye or scent by Taylor, since it was not scientifically verified though wood sampling identification (See Moorey 1994: 348, 352, 360 and Crone 2004: 31 fn.81). Consequently, a re-questioning of such archaeological sources re-evaluates the volume of the Indian teak trade, which appears less sustained than what has been presumed initially by scholarly interpretation.

It also suggests the implication of other sources of timber export than India. Indeed, several other species of wood are attested in the cuneiform and archaeological records of southern Mesopotamia from prehistoric to Hellenistic times (Ratnagar 1981: 100-101; Moorey 1994: 360; Ray 2003: 56). These encompass cedar, cypress, fig, mulberry, oak, palm, pine, walnut and willow that were locally grown and sustained (Moorey 1994: 349; Ray 2003: 56). Salonen (1939: 138 ff in Ratnagar 1981: 99) reports ten wood species used in boatbuilding from Mesopotamian texts, among them cedar, fir and mulberry, which do not necessarily indicate an Indian origin; since these can be from the Mediterranean. Indeed, Mesopotamian kings imported timber from various forested areas, other than India, such as the Lebanon, the Amanus, the Taurus and the Zagros mountain chains (Rowton 1967; Meiggs 1982; Moorey 1994: 349-352; Hourani 1995: 10). Thus, Mesopotamian timber needs for boatbuilding and construction relied on an array of sources, and this does not necessarily give a prime position to Indian supplies.

On the other hand, antique timber trade between the Swahili coast of East Africa rich in woodland and Arabia is poorly documented (Pearson 2003: 54). Nevertheless, the East African coast might have been a valid candidate for wood export to the Red Sea at least from Roman times. The *Periplus* (Chapter 17), although not specifically mentioning wood, indicates trade between Muza (probably Mocha, Southwest Yemen) and the East African coast. Several botanical finds in Roman Berenike indicate aromatic plants that might have been imported from East Africa (Sidebotham 2011: 230). Also, *Afzelia* wood originating from East Africa was found as recycled planks at the Islamic site of Quseir al-Qadim (Gale & Van der Veen 2011), and as hull planks and structural elements in the 9th century Belitung shipwreck thought to be an Arabian/Persian vessel (Flecker 2008). This will be detailed in subsequent sections of the present chapter.

When studying commerce in wood in antiquity, it is thus quite problematic to determine whether a regular timber trade was sustained in the Red Sea and the wider western

Indian Ocean due to the scarcity of related evidence. In the times preceding classical antiquity, the Red Sea areas, especially Egypt, seem to have been in contact with Mediterranean and perhaps East African regions for their supply in foreign wood; while tapping into their local wood resources. Indeed, there is no indication at these times of an Indian provenance for nautical wood in the Red Sea. Whereas areas of the Persian Gulf, received timber imports from India, the Indus valley and south western Iran. However, in light of textual and archaeological evidence, it is not clear if such a trade was on-going; and whether teak was the only wood exported, at least from India. Especially since Mesopotamia, for example, also brought timber for its boats from the Eastern Mediterranean mountain chains as well as the Zagros Mountains. Generally speaking, there are a number of factors to consider in the choice of timber for boatbuilding. These include economic considerations, and a timber's durability, resistance to stress and sea-worthiness (Arunachalam 1997). Notwithstanding, the personal preference and decision-making of the people involved in the process of boatbuilding such as timber agents and boatbuilders who are influenced by their craftsmanship experience, as seen in Section 4.5. Independently of the historical period, proximity to timber-yielding forests in easily reached areas also influence location of boatyards (Arunachalam 1997: 13). In the case of the Red Sea areas such vast forests are scarce and thus timber import plays a major role, this is why most of the boatyards were often located at port-towns. One should also keep in mind throughout this chapter that a boat is almost never built from one wood species; and the fact that primary sources mostly mention teak from India as well as East African and Mediterranean timbers, should not dismiss the fact that boatbuilders also tapped in local timber resources. The wood trade mechanisms and nautical timber use in classical antiquity and the medieval Islamic period will now be investigated.

6.1 Classical antiquity (8th century BC- 7th century AD)[55]

In the classical period, Greek and Roman traders took part in intricate pre-existing trade routes in the western Indian Ocean (Ray 1995: 111; Pearson 2003: 51). Trade in the Greek period is barely evidenced (Raschke 1975; Cohen 2006: 44); while more literary

[55] This period conventionally begins with the lifetime of the Greek poet Homer and ends with the Arab conquests.

and archaeological material is available for the Indo-Roman trade. Textual sources in this section are essentially from Greek and Latin authors; Indian sources such as Vedic, Brahmanic and Buddhist texts were not consulted as they fall beyond the expertise of the author of this thesis. Arab accounts for this period on maritime trade in the western Indian Ocean are virtually non-existent (Ray 1994: 173).

I will also look at evidence for nautical wood from Pharaonic Egypt (see 12.3.1 Table 1) in order to substantiate the use of both local and imported species. Indeed, the Pharaonic dataset is the richest discovered so far in a country which constitutes a nodal point between the Mediterranean, the Red Sea and the wider Indian Ocean. It encompasses evidence from Lower Egypt such as at Abydos where remains of 14 boats dating from c. 3050 BC were buried in boat graves (Ward 2000: 39-43); at Khufu's great pyramid at Giza, where two dismantled vessels dating from c. 2600 BC were buried and sealed in pits beside the pyramid (Ward 2000: 45-68); at Lisht, where more than 100 boat planks were recycled in roadways and ramps around the early 12th Dynasty (1939^{+16}–1760 BC) pyramid of Senwosret I (c. 1950 BC) (Ward 2000: 107-128); and at Dahshur, where five wooden boats from the Middle Kingdom (1980^{+16}–1760) were buried next to the pyramid of Senwosret III (r. 1878-1839 BC) (Ward 2000: 83-100). Pharaonic evidence from the Egyptian Red Sea coast includes nautical wood identification from two Middle Kingdom dismantled boats found in galleries carved into a sandstone mountain at Ayn Sukhna (Pomey 2012b; Tallet 2012: 150); and from recycled ship timbers from the Middle Kingdom port site of Mersa Gawasis (Bard & Fattovich 2007; Ward & Zazzaro 2010). This evidence will be also reappraised below in Section 7.2 in support of the archaeological nautical evidence pertinent to this thesis.

6.1.1 The Greek period (8th century BC- 1st century BC)[56]

The first known Greek contact with the Red Sea was established in the 6th century BC, and was inaugurated by the shipmaster Scylax of Caryanda who recounted a voyage he made from the mouth of the Indus to Egypt, under the Persian king Darius I (Karttunen 1989: 65-68; Ray 1994: 52; Hourani 1995: 11; Burstein 2005: 149). During the

[56] The Greek period extends from the start of the Classical period to the fall of the Hellenistic dynasties of the Seleucids and the Ptolemies in the 1st century BC, defeated by Rome.

Achaemenid period (550-330 BC), the westward trade with the Indian subcontinent used maritime routes via the Persian Gulf and then crossed the Arabian Peninsula by caravan (Ray 1994: 52, 174). In the 4th century BC, Alexander the Great (r. 336-323 BC) defeated the Achaemenid Empire and established his own, stretching from Athens to the Indus and into Central Asia. Alexander pushed Greek trade activity towards the East, and centred the junction of Indian Ocean and Middle Eastern maritime commerce at Alexandria on the Mediterranean coast. Alexandria was a major attraction for a multi-cultured array of merchants ranging from Greeks, Jews and Romans to Arabs, Persians, Ethiopians, and Indians (McPherson 1993: 48).

During the early Hellenistic period, trade with India was not regular nor extensive. In the 3rd century BC, Indian commodities also reached the Eastern Mediterranean through maritime networks in the Persian Gulf and overland routes through Arabia (Ray 1994: 6, 57, 174; Potts 1988); though Rao (1970: 91) argues for a maritime trade between India and Egypt, through Egyptian Greeks who acted as the main merchants of Indian goods via Ophir and Punt. Meanwhile, in southern Arabia, the Sabean kingdom sustained a lucrative trade with India (Ray 1994: 55; Agius 2008: 50), placing Yemen at a prominent position of commerce between Asia and Europe (Rao 1970: 91, 92). The Sabaeans had settled from Northwest Arabia in what is today Yemen and the Hadhramaut in the first millennium BC (Agius 2008: 50, fn.52) (Figure 6.2).

Subsequent to Alexander's death, his empire was divided amongst the Ptolemies who ruled Egypt until 30 BC, and the Seleucids who ruled from Syria to the Indus Valley until 63 BC. They were respectively defeated by Rome and by both Romans and Parthians (Cohen 2006). The Ptolemies kept an enduring Greek presence in the Red Sea in the 3rd century BC, and their interests in the area were mostly based on a military need for war elephants (Young 2001: 24; Burstein 2005: 151; Cohen 2006: 45-48). The animals were brought back from the African side of the Red Sea to Egypt via maritime routes in fleets of boats (Burstein 2005: 151). However, there is not information about the typology of these vessels, their boatbuilding location, or the wood they are made of. Still, the Ptolemies as well as the Seleucids sustained maritime commerce with India, most probably through the Persian Gulf and the Arabian Peninsula (Ray 1994: 54; Cohen 2006: 44; Agius 2008: 50). Teak figures among the Indian goods traded by the Seleucids (Sherwin-White & Kuhrt 1973: 65, 97). In the late 2nd century BC, Greeks started making regular trips to India with their discovery of the monsoon winds (Cohen 2006: 49). Despite the end of the elephant exploitation, the Ptolemies sustained their commercial and strategic interests in the Red Sea until the first century BC, while trading in other products and regions (Cohen 2006: 49). Also, during the Hellenistic period, South Asian traders and mariners sustained maritime trade with the West by establishing communities in the Middle East, thus encouraging the commerce of a large variety of goods between south Asian markets, the Mediterranean as far as the Iberian peninsula, as well as with the Middle East (McPherson 1993: 53).

Since evidence directly related to wood trade is almost absent from Greek sources as well as from archaeological remains in the western Indian Ocean, the focus here is on what these sources have to say about the species exploited in boatbuilding in the area, especially in the Red Sea.

Textual evidence on the use of nautical wood is patchy, but points to the exploitation of endemic tree species (Section 12.3.2 Table 2). These include acacia, tamarisk, balanites, willow and cypress. The first three were exploited in Egypt, and the last two in Mesopotamia as reported in the 5th and 3rd century sources. The 5th century Greek historian Herodotus (d. 425 BC) in his Histories attests to the use of *άκανθα* (Eng. Acacia; *Acacia* spp. Mill.)[57] in short hull planks and the mast of Nile cargo boats, he calls *baris* (Herodotus II.96). The hull of the *baris* is fastened with "keyed joints and dowels, and reinforced with little or no framing" (Casson 1995: 341). In his Enquiry into plants, the 3rd century Greek philosopher and botanist Theophrastus (d. 285 BC) describes *άκανθα* as a common tree of 'large stature' and used for roofing, since as he says "lengths of timber of twelve cubits are cut from it" (Theophrastus IV.2.6, 8). This length correspond to 6 metres (Ward 2000: 15). This statement needs investigation as it is slightly ambiguous. Acacia found in archaeological contexts in Egypt and that relate to shipbuilding only provides evidence for short timbers such as in the Lisht timbers (Ward 2000: 107-128; 2004: 23). This is one of the reasons why Egyptians turned to Lebanon for cedar, pine and fir trees which provided large timbers. Indeed, acacia and tamarisk were local woods to Egypt, and were used to build freighters with short planks and frames, hewn from cut trunks thus exploiting the tree's natural curvature. Native

[57] Lucas (1989: 442); Gale *et al.* (2000: 335); McGrail (2001: 39).

timbers came from shorter many branched trees rather than from the tall imported logs (Ward 2004: 14).

Theophrastus also states that there are two kinds of acacia: the white *λευκή* (*Acacia albida* Del.), which is considered weak and prone to rot, and the black *μέλαινα* (*Acacia nilotica* (L.)Willd. ex Delile) which is stronger and less prone to decay (Amigues 2006: 265) (Figure 12.5). Acacia albida Del. is a synonym of *Faidherbia albida* (Delile) A.Chev. (Gale *et al.* 2000: 335). *Faidherbia albida* was used in the upper portion of rudder blade 1 found at Mersa Gawasis (Bard & Fattovich 2007: 185, Table 12). Meanwhile, Theophrastus says that *Acacia nilotica* is used for frames. He does not state whether he intends river vessels or seagoing ships. But, Ward (2004: 14) explains that acacia was used in the construction of "the more numerous and economically significant freighters". Thus most probably, Theophrastus reports here a certain type of Nile boat with frames, and therefore slightly different from the *baris* type described much earlier by Herodotus (II.96). Such a boat type is present in the archaeological record of the mid-1st millennium BC: The Matariya river boat planks are fastened with locked mortises and tenons with no lashings, but with frames to reinforce the hull (Wachsmann 1998: 222; Ward 2000: 129, 131; 2004: 14; McGrail 2001: 40). The two other Egyptian wood species exploited for boatbuilding are: *μυρίκη* (Eng. Tamarisk; *Tamarix* spp. L.) which Herodotus says was used to make a type of rafts that towed Nile *baris* downstream with a rope (Herodotus II. 96; Casson 1995: 335; Gale & Cutler 2000: 345; Lucas 1989: 447); and *βάλανος* (Eng. Balanos; *Moringa peregrina*/*arabica*) which is "a tree of good stoutness and stature" that has strong wood useful for boatbuilding and other purposes. Balanos means literally an acorn. It is Balanus in Latin (Andre 1985:32). It could also indicate the Arabian ben or behen-nut (*Moringa peregrina* Forssk.) (Osborn 1968: 173; Amigues 2006: 274); or *Moringa arabica* Pers. (Andre 1985: 33) (Figure 12.35).

This shows that Herodotus and Theophrastus indicate species, that are acacia and tamarisk, which were used in Egyptian boatbuilding since Pharaonic times (12.3.1 Table 1). Acacia is attested in the archaeological record as assembly elements of boats from the Old Kingdom (2543–2120^{+25}) and the Middle Kingdom (1980^{+16}–1760) in Egypt: it was used for tenons in the vessels of Khufu (r. 2509–2483^{+25}) (Ward 2000: 16), at Ayn Sukhna (Pomey 2012: 43), Lisht timbers (Ward 2000: 16, 107, 110, 139) and at Mersa Gawasis (Bard & Fattovich 2007: 185-186, Table 12; Ward & Zazzaro 2010: 31) in the Middle Kingdom. Some hull planks among the Lisht timbers, and planks and steering-oar blades at Mersa Gawasis were also made of acacia. Tamarisk is another species endemic to Egypt that had been used in boatbuilding since Pharaonic times (see 12.3.1 Table 1). Ward (2006: 125) speculates that the earliest evidence of the use of tamarisk goes back to the 1st Dynasty (2900–2730^{+25}) sewn planked hulls from Abydos. Scientific identification of timber samples from Abydos is still pending.[58] Some planks found at Lisht were also made of tamarisk (Ward 2000: 19, 107, 110, 139), as well as dowels from Mersa Gawasis (Bard & Fattovich 2007: 185, Table 12), and tenons from the Carnegie Dahshur boat (Ward 2000: 84), both dating from the 12th Dynasty.

In Mesopotamia, *ίτέης* or *ίτέα* (Eng. Willow; *Salix* spp. L.) is described by Herodotus (I.194) as being used for the frames of round coracles with stretched hides (Figure 12.60, Figure 12.61). These were cargo river-boats made in Armenia and floated down to Babylon. Once there, the boats were dismantled, the framework and reeds sold, and the hides driven back to Armenia to be reused (Herodotus I.194). The use of willow frames could be seen as a surviving practice in the area: A type of rectangular coracle observed by the 20th century traveller Wilfred Thesiger (in Agius 2008: 129-130) in modern day Iraq had slender willow ribs. Meanwhile, the Greek historian Aristobulus (d. 301 BC)- quoted by Strabo (XVI.1.11) and Arrianus (VII.19.3) - says that *κυπαρίττος* trees (Eng. Cypress; *Cupressus* spp. L.) were felled for the fleet of Alexander the Great in Babylon. He can be considered as a valid reference for he had accompanied Alexander the Great on his campaigns and served throughout as an architect and military engineer. He also says that *κυπαρίττος* trees grew in the groves and the parks of Babylon despite the scarcity of timber in this region. He notes however that there was a moderately good supply of timber in the countries of the Cossaei and certain other tribes. He might be suggesting the Zagros Mountains[59] at the eastern edge of Mesopotamia, which could have offered wood resources. Alexander's expedition to India (327-325 BC) could be considered as an important contribution to the development of early botany as his "trained observers" discovered the flora of the

[58] Personal communication with Cheryl Ward by email on 10th August 2010.

[59] The Zagros Mountains were inhabited by sedentary mountain peoples, such as the Cossaeans, Kerchoi and Elymaioi, who were village-based with a subsistence economy (Ratnagar 1981: 17).

Himalayan foothills, the mangrove swamps of the Persian Gulf and the interior of Asia (Stanley Pease 1952: 46; Stearn 1976: 286).

In his Geography, Strabo, quoting the astronomer Eratosthenes (d. 195 BC), states that *ἐλάτης* (Eng. fir; *Abies* sp. Mill.) grows in India, and that Alexander the Great (r. 336-323 BC) built his ships of that wood (Strabo XI.7.4, XV.1.29). The species concerned here might be *Abies webbiana* Lindl. growing in the Indus region (Gamble 1902: 718-719). Alexander also ordered the felling of a substantial amount of *ἐλάτης*, *πεύκης* (Eng. Pine; *Pinus* spp. L.), *κέδρος* (Eng. Cedar; *Cedrus* sp. Trew), and other trees suitable for shipbuilding in the forests near the Emodi Mountains, situated between the rivers Hydaspes (the modern Jhelum River flowing in India and Pakistan) and Acesines (the modern Chenab River, flowing in Pakistan) in the country of Porus (modern Lahore). Alexander built a large fleet on the Hydaspes after floating the logs down this river (Strabo XV.1.29). The 1st century Roman historian Arrianus (V.8.5) reports the same event without mentioning tree species. Though, he describes the practice of overland transport of the dismantled boats rather than by floatation. "The boats were duly dismembered and transported; the shorter ones in two sections, but the thirty-oar ships cut into three, and the sections were brought in carts to the bank of the Hydaspes. There the flotilla was put together again, and again seen in full force, now on the Hydaspes", he says.

The cedar tree mentioned by Strabo could be identified as *Cedrus deodara* (Roxb.) G.Don that grows in parts of North-West India and is often mixed with pine and fir (Gamble 1902: 710). It is very durable and relatively waterproof (Gamble: idem 714) which might justify its use in boatbuilding. Interestingly, Gamble (idem: 714) describes the traditional practice of extracting logs of *C. deodara* from the forests in Northern India by floating them down large rivers. Arunachalam (1997: 13-14) also explains how, until recent decades, logs cut in the forests of Kerala and Karnataka, India were dragged by male elephants through cleared forest tracks to a nearby river where they were floated on bamboo rafts to coastal boatyards. This suggests a continuity in social practices of wood exploitation over time. As for the pine species, there are five endemic to India and around 70 species known around the country and widely distributed (Gamble 1902: 703-710). Thus, it is very hard to determine which pine species was used by Alexander for his fleet. Among these, Gamble (1902: 707) states that one, *P. longifolia* Roxb., was used for boatbuilding at his time.

The tree species used in boatbuilding is not always stated in the classical sources, and this leads to divergent interpretations of its identity. This is the case for a type of wood described by Theophrastus (V.4.7) and Pliny (XVI.80.221). Theophrastus (V.4.7) reports that: "In the island of Tylos [modern Bahrain] off the Arabian coast they say that there is a kind of wood of which they build their ships (*ploia*), and that in seawater this is almost proof against decay; for it lasts more than 200 years if it is kept under water, while, if it is kept out of water, it decays sooner, though not for some time". The wood is identified as teak (*Tectona grandis* L.f.) by Agius (2008: 147), Hourani (1995: 89-90), Hort (1916: 444 fn. 1), and Vermeeren (2000a: 8; 2000b: 341). However, in the Greek text the term wood is *ξύλον* (Hort 1916: 444). The Greek word *ξύλον* indicates timber, wood, log, beam, or post (Liddell & Scott 1940), but certainly not a particular tree species, nor teak. Thus, the identification of this *ξύλον* with teak is therefore purely speculative. Indeed, teak does not grow in Bahrain; unless the citation hints at imported wood (Amigues 2003: 78 fn. 15). If indeed an imported wood is meant here then it does not necessarily need to be teak, but could be any durable tropical hardwood. Meanwhile, Casson (1982: 183 fn.13) believes that Theophrastus meant Bahrain's local mangrove (*Avicennia officinalis*) based on the fact that it is used for the *ploia*. These are identified as canoes and other small craft, which do not need timber producing long hull planks, such as mangrove. Amigues (2006: 349) suggests two species of mangrove that could have been used for small trading or fishing crafts: *Avicennia marina* (Forssk.) Vierh. (Figure 12.12) and *Rhizophora mucronata* Lam. (Figure 12.45). Indeed, several modern and contemporary accounts on traditional wooden boats attest the use of mangrove in boatbuilding in the western Indian Ocean (Villiers 1969: 155; Prins 1986: 70, 84; Agius 2005: 35).

Although our present discussion focuses on the wood species used in the western Indian Ocean, it is important to note here types that are reported in the sources for Mediterranean boatbuilding, since these indicate wood species that might have been used in Greek boats plying the western Indian Ocean. Also, it is safe to infer that such species — if not the species of the same genus — could have been exploited in the western Indian Ocean hinterlands. Species that grow in the Mediterranean such as oak, cypress and pine can also be found in other areas such as the Zagros Mountains, the Indus valley and the Western Ghats. Indeed, Theophrastus says that the *οξύα* tree (Eng. Beech; *Fagus sylvatica* L.) is used in boatbuilding (Figure 12.27). He describes it as strong, of good grain and fair colour (Theophrastus III.10.1). Meanwhile the *έλάτης* (Eng. Silver-fir or fir; *Abies alba* Mill.) wood is used to make oars (Figure 12.1). Theophrastus says that *έλάτης* has many coats "like an onion" and shipbuilders obtain a strong spar by evenly stripping off layers one by one; not doing so would result in a weak one. The wood is also used for yard-arms and masts (Theophrastus V.1.7), owing to its height and straight growth. Silver-fir (or fir (Amigues 2003: 19; 2006: 282)) is used for triremes and long ships because of its lightness, and fir (or *Pinus nigra*, Eng. black pine (Amigues 2003: 19; 2006: 322) (Figure 12.38)) for cargo ships because it is rot-resistant. Fir is also used in triremes when silver-fir is not readily available (Theophrastus V.7.1, 5). *Κέδρος* (Eng. Cedar; *Cedrus* libani A. Rich.)[60] (Figure 12.19) is used in triremes in Syria and Phoenicia, since fir is more rare there, while in Cyprus they use *πίτυς*[61] (Eng. Aleppo pine; *Pinus brutia* Ten.[62]) (Figure 12.37), available in the island and seemingly superior to their fir (ibid: V.7.1, 5). Evidence for the use of cedar in vessels in Egypt is substantial from the Old and Middle kingdoms: planks of the Khufu I & II vessels (Gale *et al.* 2000: 349, 367; Ward 2000: 21, 61, 142, 2006: 123, 125); hull planks and one cylindrical baton of Ayn Sukhna (Pomey 2012: 43), possibly a timber frame from Lisht (Ward 2000: 119); planks of the Carnegie and Field Dahshur boats (Ward 2000: 21, 84-85); hull planks and deck beams from Mersa Gawasis (Ward 2006:126; Bard & Fattovich 2007: 185, Table 12; Ward & Zazzaro 2010: 31).

Theophrastus offers further details concerning the use in the Mediterranean shipbuilding of woods for various ship components depending on the level of strength of these timbers, as well as on the shocks and strains the ships' parts are exposed to: "the keel for a trireme is made of oak, that it may stand the hauling; and for merchantmen it is made of fir (or pine[63]). However they put an oaken keel under this when they are hauling, or for smaller vessels a keel of beech and the sheathing is made entirely of this wood [...]

[60] Translated as such by Amigues (2006: 296).

[61] Translated as such by Amigues (2006: 324) and Hort (1916: V.457).

[62] Identified as such by Amigues (2003: 88 fn.3).

[63] Amigues (2003: 19).

The work of bentwood[64] for vessels is made of *συκάμινος* (Eng. Mulberry; *Morus nigra* L.[65]) (Figure 12.36), *μελία* (Eng. Manna-ash[66]; *Fraxinus ornus* L.) (Figure 12.29), *πτελέα* (Eng. Elm; *Ulmus* spp. L.[67]) (Figure 12.66), or *πλάτανος* (Eng. Plane; *Platanus orientalis* L.[68]) (Figure 12.41); for it must be tough and strong. That made of plane-wood is the worst, since it soon decays. For triremes some make such parts of Aleppo pine because of its lightness. The cutwater, to which the sheathing[69] is attached, as well as the catheads[70] are made of manna-ash, mulberry and elm; for these parts must be strong" (ibid: 5.7.2-3). "However oak-wood does not join well with glue[71] on to fir or silver-fir; for the one is of close, the other of open grain, the one is uniform, the other not so; whereas things which are to be made into one piece should be of similar character, and not of opposite character, like wood and stone" (Theophrastus 5.7.2). *Δρῦς* (Eng. Oak; *Quercus* sp. L.) is used in the construction of river and lake vessels because it does not rot (Figure 12.43). However, it does decay in seawater (Theophrastus V.4.3). In Book V.7.5, Theophrastus reiterates the use of oak in ship construction, of *φίλυρα* (Eng. Lime; *Tilia* sp. L.[72]) for the decks of long ships (Figure 12.64, Figure 12.65). One wood sample from a hull plank of a seagoing boat at Ayn Sukhna, Egypt proved to be oak (Pomey 2012: 43).

The sources of the late Greek period are somehow silent on the issue of wood trade and the wood used in boatbuilding in the Red Sea and the western Indian Ocean. In his *Peri tes Erythras thalasses* (Eng. On the Erythraean Sea), the Greek historian and geographer Agatharchides of Cnidus (fl. mid. 2nd century BC) reports that in the Sabean kingdom people travel using large rafts and boats made of skins. Although no further

[64] *Τορνεβα* in the Greek text but the word may be corrupted. It might mean a certain part of the ship following Hort (1916: 457 fn. 5). Amigues identifies the *bentwood* as frames (2003: 20, 90 fn. 6).

[65] Translated as such by Amigues (2006: 337).

[66] The Greek text states 'μελία' which is ash (*Fraxinus* spp. L.) as translated by Amigues (2006: 311); manna-ash (*Fraxinus ornus*) is the English translation provided by Hort (1916: 457).

[67] Hort (1916: V.457) and Amigues (2006: 326) give here the same translation.

[68] Translated as such by Amigues (2006: 325).

[69] Amigues and Casson identify the beech *sheathing* with a false keel (Amigues 2003: 19, 88-89 fn. 4, 92 fn. 8; Casson 1995: 86 fn. 45).

[70] Casson interprets the *catheads* as outrigger cheeks (Casson 1995:86 fn. 45).

[71] For Amigues (2003: 89-90 fn. 5) the woods are not joined with glue but with pegged mortises and tenons.

[72] Amigues (2006: 344).

information is given about these rafts, Burstein (1989: 167 fn.1) associates these with rafts supported by floats made from animal skins and used in Southern Arabia as later attested in the Roman period by Pliny (Natural History VI.176) and the *Periplus* (Chapter 27 fn. 1).

Though the Greeks played an active role in the western Indian Ocean trade, the wood trade does not figure in the classical sources of that period. Greeks largely exploited the wide range of Mediterranean woods under their domain (Sidebotham 1986: 9). Sources provide a wide range of Mediterranean species that were used in boatbuilding mitigating the need to import wood for boats from the East. Wood species used locally in the western Indian Ocean of that time are more endemic types such as acacia, tamarisk, balanos, willow, and cypress..

6.1.2 Roman and Late Antiquity periods[73] (1st century BC- 7th century AD)

Indo-Roman commerce has been widely documented (Ray 1995; Basa & Behera 1999; Tomber 2008). It reached its peak during the early Roman period (1st century BC- 3rd century AD) (Tomber 2008: 154) (Figure 6.2), and was part of "a world trading system" (Basa & Behera 1999: 15, 23-25) with its own internal mechanisms and dynamics (Ray 1994: 9; 1995: 97). Recent scholarly research in the trade has challenged the traditionalist trend – set by Warmington (1974) – that the commerce was instigated, dominated and monopolised by the Romans (Ray 1994: 6, 48; 1995; Basa & Behera 1999; Tomber 2008: 13-18). Direct voyages between the Red Sea and the western Indian coast are believed to have started around the beginning of the Christian era (Ray 1994: 169, 190). But Roman trade had expanded regional maritime networks in the western Indian Ocean that were previously developed by the Achaemenids and the Greeks (Ray 1994: 51, 55, 67; 2008: 277; Young 2001: 79). Thus, it was not only a trade of luxury goods, but was also stimulated by the procurement of subsistence items and agricultural products (Ray 1994: 41, 189; 1995: 97; 2008: 276-277). Ray (1994: 36-

[73] This period begins with the annexation of Egypt by the Roman Emperor Augustus in 30 BC and ends with the Arab conquests in the mid-seventh century AD. The Late Antiquity period, from 330 AD to 632 AD, is included here since the related evidence for wood trade and nautical use is relatively scant. Thus, this approach creates a larger dataset.

40; 1995: 99) studied the organisation of the Indian trade in classical antiquity, and argues that it essentially depended upon private entrepreneurs while economically benefiting the ruling elite as well. The same could be said for the Red Sea trade in the Roman period, given the collection of imperial taxes (Young 2001: 33, 54-56, 59-62, 181-191). In the Indian subcontinent, timber was part of the natural resources of a port's hinterland, which, as Ray (1995: 98) argues, contributed in antiquity to a port's development. Rao (1970: 92-93) enumerates six port-towns on the western coast of India that might have served as timber export points in classical antiquity. However, only Barygaza is mentioned in the *Periplus Maris Erythraei* as exporting timber to Oman.

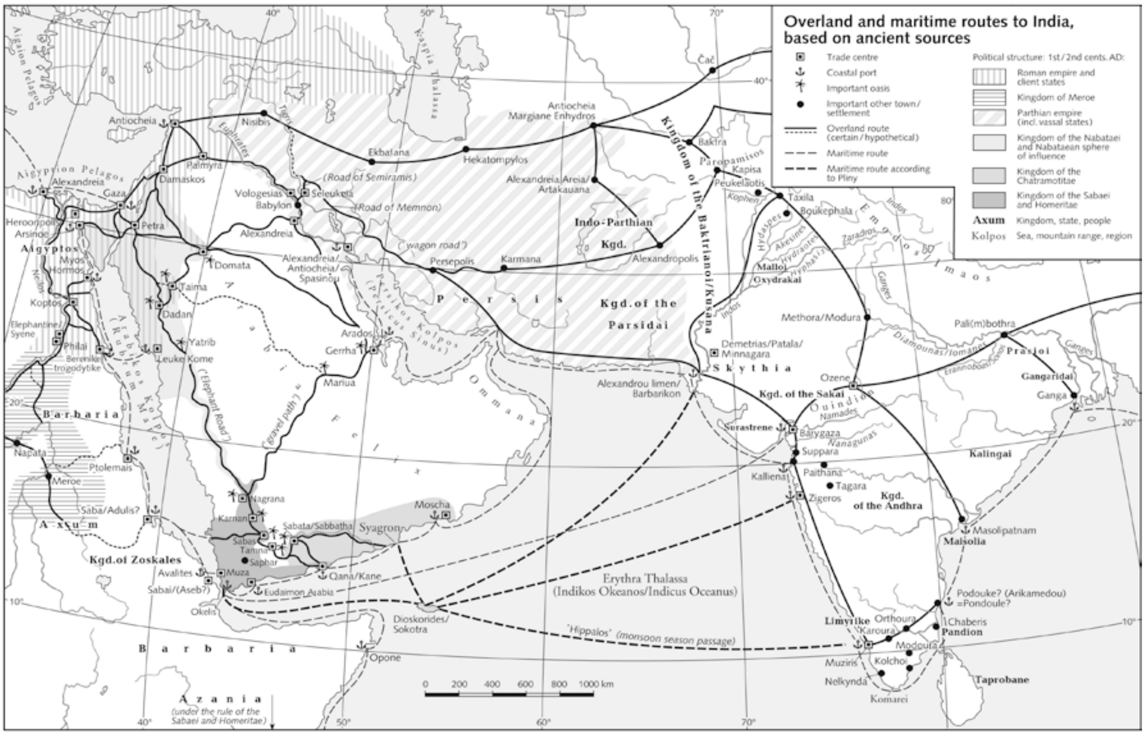

Figure 6.2: Map of maritime and overland routes of the Indo-Roman trade (©Drexhage 2006).

Rome extended its domination over the northern part of the Red Sea between 30 BC, when Augustus annexed Egypt, and the 7th century AD, with the Islamic conquests. In the southern Red Sea, several groups shared power. Among these are the Minaeans, Sabaeans, and Himyarites on the Arabian side, and the Aksumites on the African side. At the same time, Rome had to face the control by Parthia (3rd century BC- 3rd century AD), and then by Sassania (3rd-7th centuries AD), of the terrestrial eastern trade routes (Sidebotham 2005: 170; Tomber 2008: 80). To avoid this, Rome exploited the Red Sea corridor as a commercial and transit route between the Mediterranean and the Indian

Ocean, and had allies on both side of the Red Sea – the Aksumites in the west and the Himyarites in the east (ibid: 170-171). Indian kings regularly sent diplomatic envoys to Rome with gifts in search of alliances (Warmington 1974: 36-37; Basa & Behera 1999: 22; Tomber 2008: 152). It should be said that most probably Rome would have done the same. In the 3rd century, Aksumites middlemen replaced Roman mariners, thus controlling access to Indian goods.

Timber was exported from East Africa – most probably from Eritrea and Somalia – through the Aksumite port of Adulis to Middle eastern markets such as at Aden and Socotra, in Arabian and Persian crafts (McPherson 1993: 45).

Rigging components probably made with East African blackwood (*Dalbergia melanoxylon* Guillem. & Perr.) were found at Myos Hormos (Blue *et al.* 2011: 189; Gale & Van der Veen 2011: 221; Van der Veen *et al.* 2011: 208). But, it is difficult to determine if the rings were manufactured at overseas harbours and bought by the visiting crafts, or made on board by the mariners from wood obtained whenever they accosted (Blue *et al.* 2011: 196). The end of the 3rd century witnessed a significant decline in the volume of trade transiting the Egyptian Red Sea harbours (Young 2001: 73-77; Ward 2007: 161). Starting in the 4th century, the partition of the Roman Empire caused the Imperial harbour system in the Red Sea to collapse. Roman and subsequently Byzantine traders abandoned the direct route from the Red Sea to India (Mayerson 1996: 122; Nappo 2009: 71). Nappo (2009: 73) argues that the Romans reorganised their positions on the Red Sea by linking the ports in the northern parts of the sea with Axum. The early-to-mid 4th century Red Sea trade is a period poorly indicated in the textual evidence (Ward 2007; Seland 2012). Sources from India are also lacking as to the commodities exchanged through sea trade during Late Antiquity (Rao 1970: 96). Four major Roman ports existed on the Red Sea during late antiquity: Berenike, Clysma, Aila and Iotabe; all of which were involved in maritime trade with India and South Arabia throughout this period (Ward 2007: 161, 167). "It appears that throughout late antiquity, the southern ports, Berenike and Iotabe, suffered harassment from outside tribes that eventually led to the abandonment of these ports, whereas Aila and Clysma, being closer to the Mediterranean and imperial control, continued to function. This suggests that the trade routes which previously flowed through Berenike and Iotabe had moved north to the ports of Aila and Clysma, where merchants felt more secure" (Ward

2007: 167). In the 7th century AD, Rome ceased to play a major role in the Red Sea trade, following the Muslim conquest of the Middle East (Sidebotham 2005: 168).

The 1st century *Periplus Maris Erythraei* is probably the only known textual source from classical antiquity that provides direct evidence for wood trade in the western Indian Ocean. The *Periplus* mentions three types of Indian wood that were exported from Barygaza (modern Broach, Northwest India)[74] to the port of Ommana (probably south-eastern Arabia in the lower Gulf)[75]: *σαγαλίνων* (Eng. Teak; *Tectona grandis*) (Figure 12.49), as well as beams, saplings and logs of *έβενίνων* (Eng. Ebony; Diospyros spp. L.) (Figure 12.24), and *σασαμίνων* (Eng. Sissoo; *Dalbergia sissoo* Roxb.) (*Periplus* ch.36; Casson 1982: 181; 1989: 18; Tomber 2008: 73) (Figure 12.23). The interpretation of this passage differs among the three main authors who translated and interpreted the *Periplus*: Schoff (1912: 152-153) mentions sandalwood and teak in the imports; whereas Huntingford (1980: 40) mentions sandalwood instead of teak. Casson (1982: 183; 1989: 18, 73) argues in favour of teak and thus for a detailed interpretation of *ξύλων σαγαλίνων*, the reader is referred to Casson (1982). *έβενίνων* most probably refers to *Diospyros ebenum* which grows in India and Sri Lanka. This species differs from the African blackwood also known as Egyptian ebony belonging to the species *Dalbergia melanoxylon* (Lucas 1989: 435; Gale *et al.* 2000: 338). *Dalbergia* sp., probably *Dalbergia melanoxylon,* was identified at Myos Hormos (Blue *et al.* 2011: 189; Gale & Van der Veen 2011: 221; Van der Veen *et al.* 2011: 208). There are also four native *Diospyros* species growing in Sudan (El Amin 1990: 349-351), which might have also been used as timber export in antiquity.

These timbers were carried in large cargo ships (Schoff 1912: 36; Huntingford 1980: 40; Casson 1982: 183; 1984: 43-44; 1989: 18, 73; Tripati *et al.* 2009: 1362). Archaeological evidence for the export of timber logs in cargo ships is found in the Uluburun shipwreck in south-western Turkey, which was carrying African

[74] Huntingford (1980: 18, 110); Casson (1982: 181; 1989: 16); Tomber (2008: 125).

[75] Agius (2008: 49); Pliny (VI.32) locates Ommana on the Arabian side of the Persian Gulf, between the Peninsula of El Katar and Ras Musandam, then a Persian or Parthian dependency (Schoff 1912: 150). Casson (1989: 180) identifies it with either Chāh Bahār or Tiz, and with Gwadar West Bay or Pasni. Huntingford (1980: 106) also suggests several locations: near Cape Jask, at Bandar Tank, and at Ormara. Rao (1970: 97) suggests Oman.

blackwood/Egyptian ebony logs among its cargo (Haldane 1993: 348; Pulak 1998: 203; Ward 2000: 22). The timbers are not explicitly linked with boatbuilding in the *Periplus*, but one can assume that they were brought to Persia from India for this purpose, as well as for other construction needs. Contrary to common belief that ebony, is not suitable for boatbuilding due to its high density, ebony was found in the outer planking, ceiling planking and frames of the *Flower Of Ugie*, a mid-19th century British sailing merchant ship which was involved in the Indian Ocean trade (See Whitewright & Satchell 2011). As for *Dalbergia sissoo* it is mentioned by a 5th century BC Sanskrit source for its use in boatbuilding (Rao 1970: 97) (Figure 12.23). As for teak, it has been attested in boatbuilding in Gujarat from archaeological remains at the port town of Lothal dating to 2200 BC, since it was widely available in the neighbouring Panchmahals district (Rao 1970: 97). Rao (ibid: 97, 102) suggests several locations on the western Indian coast, in the Karnataka district and at Musiris, where teak could have been resourced for boatbuilding, and sent to the ports of the Persian Gulf, starting the early historical period. In the Red Sea, teak was found in archaeological contexts from the Red Sea harbours of Berenike[76] and Myos Hormos,[77] dating from the Roman period. Hull planks from dismantled boats, and other sailing paraphernalia such as sheaves, pulleys and brail rings, as well as wood shavings, all made with Indian teak, indicate the presence of boat repair, refurbishment, dismantling and recycling practices of either Roman ships built in India, or Indian ships that visited the Red Sea coast (Whitewright 2007a).

The fact that there are recycled teak plank boats, and not complete shipwrecks, at Berenike and Myos Hormos is an indicator of dismantling boat parts for their re-use. It is not an indicator of wood trade, since these boats could have been built in India, whether they were manned by Romans or Indians. Also the fact that Myos Hormos and Berenike are not interpreted as boatbuilding centres but rather repair sites (Rougé 1988: 70; Sidebotham & Wendrich 1998; Peacock & Blue 2011) indicates that perhaps trade in Indian woods was not a necessity for boatbuilding in the Red Sea. So far, archaeological research has not revealed ancient boatbuilding sites on the Red Sea coast. Ray (1995: 99) explains that the lack of large scale boatbuilding activities on the

[76] Sidebotham & Wendrich (1998: 91, 92); Vermeeren (1999: 201-202; 2000a: 5, 7-8, Table.2; 2000b: 315-328, 334-335, 341-342); Sidebotham & Zych (2010: 21).

[77] Gale & Van der Veen (2011: 221, 223, 225); Van der Veen *et al.* (2011: 206, 207 Table 5.1, 210, 223-224).

west coast of the Red Sea is due to the scarcity of potable and rain water, and timber in the Eastern Egyptian desert. However, I do not believe this was a reason as local timber species were used in boatbuilding and foreign timbers could have been imported as well. Perhaps, the question needs to remain open until further archaeological investigations in the Red Sea areas.

Again, there is no textual evidence for teak export from India to the Red Sea. Raschke (1978: 1016 fn. 1510) erroneously claims that Lewis (1960) argues that teak masts were imported from India to the Red Sea, based on the 1st century Coptos Tariff. The inscription known as the Coptos Tariff specifies the tax levied upon users of the roads between Coptos and the Red Sea (Young 2001: 42; Van der Veen *et al.* 2011: 223). In fact, it only mentions the tax levied on a mast and an animal horn/yardarm (lines 29-30), without determining the wood type or the provenance. Thus, teak and India are not mentioned in the inscription. The lines 29-30 are: *ιστού δραχμάς εϊκοσι, κέρατος δραχμάς τέσσαρες*. According to Lewis (1960: 137) this sentence should read as "a mast, twenty drachmas, a yardarm four drachmas". But *κέρατος* is the genitive of the word *κέρας* which means animal horn in English (Sophocles n.d.: 660). *Κέραία* (genitive *κέρας*) means yard (Sophocles n.d.: 659) but also horn, and yard arm (Liddell & Scott 1940: 939-940). Therefore, Lewis' translation is erroneous. Young (2001: 44) suggests a more likely translation: "a mast, twenty drachmas; an animal horn, four drachmas". In addition to the above lexicographical analysis and from an economical point of view, if a mast's tax is fixed at twenty drachmas, it would be logic that a yard would cost either something similar or close to that number. Perhaps, the tax of four drachmas indicates an item of a smaller size like an animal horn. Finally, archaeological evidence from Myos Hormos supports the translation of *κέρατος* into animal horn since horn brail rings were found on site (Blue *et al.* 2011: 179, 191, 196). These could indicate "the reuse of horn from animals slaughtered at the site for food. Alternatively, the horn rings could have been manufactured on the Nile, as a bi-product of cattle slaughtered there, before being transported to the coast" (Blue *et al.* 2011: 196).

Moreover, Lewis (1960: 138) generically argues that the supply of timber to the Red Sea came 'from the East' whilst basing himself on teak import to the Persian Gulf according to Theophrastus (V.4.7), Pliny (XVI.80.221), and the *Periplus* (chapter 36). As I previously argue, Theophrastus and Pliny do not mention teak, nor any import of it.

Also, all three of these sources relate to the Persian Gulf and not the Red Sea. Moreover, Lewis (1960: 138) interprets the nautical elements referred to in the Coptos Tariff as imports transiting from the Red Sea to the Nile valley and not the other way around. Whilst this might be a possibility for certain commodities, it is not supported for timber movements by clear textual or archaeological evidence, as demonstrated in this chapter. Therefore, a transit from the Nile to the Red Sea should be considered in this case, with boat parts originating either in the Nile valley or imported from the Mediterranean. These were transported overland as was common practice since the Pharaonic period (Garcin 1976: 209-2010; Whitcomb & Johnson 1979: 3; Sayed 1980: 156; Bülow-Jacobsen 1998: 66; Wild & Wild 2001: 218; Cohen 2006: 333; Van der Veen *et al.* 2011: 223) until at least the 18th century (McFarlane 1964: 156).[78] Also, archaeological evidence from Myos Hormos sustains a Coptos-Red Sea direction, based on the presence of horn brail rings, whether these were fabricated on site or on the Nile.

In the light of this discussion, the *Periplus Maris Erythraei* constitutes thus far the only textual source for teak export from India to the Persian Gulf. Whereas, teak export to the Red Sea remains speculative, and only based on the assumption that it followed the same trade pattern as that of the Persian Gulf. The *Periplus* is also a rich source for indigenous wooden boatbuilding, but does not specify the tree species used. It mentions sewn boats (*Periplus* ch. 15, 16, 36), rafts buoyed by inflated skins (*Periplus* ch.27), fishing canoes hollowed from single logs (*Periplus* ch.15), and other peculiar Indian vessels such as the *sangara*[79] and the *kolandiophônta*[80] (*Periplus* ch.60) (Schoff 1912: 28; Huntingford 1980: 29, 54, 158-159, 163; Casson 1989: 9, 59, 89, 141, 230; 1995: 9 fn. 24; Blue 2006: 277). The timber resources remain unclear and one cannot assume

[78] For the Spanish and Portuguese practice in the 16th century of carrying dismantled boat parts for their reconstruction see (Barker 1992: 443).

[79] Schoff (1912: 243) identifies this type of boats as made of hollowed logs with plank sides and outriggers, such as are still used in South India and Ceylon. Huntingford (1980: 54, 163) describes the *sangara* as "very large vessels made of single logs bound together" relating to the Indian type consisting of two boats joined by a wooden platform with a bamboo rail. To Casson (1989: 89, 230), they are "very big dugout canoes held together by a yoke".

[80] Schoff (1912: 243) compares these ships to the Chinese junks. Huntingford (1980: 163) states that the *kolandiophônta* is a two-masted ship with pointed ends and a stout outrigger steered by quarter oars. Casson (1989: 230) identifies them as "large ocean-going ships of south-east Asia" that travel to Chrysê (Chrysê region is identified with Burma and Chrysê island with Sumatra (Huntingford 1980: 18,120; Casson 1989: 235) and the Gangês, Modern Tamluk (in the district of West Bengal, India) (Casson 1989: 236) but unknown location to Huntingford (1980: 120).

they were all made of teak as the forest cover in South Asia is, and presumably was, immensely rich in suitable woods for boatbuilding. Despite mentioning this wide variety of craft used in the Indian Ocean, the *Periplus* does not refer to Roman vessels, or Red Sea boatyards where these could have been constructed (Ray 1995: 99).

Concerning wood species exploited in boatbuilding in the Red Sea hinterlands, textual evidence is scarce and only relates to Egypt (See 12.3.2 Table 2). Balanos and acacia, two endemic species, continue to figure in local Egyptian practice of boatbuilding in the early Roman Period. The 1st century naturalist Pliny the Elder (XIII.17.61) reports the *balanus* (Eng. Balanos) tree – previously mentioned by Theophrastus (IV.2.6) – as being very durable, knotted and twisted and only employed for boatbuilding purposes. He also mentions the wood of *spina nigra* (Eng. black thorn) growing in Egypt and used for boat frames, since its wood is very durable even when soaked in water (Pliny XIII.19.63). Pliny might be referring here to *Acacia nilotica* also known as 'Egyptian thorn' due to the thorns present on the branches and whose bark is very dark brown to black[81] (Figure 12.5).

Pliny is a valuable literary resource on wood use in boatbuilding. However, he does not specify the origin of the timber species or where such species were used: these being pine, fir, cedar, beech, larch, and olive. We can only assume that these were most probably used in the Mediterranean maritime sphere.

The evidence from Pliny is presented here. The *tibulus* (Eng. Tibulus; *Pinus sylvestris* L.)[82] growing in Italy is described as reaching great heights: It is slender and free from knots and thus is used for the construction of light galleys (Pliny XVI.17.39). The wood of the *Abies* (Eng. silverfir; *Abies pectinata* Lmk.)[83] (Figure 12.3), growing in high mountains, is extremely highly valued for boatbuilding because of its resinous and durable qualities and the lightness of its wood (Pliny XVI.18.42). Fir is favoured for the production of masts and sail yards since it is light and has a straight, relatively tall, trunk. On this account Pliny (XVI.76.201-203) reports the following: "An especially

[81] Rico (n.d.); Lucas (1989: 442); Gale *et al.* (2000: 335).

[82] Identified as such by Andre (1985: 261).

[83] Identified as such by Andre (1985: 1), whereas it should be *Abies pectinata* DC. which is the equivalent of *Abies alba* Mill.

wonderful fir was seen in the ship which brought from Egypt at the order of the emperor Gaius the obelisk erected in the Vatican Circus and four shafts of the same stone to serve as its base... It took four men to span the girth of this tree with their arms; and we commonly hear that masts for those purposes cost 80,000 sesterces and more". This story might well be mythical, and does not give any information about the origin of this large fir trunk; it only proves the suitability of fir for its use as masts. Pliny (XVI.76.201-202) also states that rafts made of fir were expensive and were valued at forty thousand sesterces. Fir was also used for log boats: the 'pirates' of Germany navigated their seas in vessels formed of a single fir tree hollowed out that could contain around thirty men (Pliny XVI.76.203). He further adds that in Egypt and Syria the kings would use *Cedrus* (Eng. Cedar; *Cedrus* spp.) for vessel construction since fir was not available. The largest cedar known in Pliny's time was reported to be 130 feet long (38.48 metres)[84] and needing three men to span its girth. It originated in Cyprus where it was felled to form the mast "of a galley of eleven tiers of oars that belonged to Demetrius" (Pliny XVI.7s6.203). Vessels made of *Fagus* (Eng. Beech; *Fagus sylvatica* L.)[85] were highly esteemed in earlier times because of the good quality of the wood (Pliny XVI.73.185) (Figure 12.27). *Larix* (Eng. Larch; *Larix* spp. Mill.) is capable of resisting moisture, however it is vulnerable to attack from wood worm when used in sea-going ships as most of the woods except for, as Pliny says, the wild and cultivated olive (Pliny XVI.79.219) (Figure 12.31). Olive is widely used in antique Mediterranean boatbuilding for small components that need strength and durability (Figure 12.57). An olive brail ring was found at Myos Hormos but it was probably locally made (Gale & Van der Veen 2011: 221, 223; Van der Veen *et al.* 2011: 206, 209).

Among the tree species mentioned by Pliny, pine and cedar were found in the form of dismantled boat planks reused in terrestrial construction at Berenike; also as products of wood working sustaining the presence of recycling activity of previous boat planks (Vermeeren 2000a: 5, 8; 2000b: 334-335, 341; Sidebotham & Zych 2010: 21). Mediterranean Roman boats either sailed from the Nile through the canal of Trajan to Clysma (Sidebotham 1986: 68; Ray 1994: 170; Young 2001: 67-69), or were transported in pieces overland, as previously mentioned. Rougé (1988: 70) suggests that timber coming from the Syro-Phoenician coast was gathered at the Gulf of Suez and

[84] In Roman times 1foot= 0.296 metres (Humphrey *et al.* 2002: xxiv).

[85] Identified as such by (Andre 1985: 101).

floated in rafts south to Myos Hormos or Berenike. This remains speculative, however as there is no textual or archaeological evidence for floating timber logs down the Red Sea. To sum up, textual and archaeological data on timber identification and nautical exploitation supports the hypotheses that Roman boats made with Mediterranean woods were plying the Red Sea.

Generally, literary evidence from the third to the fifth centuries, related with trade in the western Indian Ocean, is scarce (Hourani 1995: 36; Tomber 2008: 23). Among these, the 6th century Byzantine historian Procopius of Caesarea does not mention, in his *History of the Wars*, the type of trees used in boatbuilding. However, he does note the peculiarities of the boats found in India and on the Red Sea: These ships are not smeared with pitch or with any other material. Planks are not fastened with iron nails but are "bound together with a kind of cording". Procopius explains this aspect of shipbuilding technology by the lack of iron or any other mineral suitable for such purposes in India and Ethiopia (Procopius I.19.24).

In conclusion, the economic history of the western Indian Ocean is quite complex, and evidence for the timber trade is scarce in all periods. In the times pre-dating the Graeco-Roman era, timber imports flowed from the Mediterranean and East Africa to Egypt, whilst Mesopotamia and South Arabia turned to India and the Zagros Mountains for wood. Evidence for timber trade is almost nonexistent from Greek textual sources and archaeological data going back to that period. The only direct textual evidence for timber trade is provided by the *Periplus*, which indicates exports of wood from northwest India to the Persian Gulf. It might not be sufficient, however, to construct a comprehensive image of the western Indian Ocean wood trade at that time, not least the volume of commerce carried. The evidence in the *Periplus Maris Eritrea* does not indicate whether there was a constant flow of Indian timber to the Persian Gulf or whether the trade was irregular.

Lack of textual evidence for timber trade has been noticed not only in the primary sources but also in the secondary ones . For example, Ray (1994: 71-79) studied the imports and exports between India and the West in antiquity, but there is no mention of timber exchange in the list of goods cited. It is interesting to investigate the reason behind this lack of data. It might be due to the fact that timber maybe figured among the exports that need not be recorded. Also, archaeological investigations only recently became interested in the issue of the nautical use of timber and its identification. The western Indian Ocean, especially the Red Sea, has perhaps more untapped archaeological potential in that perspective. In the current state of research, data revealing the lack of evidence for timber trade might be an indicator for underestimating perhaps the exploitation of local timber resources in boatbuilding in the Red Sea and the Persian Gulf. Another argument would be the use of Mediterranean species in boatbuilding, especially in the Red Sea region. Greeks and Romans could have led their boats to Egypt where they were dismantled and transported either on land or by fluvial means to the Red Sea coast where they were rebuilt. Indeed, the Classical period harbours of Myos Hormos and Berenike yielded archaeological evidence for ship refurbishment practices, and recycling of woods which originated from India as well as from the Mediterranean world.

Both literature and archaeology indicate the exploitation of endemic species in boatbuilding in the Red Sea area and the Persian Gulf. Species such as acacia, balanos, cypress, tamarisk, and willow were locally used in the Classical period, mainly for frames or short planks. But in the case of cypress, tall planks can be attained, since the tree can reach 35 metres in height.

Other tree species include mainly species which grow in both the Mediterranean and India such as cedar, fir and pine. These could have been used for hull planking in a vast array of boats plying the western Indian Ocean, whether Graeco-Roman, Arabian, Persian or Indian vessels. Finally it should be mentioned that the Zagros Mountains forest resources have been surprisingly left out from the study of the timber trade and timber exploitation in boatbuilding in the western Indian Ocean. Some authors such as Ray (1994: 173) deemed the native trees of the Persian Gulf regions like the palm and cypress unsuitable for shipbuilding. If it is the case for palm trees, it is not for cypress which has been attested in boatbuilding as per textual and archaeological data. The Zagros mountain chains also yield vast forest stands of various species such as oak, oriental plane, and poplar (Haden-Guest *et al.* 1956: 425; Zohary 1973b: 354, 359; Ratnagar 1981: 3, 7). It would be interesting in the future to investigate the maritime archaeological potential of the Western coast of present-day Iran and perhaps have a clearer idea of timber nautical exploitation in antiquity.

6.2 The Medieval Islamic period

> *"This craftsmanship* [carpentry] *is essential for construction, the material of which is timber. God has given everything certain useful properties so that man may satisfy his needs. Trees, for example, can be utilised in a number of ways, as everyone knows. When they dry, they provide the most useful timber for shipbuilding* " (Ibn Khaldūn 1996: 380).

Agius (2002: 176) stresses the importance of geographical, travel and historical sources in studying the boatbuilding techniques and boat typology in the western Indian Ocean. The lack of wrecks in the Red Sea and the Persian Gulf limits the input of archaeology in understanding past boatbuilding activities, and more so the use of wood species to that end. Thus, the present chapter aims at studying the primary sources in order to contextualise, analyse and interpret the use of wood in boatbuilding mainly in the Red Sea, but also in the wider western Indian Ocean, according to the accounts of the medieval Islamic authors. It starts with a historical summary of political players taking part in the western Indian Ocean trade during the period from the 1st/7th century, at the advent of Islam, to the 10th/16th century marked by the rivalry between the Ottoman Turks and the Portuguese. The Geographical scope focuses on the two mains corridors of the western Indian Ocean, the Red Sea and the Persian Gulf, to give a broad context to the study. Egypt's Nile and its Mediterranean coast are considered within this geographical framework due to the nodal place of Egypt in the wood trade, and the use of Mediterranean timber in boats plying the western Indian Ocean. The main trends developed in this chapter investigate the exploitation of local wood and imported species (See 12.3.3 Table 3), and mechanisms of wood trade for the Islamic medieval period. Centres of boatbuilding activities in the Red Sea and the Persian Gulf are also mentioned to complement our understanding of nautical wood exploitation. The main harbours active in each period are also discussed so as to determine potential points of import and/or export of traded timber species.

At the death of the Prophet in 10/632, Islam spread from the Hijaz area through maritime ways and existing Arab trade networks to gradually reach, in subsequent decades, Persia, Egypt, North Africa, the Levant, Turkey, Iraq, and northwest India (Pearson 2003: 76). By the early 1st/7th century AD, this newly created political order existed along with the Byzantine Empire and Sassanid Persia (McPherson 1993: 91;

Hourani 2005: 14). As McPherson (1993: 95) puts it: "The Islamic empire created an environment favouring a growth in urban centres as well as economic activity by restoring peace to the agricultural lands of the Middle East which had long been ravaged by wars between the Persian and Byzantine empires. This was the biggest empire and largest collection of economies and cultures under one political system that the world had seen". During the beginning of the classical Islamic period (1^{st}-2^{nd}/7^{th}-8^{th} centuries), the first four caliphs in Islam's history, the Rashidun Caliphate (r. 10-40/632-661), ruled over a large domain extending from the Arabian Peninsula, the Levant, to the Caucasus in the north, from Egypt to present-day Tunisia in the west, and the Iranian highlands to Central Asia in the east. The Umayyad Caliphate (r. 40-132/661-750) was the second of the Islamic caliphates established after the death of Muhammad in Syria with Damascus as its capital. During the Umayyad caliphate, the Islamic world was under a single political rule. This situation changed with the revolution of the ^{c}Abbāsid caliphs (r. 132-656/750-1258) (Chaudhuri 1985: 36, 45). Spain remained Umayyad after the 132/750 ^{c}Abbāsid revolution. Subsequently, the ^{c}Abbāsid hegemony started breaking down, and by the 3^{rd}/9^{th} century the Islamic world was politically fragmented with leaders in Baghdad, Cairo and Cordoba, all claiming the title of caliph (Hourani 2005: 83).[86] However, in the early medieval period (3^{rd}-4^{th}/9^{th}-10^{th} centuries), it was "united by a common religious culture expressed in the Arabic language, and by human links which trade, migration and pilgrimage had forged" (Hourani 2005: 83).

The middle medieval period (5^{th}-8^{th}/11^{th}-14^{th} centuries) witnessed several turning points in the history of the Muslim world; especially the advent of the Crusades in 487-488 /1095 which impacted trade networks in the Red Sea. The 5^{th}-6^{th}/11^{th}-12^{th} centuries witnessed rivalry between the ^{c}Abbāsid caliphs (r. 132-656/750-1258) and the Seljuk sultans (r. 4^{th}-8^{th} /10^{th}-14^{th} centuries) over Iraq, Iran, Syria and parts of Anatolia. In Egypt, the Fāṭimids (r. 297-567/909- 1171) gave way to the Ayyūbids (r. 567-650/1171-1252). The Ayyūbids also ruled Syria until 658/1260 and a part of western Arabia until 626/1229 (Chaudhuri 1985: 60). In the 7^{th}-8^{th}/13^{th}-14^{th} centuries, the ^{c}Abbāsid caliphate of Baghdad ended in 656/1258 with the invasion of the Mongols from eastern Asia (Chaudhuri 1985: 36); while the Ayyūbids were toppled by the Mamlūks in 648/1250. Islam also spread along trade routes into northern India and on the East African coast

[86] For a detailed description of the Islamic world three broad areas and their power centres, see Hourani (2005: 83-84).

(Hourani 2005: 85). In the late medieval period (9th-10th/15th-16th centuries), the kingdom of Granada was taken over in 898/1492 by the Christian conquest of Spain and Muslim rule in Iberia came to an end. The Ottoman Turks rose to power and established their new capital at Istanbul in 855/1453. They defeated the Mamlūks in the early 16th century and integrated Syria, Egypt and western Arabia into the Ottoman Empire (Hourani 2005: 86). At the same time, Iran was under Safavid rule (r. 906-1145/1501-1732), and northern India under the Mughals (r. 932-1275/1526-1858).

This short chronological introduction aims at providing a geopolitical backdrop for the study of wood in boatbuilding in the Red Sea and the wider western Indian Ocean. It historically contextualises mechanisms of the timber trade, and aids in understanding the reasons or motivation behind the exploitation of timber in boatbuilding in our areas of interest in the medieval Islamic period; especially when most of the medieval Islamic sources speak of naval exploitation of timber commissioned by political elites. Thus, these authors mention large scale naval construction operations which were hosted at several boatyards. These latter were at times located nearby harbours which traded with timber among other commodities.

Most of the harbours of the Red Sea and the Persian Gulf, involved in the Indian Ocean trade, were, in the 1st/7th century, under either Byzantine or Sassanid control (Chaudhuri 1985: 43-45). Several Arabian ports had lost their ancient prosperity except for the caravan cities of Mecca and Medina. The birth of the Islamic empire changed the political and economic picture of the Middle East and the Mediterranean, and provided a new momentum to the western Indian Ocean trade (Rougeulle 1996: 159). Commercial networks were weaved by Muslim traders and extended, especially from the 2nd-7th/8th-13th centuries, across Eurasia from the Atlantic to the Pacific (McPherson 1993: 91, 99). "Arabs [sic Arabians] had long traded with the Indian coast, and Indians with the Arab world. When the Arabs [sic Arabians] became Muslims they continued to trade, and conversions in littoral India occurred very early, long before Muslims ruled large areas of the inland subcontinent" (Pearson 2003: 78). The 2nd-5th/8th-11th centuries were particularly prosperous periods for the trade in the Persian Gulf, as the main centres of the Caliphate shifted from the Umayyad control in the Mediterranean area to ʿAbbāsid Iraq and Iran (Chaudhuri 1985: 46-48; Rougeulle 1996: 162). However, Shatzmiller (2009: 119-120) argues that: "Any study of the economic history of Islamic trade in the 2nd-4th/8th-10th centuries suffers from a serious handicap in comparison with later periods: it lacks archival documentation. As a result we lack the numbers needed for quantification, depriving us of quantitative studies and analyses based upon them". This can be applied to the medieval Islamic timber trade as well since a quantitative analysis is almost impossible with the dearth of information from available sources and archaeology.

With the advent of the Muslim Empire, raw materials for manufacture and luxury goods were used to exhibit power and wealth in large Islamic cities (Figure 6.3). Luxury goods comprised muslin, silk and other textiles, ambergris, diverse spices, pearls, porcelain, precious stones and metals, animals like horses, and brazilwood from Burma and India (Lewis 1973: 254-255; Chakravarti 2002: 55; Pearson 2003: 83-84). Most of these goods, such as spices from India and Southeast Asia, were conveyed to the Gulf and the Red Sea from where they reached Middle Eastern markets, and from there to Europe (Pearson 2003: 82-83). Meanwhile, "bulk goods could not profitably be carried a very long way, and for most of its food a city had to look to its immediate hinterland. But for some goods the economic return was as such as to justify their being carried over long distances" (Hourani 2005: 43-44). Perhaps, the scarcity of timber producing long planks in Arabia and Mesopotamia justified its long-distance import, resulting in a profitable return. Thus, western Indian Ocean vessels were carriers of staples and bulk items, like iron and copper, and timber and coir for boatbuilding from the west coast of India to Arabian shores (Lewis 1973: 257; Chakravarti 2002: 55). Timber was also exported from East Africa to Hormuz (Pearson 2003: 86). Meanwhile Red Sea vessels supplied the Hijaz with Egyptian grain (Cooper 2009).

6.2.1 Classical Islamic period (1st-2nd/7th-8th centuries)

The textual sources for the first two centuries after the Islamic conquest are quite scarce, albeit in relation to the use of wood in boatbuilding. What little evidence we have points to the use of species endemic to both the Red Sea and the Persian Gulf regions, such as acacia, fig, palm, and juniper, and imported species such as teak (12.3.3 Table 3). These sources give skewed information in that they speak of boatbuilding practices during this period which concentrated in Egypt, but mention trading centres in the Persian Gulf. Meanwhile, we know from the Egyptian author Ibn ᶜAbd al- Ḥakam ([d. 256-7/870-1] 1922: 164-165) that in the 1st/7th century, Egypt was sending grain supplies to the Hijaz in support of a food crisis (Cooper 2009: 197-198). Most of the sources mentioned and referenced here do not date from the classical Islamic period but narrate events which occurred in this period. This anachronism is thus justified even more so when contemporary sources are lacking.

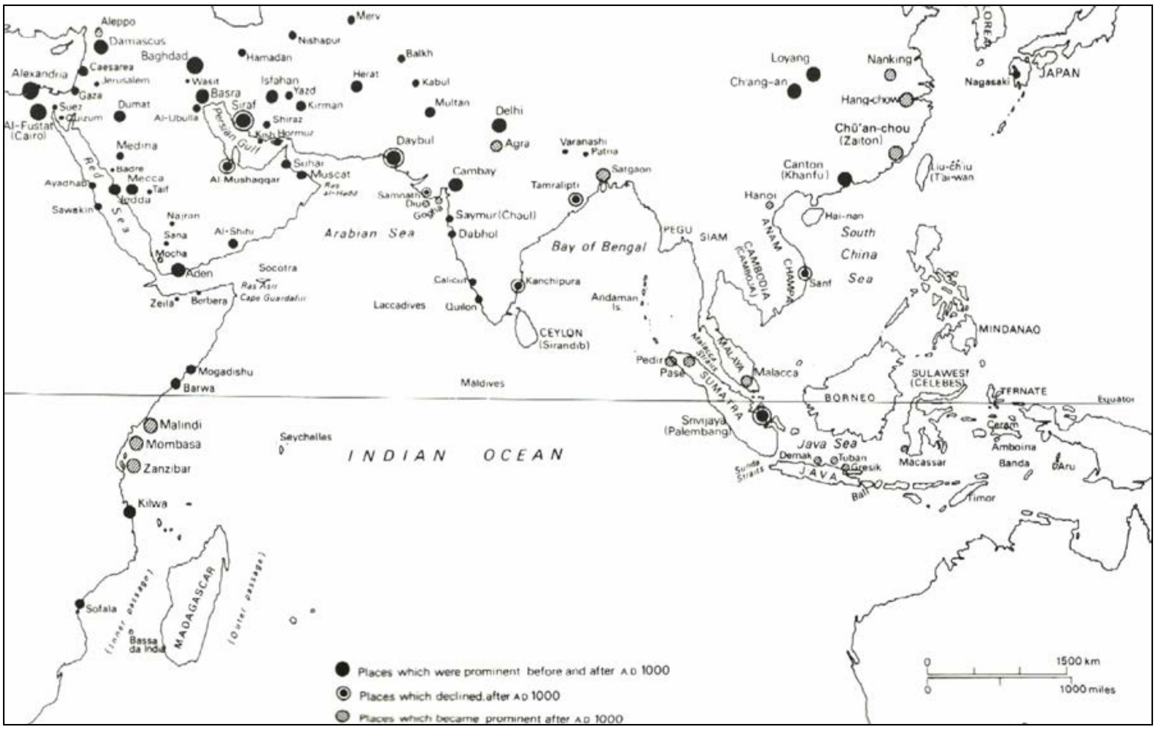

Figure 6.3: The main trading ports and cities in the Indian Ocean 618-1500 (Chaudhuri 1985: Map 7).

The wood supply for boatbuilding depended partly on endemic wood species such as acacia, fig and palm. Acacia figures among the types of nautical timber mentioned in the Greek papyri of Islamic Egypt dating to the 2nd/8th century (Bell 1908; Fahmy 1966: 76-77).[87] Fig and palm trunks also figure in the Aphrodito papyri as materials necessary for boatbuilding (Fahmy 1966: 37, 77-78). In one of these letters No. 1371, dated from 92-93/ 710-11, al-Aᶜlā b. Abī Ḥakīm the superintendent of the boatyard on the island of Babylon (i.e. Roda Island), which was founded in 54/674 in Fustat,[88] obtained beams of palm and fig tree for boatbuilding among a number of other materials (Fahmy: ibid). Although the source of these wood species is not mentioned, it is safe to infer that it was from local stands since these trees are endemic to the Egyptian landscape (Täckholm

[87] The payri were found in 1901 by Quibell at Komn Ishgau, a village situated 7 km to the South West of Tema in Upper Egypt (Bell 1908: 97), known in antiquity as Aphrodito (Fahmy 1966: 5).

[88] For a more detailed discussion on the location of Babylon see Fahmy (1966: 38).

1974: 54-55, 763). It is not clear what these woods were used for in boats but both are not ideal nautical timbers. Indeed, the wood of the date-palm has a loose fibrous texture thus unsuitable for joinery (Gale *et al.* 2000: 348). The doum-palm (Lat. *Hyphaene thebaica* (L.) Mart.) is a better candidate since it is suitable for boatbuilding owing to its hard and compact wood (Gale *et al.* 2000: 347). Fig wood is attested in the archaeological record from Egypt at several periods, usually used in fastening elements and superstructure (see Section 7.2). As for locally exploited wood in boatbuilding on the east coast of the Red Sea, evidence is also non-existent but can be inferred from the following. Al-Masᶜūdī ([d.345/956] 1970: IV.253)[89] says that a wood called *ᶜarᶜar* (Ar.) was used for the doors of Prophet's mosque in Medina. *ᶜarᶜar* is mentioned by Ibn Sīdah ([d. 458/1066] 1965: XI.140) as a mountain tree but with no clear definition. The Persian geographer al-Qazwīnī ([d. 682/1283] 1957: 154) identifies it with 'mountain cypress' (Ar. *sarū jabalī*). Recent botanical and vernacular studies identify it with juniper (Lat. *Juniperus procera* Hochst. ex Endl/ *J. excelsa* M.Bieb), a wood endemic to Yemen and parts of Arabian Peninsula (Wood 1997: 63; Alkhulaidi & Kessler 2001: 66; Al-Nafie 2008: 169) (Figure 12.30). If the sources are silent on the use of *Juniperus procera*/*J. excelsa* for boatbuilding, the evidence is provided by archaeological finds from as early as the Pharaonic period (12.3.1 Table 1): hull planks of *Juniperus excelsa* and J. *communis* were found in the 26th century BC Khufu I vessel in Egypt (Ward 2000: 23). Also, Liphschitz identified *Juniperus procera* in a sample from the ceiling planks in the 9th century Belitung shipwreck (Flecker 2008). All the above indicate that *Juniperus procera* could have easily been a locally exploited wood in regions of the Red Sea for boatbuilding and other construction.

There are no literary sources explicitly attesting the use of foreign timber species in boatbuilding in the Red Sea during the classical Islamic period – though there is evidence of timber import for other uses. Generally, goods reached the Egyptian Red Sea harbours from where they travelled to Fustat and subsequently to the harbours of Damietta and Rosetta and Alexandria through which they were distributed to Mediterranean markets. Some must have remained in Egypt and other Red Sea import centres for their local consumption and use. Valuable goods were also exported from Ethiopia and reached Fustat though the Nile and by caravan (Hourani 2005: 111). This

[89] As well as al-Nuwayrī al-Iskandarānī ([fl. 8th/14th century] 1970: 146 ft.7, 149) and al-Maqrīzī ([d.845/1442] 2003: IV.1.13).

import is hard to quantify, still, a few insights can be drawn from the wider contemporary economic context prevailing in the Red Sea at that time. Indeed, the Red Sea trade system witnessed an economic decline from the 1st/7th until the 3rd/9th century (Damgaard 2009: 88; Shatzmiller 2009: 123). Harbour towns such as Berenike and Leuke Kome were abandoned – probably due to a combination of silting harbours and decreasing Roman influence in the region – and were outlived by Aila and Clysma (Ar. Al-Qulzum) (Ward 2007). Power (2009: 111) explains this deceleration by arguing that the priority of Muslim rulers at that time was to consolidate their political control over the Red Sea, rather than to boost the economy. Meanwhile, commerce in the Red Sea was in the hands of non-Muslim Iranians, Indians, Syrians, and Greeks (Arenson 1988: 246). Regarding the presence of foreign timbers in the Red Sea, it seems that teak enjoyed a particular status of a highly-valued wood, since it was mainly imported by order of the ruling elite of the caliphal courts. This is implicitly inferred through its use for construction and furniture purposes, mainly in Medina on the east coast. Upon his death in Medina, Abū Bakr, the first caliph (r. 11/632-13/634), was laid on a bed made with teak planks sewn with coir (al-Nuwayrī [d.733/1333] 1975: XIX.129). Al-Balādhurī (1916: I.20, 1978: 20-21] and al-Ṭabarī ([d. 310/923] 1990: XV.38]) tell us that the third caliph ᶜUthmān b. ᶜAffān (r. 23-35/644-655) used teak for the roof in the reconstruction of the Prophet's mosque in Medina,[90] and for the doors of his dwellings. Mediterranean timbers for boatbuilding also made their way to Egypt from the mountain chains of the Amanus in Syrian and Casius in Anatolia (Lombard 1959: 243). Lombard (1959: 243-244) says that in mid-7th century AD Muslim Syrian and Egyptian fleets raided the coasts of Cyprus, Crete and the southern Anatolian coast especially for cypress wood, as well the Dalmatian coasts, and some regions in the Western Mediterranean basin such as Sicily, Corsica and Sardinia (Figure 6.4).

[90] This has also been counted by Ibn al-Athīr ([d. 630/1233] 1987: II.493).

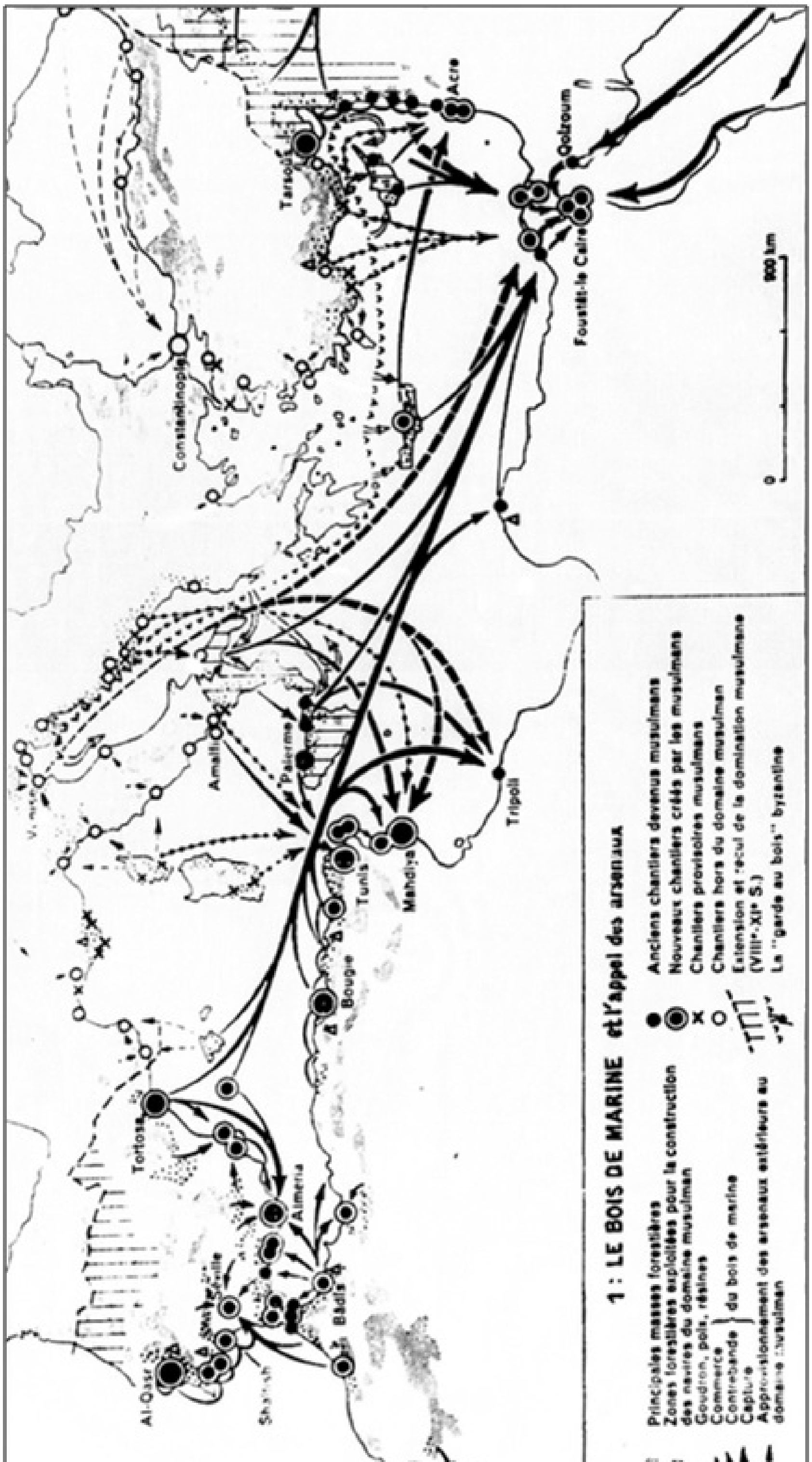

Figure 6.4: Map showing the wood supply to Mediterranean Islamic boatbuilding centres during the 1st-5th/7th-11th centuries (Lombard 1956: Map 1).

I will now look at the situation in the Persian Gulf, although peripheral to our main subject of enquiry but no less important to constitute a bigger picture of timber exploitation and trade during the classical Islamic period in the western Indian Ocean.

The establishment of the ᶜAbbāsid caliphate with Baghdad as its capital stimulated trade between the Persian Gulf and the rest of the Indian Ocean (Hourani 1995: 64; Arenson 1988: 246; Shatzmiller 2012). Along Baghdad, the main Persian Gulf trade centres during this period were Siraf, Basra, Julfar, Ubulla, Hormuz, and Sohar, and received goods from South Asia and East Africa (Boxhall 1989: 291; Pearson 2003: 88; Hourani 2005: 44; Agius 2008: 80-86). This trade was done in two ways: through Arabian and Persian ships sailing to western Indian harbours, south-east Asia and China; and Indian merchants who maintained regular trade with Persia, transporting goods on their own ships (Gopal 1999: 95). Thus, a multitude of actors could have dealt with tropical timber cargoes.

Similar to the case of the Red Sea, textual sources do not explicitly inform us on timber import for boatbuilding via the Persian Gulf but this can be implicitly deduced from albeit limited data. Teak and other woods were used in buildings in Baghdad, that were mainly royal possessions, such as houses owned by Caliphs who could afford the use of imported timber (Ibn al-Athīr 1987: VII.52). Baghdad was a prosperous administrative and military centre with a commercial district, which imported goods through Basra and the Tigris; and from there these were transported via caravan routes to Syria, Egypt, and Constantinople (Hourani 2005: 44). Although a late medieval source, the Tunisian historian Ibn Khaldūn (1956: I.363) says that Ṭalḥa b. Ubayd Allāh[91] (d. 36/656), a prominent companion of Muhammad and one of the first eight converts to Islam, used teak in his dwellings in Kufa during the caliphate of ᶜUthman b. ᶜAffan (r. 23-35/644-655). Teak was also used for the fence of a small mosque in Kufa built by the fourth caliph Alī b. Abī Ṭālib (r. 35-40/656- 661) (Ibn Baṭṭūṭa 1962: II.323). It also had a teak balustrade that enclosed the mihrab, according to Ibn Jubayr ([d.614/1217] 1907: 311, 2008: 20). Such data testifies to the import of teak for the benefits of the ruling elite, from India and/or South-East Asia via the Persian Gulf.

The range of data concerning boatbuilding activities in the classical Islamic period is quite limited. Activities of boatbuilding and/or repairing must have been happening throughout the Red Sea at that time, for the needs of fishing, local transportation and trade. But contemporary sources do not speak of this, thus obscuring a large part of our

[91]http://www.brillonline.nl/subscriber/uid=1963/entry?result_number=5&entry=islam_SIM-7362&search_text=talha&refine_editions=islam_islam#hit [Accessed 18th May 2011].

understanding of the nautical timber used in boats for such purposes. What little data there is, refers to four main boatyards in Lower Egypt: 'The island of al-Rawḍa' (Ar. Jazīrat al-Rawḍa) also known as 'The island of Babylon'; a second one at Damietta on the main eastern branch of the Nile; a third at Alexandria on the Mediterranean coast of Egypt; and a fourth at al-Qulzum on the Gulf of Suez (Colin & Cahen 2012).

The island of al-Rawḍa, also known as 'the island of the shipyard' (Ar. Jazīrat al-ṣinā^{c}at) and the 'island of Babylon', was, and is, an island in the Nile west of Fustat.[92] It also sometimes figured as 'the island' (Ar. al-Jazīrah) or 'the park' (Ar. al-Rawḍa)[93] in medieval Islamic sources. Later medieval Islamic historians claim it as the first boatbuilding site to have been established in Egypt (al-Qalqashandī 1963-1970: III.475; al-Maqrīzī [d.845/1442] 2002: III.622), although the evidence is overwhelming that it was not (See e.g. Ward 2000). These authors probably mean that the yard was the first shipyard in Egypt established by the Arabs after the Muslim conquest of 639 AD. The earlier Classical texts do not reveal any information on al-Rawḍa. It was occupied during the Byzantine period (al-Qalqashandī 1963-1970: III.335) but there does not seem to have been any boatbuilding happening. The site was active from at least the 2nd/8th century, when Ibn ^{c}Abd al-Ḥakam (d. 256-7/ 870-1) tells us that wood was sought for boat construction under the Umayyad caliphate of ^{c}Umar b. ^{c}Abd al-^{c}Azīz (r. 98-101/717-720). Al-Maqrīzī (2002: III.622) states that the nautical activity on al-Rawḍa was on-going from the time of its foundation until at least the Ikhshidīd governorate of Muhammad b. Tughj al-Ikhshīd (r. 268–334/882–946). Broadly, boatbuilding activities as well as repairing, refitting and cleaning of vessels (Fahmy: 1966: 37, 77-78) continued for at least six centuries, until the 9th/15th century. Evidence for this is provided by Ibn Taghrībirdī ([d. 815/1412] 1963-1971: I.10) who mentions the contemporary island as (Ar.) mawḍi^c al-ṣinā^{c}a (a place where boatbuilding was happening) and al-Qalqashandī (1963-1970: III.519) who says that shipbuilding was on-going at his time.

[92] For a detailed discussion on the location of the arsenal site see Fahmy (1966: 41-42); and a more comprehensive history see Fahmy (1966: 42-48).

[93] In this chapter the island will simply be referred to as al-Rawḍa. For more details on the nomenclature of the island see Fahmy (1966: 39-40).

On the Mediterranean coast, Damietta was a naval centre administered by a Christian official.[94] It functioned from the early classical Islamic period until its destruction in 624/1226 (Fahmy 1966: 35). With its crucial position close to the Mediterranean Sea, Damietta must have received woods for boatbuilding from Mediterranean lands. Just as timber imported from Syria was used at Alexandria in the 1st/7th century. Alexandria was a naval base with large shipyards where Coptic carpenters mainly built warships (Fahmy 1966: 27-28; Hourani 1995: 57).

Meanwhile on the Red Sea, al-Qulzum figures as a harbour and a naval boatbuilding site in early Islamic papyri, with provisions of acacia wood conveyed there for building and fitting ships (Fahmy 1966: 26; Mayerson 1996: 126). The port, known in Roman times as Clysma, was located at the mouth of the Nile-Red Sea canal. Thus, timbers could transit trough it (Fahmy 1966: 23-25). This canal was re-excavated in the 1st/7th century AD, after a short period of disuse in the Late Roman period, in order to export Egyptian grain and other foodstuff to the Hijaz in response to famine (Ibn ᶜAbd al-Ḥakam 1922: 164-165). Al-Qulzum must have sustained an activity of boat assembly/building and repairing until at least the Fāṭimid period since it remained an important port of grain export to the Hijaz via the Red Sea, until that time. The canal was abandoned due to the closure of the land route to Arabia subsequent to the onset of the First Crusade (1096-1099) (Cooper 2014). Perhaps then boatbuilding activity would get to halt as al-Qulzum prosperity declined with the filling of the canal.

6.2.2 *Early medieval period (3rd- 4th/9th -10th centuries)*

Timbers figuring in textual sources during the early medieval period (12.3.3 Table 3) include endemic species such as acacia and lebbeck in Egypt, and wood resources from the Zagros Mountains in the Persian Gulf. Imported species include teak and other Indian and East African timbers as well as Mediterranean types. Early medieval Islamic sources speak of a few places which demonstrate the presence of foreign timber exploitation including: Mecca and several locations in Egypt for the Red Sea region; and Basra, Siraf, and Sohar in the Persian Gulf region. Some of the these were import centres and/or destination cities. Sources also inform us on some of the boatbuilding activities at that time which, they say, were located in Egypt and on the Tigris riverside and Basra in the Persian Gulf.

[94] For a detailed description of the medieval Islamic period see Fahmy (1966: 30-35).

Early medieval sources tell us that endemic species to the areas of the Red Sea such as acacia and lebbeck were also used during the 3rd- 4th/9th-10th centuries. Despite Egypt's need to import foreign timber, it always possessed some timber-producing trees for boatbuilding (Fahmy 1966: 79; Ward 2000: 15-20).This refutes radical general assumptions that the country was completely without such species (e.g. Cahen 1964: 258). The Egyptian historian Ibn ᶜAbd al-Ḥakam (1922: 90) relates that on one occasion when timber was needed for shipbuilding at Rawḍa,[95] the governmental manager of finance Ḥayyān b. Shurayh had to buy it locally from Coptic merchants. Most probably these included acacia wood which is an endemic tree in Egypt, and must have been highly prized there in early medieval times. Indeed, the Persian geographer Ibn al-Faqīh al-Ḥamadānī ([d. 290/903] 1885: 66) describes it as "one of the wonders of Egypt". The use of acacia in boatbuilding for short hull-planks and structural timbers goes back to Pharaonic times (12.3.1 Table 1; Ward 2000: 16, 107-128). Acacia hull-planks were also found in a recycled context at a 12th -15th century burial at Quseir al-Qadim in Egypt (Gale & Van der Veen 2011: 223; Van der Veen 2011: 34). It is also mentioned in the Graeco-Roman literature as being used in boatbuilding (see Section 6.1).

Lebbeck[96] (Ar. *al-libakh*, Lat. *Albizia lebbeck* (L.) Benth.) (Figure 12.10) is another tree local to Egypt that was used for hull planking, as several Islamic sources from the early and middle medieval period tell us.[97] These authors say that lebbeck trees were commonly distributed in Upper Egypt and especially in Ansina. They claim that if two planks of this wood are fastened together and left to soak in the water for a year, they became indistinguishably joined. They add that a ship made of lebbeck wood and kept afloat for some time appears as if made of one single piece of wood. This fantastical account perhaps symbolises the suitability of lebbeck wood for boatbuilding in that it produces watertight hulls. Indeed, al-Baghdādī ([d. 629/1231-2] 1998: 63) describes lebbeck as being a black hardwood of very good quality – resistant, robust, precious and

[95] For a detailed discussion on the location of the boatyard site see Fahmy (1966: 41-42); and a more comprehensive history see Fahmy (1966: 42-48).

[96] Al-Sheikh (1998: 62 ft. 9) identifies al-libakh with *Albizia lebbeck*. For Provençal (2010: 65), the "standard transliteration (sic.)" *al-libakh* (name from Egypt) is also known in Classical Arabic as *labakh* or *labkh*, where it used for various trees.

[97] al-Baghdādī (1998: 64) quotes the 9th century botanist Abu Ḥanīfa Dīnawarī (d. 282/ 895). This was also repeated by Yāqūt ([d. 626/1229], 1988: I.266), al-Qazwīnī (1960: 149), and al-Maqrīzī (2002: I.555, 2004: IV.2.1039).

highly appreciated by Egyptians. This explains why this wood was used in shipbuilding, since it has, I believe, the required qualities of ship timbers, such as resistance to the physical strains on the ship's hull in terms of wave action; cargo and crew weight; as well as biological resistance against the teredo shipworm. Al-Baghdādī (1998: 62, 64) adds that lebbeck originated in Persia and was brought to Egypt, where it grows in small numbers. However, he does not say how or in which period the introduction of the species happened. The answer is provided by Fahmy (1966: 143) who, quoting a few classical sources, states that the introduction of lebbeck to Egypt happened during the 1st century AD under the Roman domination of Egypt. He says that lebbeck trees were widespread in all parts of Egypt but began to be scarce at the end of the 4th or the beginning of the 5th century AD. He adds that, starting in the medieval period, lebbeck stands were rare in Lower Egypt but still existed in parts of Upper Egypt (Fahmy 1966: 147). Such textual evidence is the only one I found testifying to the use of lebbeck in boatbuilding.

When early medieval textual evidence is scarce, or when these sources omit the species of nautical timber, we can only infer that local wood resources were exploited in the Persian Gulf and Red Sea areas. For example, the Persian geographer Ibn al-Faqīh al-Ḥamadānī (19731: 158) reports that tall and broad trees were felled on Qandīl Mountain in northeast Iraq for their timber. This mountain belongs to the Zagros mountain chain, which is rich in tree species suitable for boatbuilding. These include oak, oriental plane and poplar (Haden-Guest *et al.* 1956: 425; Zohary 1973b: 354, 359; Ratnagar 1981: 3, 7).

As for imported wood to the Red Sea and the Persian Gulf, India was still in the 3rd/9th century providing wood such as teak and benteak cut from the Malabar forests to Arabian and Persian traders for boatbuilding, through the harbours of Cochin, Calicut and Cannanore (Boxhall 1989: 292; Blue 2009: 9). Specifically, the trade in woods from India to the Red Sea seems to be associated with the revival of mercantile activity there in the 3rd/9th century, which was encouraged by "a unitary commercial culture in the Red Sea" that flourished in "the shadow of ᶜAbbāsid internationalism" (Power 2009: 116, 2012: 142). In the 4th/10th century, the Persian geographer Ibn Rustah ([f. 903-13] 1892: 83) describes India as the land where teak is acquired. Al-Maᶜsūdī ([d. 345/956] 1917: III.12) tells us it was exported from India to Basra, Iraq and Egypt in the form of tall natural logs. He says that teak is taller than the palm tree and more voluminous than the chestnut tree. He is the only author from his time to provide us with information on the form in which teak trees were exported: in their raw state as logs cleared of branches to render their export easier. It seems they were not pre-sawn at Indian export centres, perhaps to grant the boat builder the freedom to saw logs as he saw fit.

There is even some textual evidence to suggest that Indian teak made it into the Mediterranean. Al-Maᶜsūdī (1861: I. 365) says that teak planks drilled with holes and joined together with coir has been found, during his time, in the Mediterranean near Crete. He claims these timbers arrived there by "floating from the Red Sea", which is an impossible explanation. Nevertheless, further evidence suggests that teak made it to Egypt, and it is not impossible to imagine that some of it made it into Muslim ships used on the Mediterranean.

The import of teak via the Red Sea to Ṭūlūnid Egypt – albeit not explicitly for boatbuilding purposes – is also reported in the historical texts: Aḥmad b. Ṭūlūn (r. 254-868/270-884) had palace doors made of this wood, at Al-Qaṭaᵓīᶜ, the Ṭūlūnid capital, near Fustat; his son Ibn Khumāraweh used teak to build aviaries for exotic birds in the palace's garden, and for roofing the fountain in the courtyard (Ibn Taghrībirdī 1963-1971: III.16, 54; al-Maqrīzī 2002: II.86, 88; 2003: IV.1.74). We also have evidence of teak being used for buildings in the Hijaz. In Mecca, teak planks or poles were used in tall buildings, as a reinforcement for the walls made with baked brick (al-Maqdisī ([d.380/990] 1906: 71; Yāqūt ([d.626/1229] 1988: V.187); and in the construction of a number of shops (al-Maqdisī 1906: 76).

Meanwhile, it appears that the use of teak in Persian Gulf cities was widespread during the 3rd-4th/9th-10th centuries. Several early-to-late medieval Islamic sources[98] describe Siraf's opulence with its buildings of teak, as well as other wood species imported from the lands of the Zanj (East Africa). The presence of teak in Sirafi buildings could also suggest its import for boatbuilding either at Siraf itself or for transhipment to other boatbuilding sites. The origins of the teak in question is not specified by these authors, but Indian (Hourani 1995: 70) or another south Asian provenance are the most probable. The other wood species from East Africa are also not identified, but must have been

[98] al-Iṣtakhrī [d. 346/957] 1927: 127; al-Maqdisī [d. 380/990] 1906: 426; Ibn Ḥawqal [fl. 4th/10th century] 1964a: 54, 248, 1964b: I.47, II.77; Yāqūt 1988: III.295; Ibn Saᶜīd [d.685/1286] 1970: 160; Abū al –Fidā [d.732/1331] 1840: 326-327; al-Qalqashandī [d.821/1418] 1963-1970: IV.346).

imported by Arabian and Persian merchants who traded there in search of timber, among other goods (Boxhall 1989: 292-293; Hourani 1995: 80, 2005: 44; Rougeulle 1996: 165). The species could have been any of the following indigenous timber-producing trees, destined for terrestrial and nautical construction: (Lat.) *Albizia schimperiana* (Dharani 2005: 46), *Diospyros abyssinica* (ibid: 85), *Markhamia lutea* (ibid: 126), *Newtonia buchananii* (ibid: 136), *Prunus africana* (ibid: 150), and *Zantboxylem gilletti* (ibid: 185). Al-Qalqashandī (1963-1970: IV.346) says that both teak and other timbers were imported from East Africa. An East African origin for the teak is quite doubtful, since it originates from India and south-east Asia. The introduction of teak as plantation timber outside Asia in areas of Africa such as Nigeria, Ghana, and Côte d'Ivoire and Sudan dates from the early 20th century (Kaosa-ard 1998; Pandey & Brown 2000). Al-Qalqashandī might have confused a different East African durable hardwood tree with teak; or wrongly copied previous authors. Indeed even nowadays speaking of commercially exploited timbers, Titmuss (1965: 243) states that: "The name of Teak is often given to timbers not of the true Teak family (the Verbenaceae) and often of local importance only. Care should be taken to distinguish between such timbers and the true Teak".

There are several instances where teak is mentioned in the early medieval Islamic period as used for on-land construction other than at Siraf. These mentions are important as they point to substantial teak imports into the Persian Gulf, which might have also sustained boatbuilding activities. Al-Maqdisī (1906: 92) says that teak was used in the building of houses in Sohar on the north-east coast of Oman, and that it was the centre of trade in the eastern Arabian Peninsula for timber products such as teak, ebony, and coconut (ibid: 97). Cargoes of teak arrived at Sohar for local use and re-export to other destinations in the Middle East. The same might have occurred at Basra. In his *Kitāb al-Buldān,* the Arab geographer al-Yaᶜqūbī ([d. 284/897] 1892: 258) narrates how the ᶜAbbāsid caliph al-Muᶜtaṣim (r. 218-227/833-842) used teak and other woods, transported from Basra, in his foundation of Samarra on the east bank of the Tigris north of Baghdad in 218/833. This stresses the role of Basra in the western Indian Ocean trade where it appears as an important shipping place (Agius 2002: 181), especially for woods coming from India or wider South Asia. However, Basra must have kept some of the wood cargoes for its own needs, since teak was used in its buildings: al-Balādhurī (1924: II.61; 1978: 342) and Ibn al-Faqīh al-Hamadānī (1973:

20) report that the city's governor Ziyād b. Abīhi (r. 45-53/ 665-673),[99] roofed the city mosque with teak. Basra was also a boat repairing and building and site at least from the 3rd/9th century: Ibn Khaldūn (1957: III.646) reports that a boatyard at Basra was used by Manṣūr b. Jaᶜfar who was commissioned by theᶜAbbāsid caliph al-Muᶜtamid (r. 256-279/870-892) to repair his warships after his defeat against the Zanj in Bahrain. It was also there that, in a later confrontation with the Zanj in 258/872, the caliph al-Muwaffaq (r. 261-278/875-891),[100] the brother of al-Muᶜtamid, undertook ship repair in Badarūd near the river Abi al- Asad (a canal at the junction of the Tigris and the Euphrates)[101] (Ibn Khaldūn 1957: III.649). Ibn Khaldūn (1957: III.687) adds that there was a ship shed for boat construction, belonging to the Zanj on the Abū al-Khaṣīb canal in Basra, which was burnt down in 269/883 by al-Muwaffaq. Also, we are informed by al-Ṭabarī (1987: XXXVII.99)[102] that teak planks were used by the Zanj to construct a bridge on the same canal. The availability of teak at Basra and the fact that the city was a site for boat construction and repairing suggest that teak would have been used there for nautical purposes.

Teak most probably had conserved its high status as a precious wood since the classical Islamic period. Indeed, al-Ṭabarī (1989: I.359-361) says that God ordered Noah to build his ark from teak planks. This religious belief suggests the superiority of teak wood in boatbuilding, as if it was the timber of choice at the origin of wooden boatbuilding in the Muslim socio-cultural context. With its high durability and suitability as a nautical wood, it is no surprise that Islamic authors considered teak suitable to reinforce a myth demonstrating the archetypal resistance of human kind against apocalyptic conditions, under divine guidance. As Kobylinski (1995: 18) argues: "ships can give rise to emotional states, accruing spiritual senses and gradually acquiring symbolic functions".

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[99] Governor of Iraq and the eastern provinces of the Umayyad caliphate during the reign of Muʿāwiya b. Abī Sufyān. For a complete bibliography on Ziyad's life see http://www.brillonline.nl/subscriber/uid=1963/entry?result_number=1&entry=islam_SIM-8176&search_text=Ziyad+basra&refine_editions=islam_islam#hit [Accessed 15th May 2011].

[100] ᶜAbbāsid caliph, son of the caliph al-Mutawwakil and a slave girl Umm Isḥāq, regent and virtual ruler of the caliphate during the time of al-Muᶜtamid.

[101] http://www.brillonline.nl/subscriber/uid=1963/entry?result_number=1&entry=islam_SIM-5079&search_text=Nahr+abu+al+asad&refine_editions=islam_islam#hit [Accessed 19th May 2011].

[102] This same event is later reported by Ibn al-Athīr (d. 630/1233; 1987: VI.320) and al-Nuwayrī (d.733/1333; 1984: XXV.170).

Indeed, teak was a commodity that was traded in the western Indian Ocean at least from Roman times (Periplus ch.36). It is no surprise that fashioning component of hulls from this wood, in areas with no long-planks producing timbers, became a common social practice, and thus constituted a prototype of a religious object i.e. Noah's ark. As Kobylinski (1995: 17) says: "The reasons why the boat acquired symbolic functions should be looked for in the properties of the socioeconomic structure of the social systems". The durability of this symbolism and its persistence in the sphere of spiritual culture, concepts put forward by Kobylinski (1995), is demonstrated by the fact that four centuries later Ibn al-Athīr (1987: I.56) also believes that teak was used for Noah's ark.

Indian and other south Asian woods were not the only types of timber used in vessels plying the western Indian Ocean. Mediterranean species were also present, and their point of entry to the Red Sea was through Egypt. Baynes (1949: 217) and Cahen (1964: 259) tells us that Venice supplied Egypt in the 3rd- 4th/9th-10th centuries with timber despite the ban on this trade imposed by the Byzantine Empire. In the late 4th/10th century, wood from the Amalfi coast and Italian cities was exported to Egypt in Italian ships to construct warships (Shatzmiller 2009: 127; Bramoullé 2012: 134). According to the fiscal treaty Minhāj of al-Makhzūmī, dating from the Fātimīd-Ayyūbīd periods, wood was exported to Egypt by means of floating logs behind ships and arrived through the three ports of Alexandria, Damietta and Tinnis (Cahen 1964: 227, 234). Thus, we could infer that during the early medieval period two methods of sea transport existed for log trade: loading them onto ships; or floating them behind vessels. The latter method has been used since the Bronze Age (Semaan 2007: 64-67). Bramoullé (2012: 135) explains that "according to the Egyptian tax system, European merchants who arrived there with strategic raw materials enjoyed certain tax exemptions on Red Sea products. Against wood or iron they could export products from Egypt at lower prices and sell them at large profits". The import of timber from across the Mediterranean to Egypt for nautical purposes was essentially controlled by the government (Cahen 1964: 258). A government agency called (Ar.) *Matjar* held the monopoly over imported wood and would sell the surplus to private merchants, only when governmental nautical needs were fulfilled (Cahen 1964: 258). Such disposition of timber surplus in the free market existed mainly at Damietta and Tinnis (Cahen 1964: 259), but it is not clear whether these merchants would sell it for boatbuilding or other purposes. Perhaps we can see here a way for local fishermen to fulfil their need in nautical timber. This is speculative since it is not mentioned by the sources but not impossible since more modest boats should have been also built.

Indeed, sources only speak of governmental naval boatyards which were mostly located on the Mediterranean coast of Egypt, using local shipwrights and Mediterranean timber such as pine (Arenson 2007: 91). Those destined for the Red Sea were dismantled and carried on camel-back to one of the ports there, where they would be reassembled, armed and launched as was common practice in Pharaonic times (Garcin 1976: 209-2010; Whitcomb & Johnson 1979: 3; Sayed 1980: 156; Bülow-Jacobsen 1998: 66; Wild & Wild 2001: 218; Cohen 2006: 333; Arenson 2007: 91; Van der Veen *et al.* 2011: 223). Another way for boats or dismantled boat timbers to reach the Red Sea was through the Nile-Red Sea Canal until its abandonment in the 12th century (Cooper 2009). Sources tell us that two main yards located in Lower Egypt were active during the early medieval period: 'The island of al-Rawḍa' (Ar. Jazīrat al-Rawḍa) and 'Egypt's shipyard' (Ar. Ṣinā^cat Miṣr). The latter was a newly established boatyard often functioning along with al-Rawḍa, and was located slightly north of Fustat (Fahmy 1966: 48-50). It was founded in 325/937 by the Ikhshidīd governor Muhammad b. Tughj al-Ikhshīd (r. 268–334/882–946) (al-Maqrīzī 2002: III.622). It also had a naval character for building fleets during the subsequent Fāṭimid, Ayyūbid and Mamlūk dynasties, just before 700/1300 where it was turned into a garden (al-Maqrīzī 2002: II.570, III.622-624). For example: in 577/1181, four *harārīq* warships (Agius 2008: 343-348) were built there, and were bound to sail for Yemen (al-Maqrīzī 1956: I.1.74). It is quite frustrating that sources omit other boatyards that must have been located on the Red Sea coasts.

As for the Persian Gulf adjacent regions, we get a one-off mention by al-Ṭabarī (1992: XXXI.226) regarding boatbuilding in Iraq. He reports that in 198/813 the ᶜAbbāsid caliph Muḥammad b. Hārūn (r.193-198/809-813) ordered the construction on the Tigris of five expensive fire-launching (Ar. *ḥarrāqa,* pl. *ḥarrāqāt*) ships in the shape of animals: "a lion, an elephant, an eagle, a serpent and a horse". It would be quite surprising, and technically impossible to assign such zoomorphic shapes to the hulls of these vessels. Most probably al-Ṭabarī refers here to the warships' prows, which might have been shaped as heads of animals, which perhaps symbolized strength and power.

Agius (2008: 241) argues that zoomorphic symbols go back to the Bronze Age. He adds that several medieval Persian miniatures show ships or boats with animal stem-heads (Agius: ibid). Basra, as mentioned above, was probably a location for boatbuilding and/or refurbishment from the 3rd/9th century until at least the 8th/14th, when it was still a major port of the Persian Gulf (Agius 2008: 364). However, we do not have a direct mention for what types of timber were employed at such boatyards. Perhaps timber use at that time witnessed a setback in these areas due to a shift in the main route of east-west trade in the western Indian Ocean from the Persian Gulf to the Red Sea in the late the 4th/10th century. This shift was mainly due to the growing trade links between Egypt and Italian markets with the rise of Cairo as the Fāṭimid political and economic centre in 359/969 (Rougeulle 1996: 167; Hourani 2005: 44; Facey 2009: 170; Abulafia 2011: 255, 270, 292-294). As the trade in the Red Sea picked up momentum, its harbours, such as Aden, al-Jar, Jeddah, al-Qulzum, Aydhab and Quseir, flourished (Arenson 1988: 247; Hourani 1995: 82; Rougeulle 1996: 175-176; Bramoullé 2012: 128; Power 2012: 139). Also, the ᶜAbbāsid caliphate was facing several threats from Bedouin, Qarmāṭians and the Būyid dynasty of Fars (Rougeulle 1996: 167; Arenson 1988: 247), while the rise of the Cholas dynasty (985-1279 AD) increased the importance of the Malabar coast (Kulke 1999: 214-215).

6.2.3 Middle Medieval period (5th-8th/11th-14th centuries)

Nautical wood is reported in middle medieval sources (12.3.3 Table 3) as being from local species such as acacia, lebbeck, and possibly sidr; as well as teak from India and Sind, and coconut from the Maldives and Laccadives; Mediterranean woods such as pine and Cilician fir; and possibly some East African woods. Imported timber from the Mediterranean, India, Sind and the Maldives and Laccadives, made its way to Egypt through respectively its Mediterranean coast and Red Sea coast through the harbours of Alexandria and Damietta, Aden, Aydhab, Tur; and to the Persian Gulf mainly through Hormuz and Sohar. Boatbuilding yards mentioned in the sources of this period include several yards in Lower Egypt and Middle Egypt, in the Gulf of Suez, in Aden, and the Hijaz.

The use of endemic wood species for boatbuilding in the 5th/11th century is not stated explicitly in contemporary primary sources. Later, in the 6th/12th century, the Egyptian historian Ibn Mammātī ([d. 578/1182] 1988: 112, 289-290, 310 note 177)[103] says that acacia wood had been used for the purpose of building galleys *shawānī* (Ar. s. *shīnī*; Agius 2008: 334-338), since at least the Fātīmid period. We also have substantial information from Ibn Mammātī about Egyptian forestry and the highly complex administration dealing with wood supplies. He says that acacia and other trees were widely distributed in Upper Egypt especially at Qus, and in Middle Egypt at Beni Suef and Minya and in Lower Egypt. They were protected by guards from the *dīwān*, the forest administrative office who controlled felling. In order to preserve trees, the numbers felled did not exceed the quantities needed for shipbuilding, Ibn Mammātī explains. He also states that local people were forbidden by the public treasury (Ar. *Bayt al-māl*), which owned the forests, from cutting down acacia that was suitable for boatbuilding, and were only given permission to fetch branches to use as firewood. Thus, it is certain that acacia — "one of the wonders of Egypt" as Ibn al-Faqīh al-Ḥamadānī (1885: 66) calls it— was prized in Egypt as one of the rare timber species growing there. Between Girga and Aswan there was reportedly a forest of some 8,094 hectares (twenty thousand acres) (Perlin 1991: 140). As to the economic regulations of tree felling, Ibn Mammātī, who was later quoted by al-Maqrīzī, provides insights into exploitation of acacia in Egypt. He tells us that people who fell, transported and sold acacia wood were subjected to several taxes (Ibn Mammātī 1988: 289-290). Ibn Mammātī adds that the trees were felled in the Coptic month of *Baramūdah* (April 9-May 8) and floated on the flooded Nile to Fustat;[104] where they would have been delivered to the boatyard. Indeed, choosing the right moment to fell a tree is equally important as the quality of timber and the treatment it receives after felling in terms of drying and conversion (Delgado 1991: 323). We also have evidence from other Arabic medieval sources, dating from the 3rd/9th to the 7th/13th centuries, which suggest alternative timing options to fell trees. These mainly consist of several calendars which link astronomical knowledge and agricultural methods in Andalusia. Three dates seem suitable for felling trees so the wood does not rot: January especially on the first day of the month (Renaud 1948: 3; Navarro 1990: 53), August especially on the third day of the month (Renaud 1948: 12; Navarro 1990: 108, 113) and October (Navarro 1990: 125). The anonymous Andalusian calendar, *Risāla fī awqāt al-sana*, specifically

[103] He was quoted by al-Maqrīzī ([d. 845/1442] 2002: I.298, 736) in the 9th/15th century.

[104] Ibn Mammātī (1998: 112) speaks of transporting acacia to *Sāḥil Miṣr* literally meaning ‘the coast of Egypt’. It is identified as Fustat by Fahmy (1966: 146).

mentions the 15th of October as the ideal date to fell trees for boatbuilding (Navarro 1990: 125). Presently, Atef Matar, an Egyptian lumberjack and timber merchant I spoke with, told me that usually autumn-winter time – from October to February the dormancy period of a tree – is ideal for felling trees (see Section 9.3.2). Thus, the schedule mentioned by Ibn Mammātī might have aimed at syncing the felling of trees and the drying of logs in April-May, with the start of the Nile's flood in June for their transport.

We can assume that acacia continued to be used for boatbuilding into the 7th/13th century. Its qualities of hardness and durability were recognised by the Iraqi scholar al-Baghdādī (1998: 76-77). However, Egyptian forests were dwindling from the end of the Ayyūbid period in the 7th/13th century, as trees were felled illegally by peasants who profited from their sale (Mikhail 2011: 124). "Some estimates cite that more than 5,059 hectares (12,500 acres) of forest were destroyed during the period and that, for example, in forests in and around alone more than four thousand trees were cut" (Mikhail 2011: 126).

In the 8th/14th century, Ibn Khaldūn (1956: II.159) says that acacia (Ar. *sanṭ*) had been used in Noah's ark. This contrasts with previous beliefs, as stated above, of earlier Muslim historians such as al-Ṭabarī and Ibn al-Athīr who claimed that it had been made of teak. Perhaps the use of acacia at the time of Ibn Khaldūn was so widespread and precious that it was associated with the symbolism of the durable hull of the ark (See above Kobylinski 1995). Lebbeck was also used for boatbuilding in Egypt in the middle medieval period as stated by Yāqūt (1988: I.266), al-Baghdādī (1998: 76) and al-Qazwīnī (1960: 149). Another type of tree that al- Baghdādī (1789: 33) mentioned as growing in Egypt is the sidr (Ar. *Sidr*, Lat. *Ziziphus spina-christi*) (Figure 12.53). This endemic species has been used in Pharaonic times for tenons (12.3.1 Table 1; Ward 2000: 18, 50,129; Gale *et al.* 2000: 367). Ethnographic evidence presented and analysed later in this thesis also indicates the modern-day use of sidr for structural components of boats in Egypt, Saudi Arabia and Oman (See Chapter 8). It is equally possible that it might have been used in the middle medieval Islamic period and gone unrecorded by contemporary authors.

As for the wood trade and nautical use of exotic wood, literary evidence from the middle medieval sources is also quite scarce. Perhaps the only mention of teak being used in boatbuilding in the Red Sea comes from 6th/12th century geographer Ibn Jubayr

(1907: 70; 2008: 65), who was later quoted by al-Maqrīzī ([d.845/1442] 2002: I.551). He says that teak from India was imported at Aydhab on the Red Sea, and through Aden to construct cargo and pilgrim vessels called *jilāb* (Ar. s. *jalba*; Agius 2008: 316-320; Broadhurst 1998: 393, De Goeje 1907: 27). Ibn al-Mujāwir (2008: 159, 161, 195) adds that Indian boats carrying cargoes of teak were subjected to taxes during the Mamlūk period. Otherwise, we have few insights from sources about the use of teak and coconut in boatbuilding from a wide range of places in the western Indian Ocean. Indian teak was being traded and employed in boatbuilding at the times of the Andalusian lexicographer Ibn Sīdah (1965: XI.18). He also says that teak was used to build war galleys (Ar. pl. *qarāqīr*; Agius 2008: 289-292, 332-334) (Ibn Sīdah: X.26). However, he does not indicate in which particular boatyard this activity took place. Teak use for warships is not surprising, as a strong and resistant hardwood is needed for sea-going hulls that could bear the heavy load of ammunition, troops, horses and other cargo. The Andalusian geographer al-Bakrī (2003: I.144) also attests to the use of teak in hulls by the inhabitants of the areas around the Arabian Sea, his *Baḥr Harkand*. Teak was also used in boatbuilding at its place of origin: the Damascene geographer al-Dimashqī ([d. 727/1327] 1923: 157) states that teak was used for log boats that were 40 cubits long (c.18.2 metres) and 7 cubits wide (c. 3.2 metres) in the island of Malay, possibly the Malay Archipelago, east of the island of *Qamar*/*Qumr*, possibly the Comoros archipelago in the Indian Ocean (his *Baḥr al-Ṣīn*). These are the only direct mention of the middle medieval times of teak being used in boatbuilding in the wider western Indian Ocean. As for coconut, Al-Idrīsī ([fl. 548/1154] 1989: I.75) says that the Maldives and Laccadives islands[105] were rich in such trees that were sought by mariners coming from Yemen and Oman for masts. He also says that these sailors would also build their boats from this wood, and load their vessels with it for sale upon their return. Coconut wood is densest and harder on the outer perimeter of the trunk and gets less hard towards the centre. It also hardens with time, and its density increases, thus structural components of a boat can be hewn from dense coconut timber. Coconut palm has no branches so the wood is free from knots and is not weakened by the presence of natural defects (Figure 12.20). But using coconut timber has few shortcomings. Saw logs produced from coconut timber are limited in length and width because the wood does not have any lateral growing tissue thus it does not increase in diameter with time.

[105] See Arenson (1988: 246) and Hourani (1995: 91).

Stems are often curved so this limits the length of saw logs that can obtained, generally reaching a maximum length of four metres. Also, coconut wood is not very durable, as it has no natural resistance to attack by decay fungi and wood-borers (FAO 1985: 6-8). However, coconut is still used in wooden watercraft of the Maldives. During his recent ethnographic investigations, Maniku (1998: 13-14) observed coconut use in fishing, and passenger and cargo vessels in the Maldives Islands. It is used for planks, inwales, oar looms, and masts (Maniku 1998: 16).

Meanwhile in case of the Red Sea, we have evidence for the use of teak in prestige buildings in Egypt and Arabia during this period, but not for boatbuilding in particular. Sources from the 5th/11th to the 8th/14th centuries mention teak as being used in buildings at Medina, Mecca, and Najd in the Arabian Peninsula (Nāṣir-i Khusraw ([d.465 or 471/1072 or 1078] 1986: 76; Kitāb al-Istibṣār [c. 587/1191] 1986: 16, 22, 37; Abū Shāma [d. 666/1268]1956: 503; Ibn al-Mujāwir ([d. 690/1291] 2008: 224]; Ibn Baṭṭūṭa (1972: I.195); in Ahwab in Tihama and Sanaa in Yemen (al-Nuwayrī [d. 733/1333] 1954: I.383); Ibn al-Mujāwir 2008: 247). The Judaeo-Arabic manuscripts of the Cairo Geniza, dating from the 5th/11th and 6th/12th centuries, mention timber as part of the goods being traded between India and Egypt and Arabia. Goiten (1966:197) asserts that: "Timber must have been one of the great exports of India, but the shipbuilders of Arabia most probably carried the timber needed by them on their own dhows, while the building industry in the Egyptian cities must have made use of importers other than those represented in the Geniza. In any event, Indian timber is almost absent from our records".

Meanwhile the Mediterranean countries also acted as wood providers to Egypt during the middle medieval period– albeit not specifically for boatbuilding purposes. Also, the sources do not tell us if such a trade was consistent throughout the period or what volume this trade took on. The Moroccan traveller Ibn Baṭṭūṭa (1962: II.417) says that the coastal city of Alaya (ancient city of Alanya, south coast of Turkey) exported large quantities of wood to Alexandria and Damietta from where it was distributed to the rest of Egypt; he gives no information on the types of wood or their uses, however. It might have been long logs or planks that could not be obtained from the endemic species, such as the pine or cedar. Another piece of evidence is provided by al-Nuwayrī al-Iskandarānī ([fl.8th/14th century]; 1970: IV.7) who says that *ṣanawbar* (Eng. pine, Lat. *Pinus* spp.; Nehmé 2000: 204), *buqs*, *qarū*, and *shūḥ* (Eng. Cicilian fir, Lat. *Abies* *cilicica* Ant. & Kotschy Carriére; Nehmé 2000: 23) (Figure 12.2) woods were imported by Egypt from Mediterranean countries. I have not been able to identify the species for *buqs*. I suggest that perhaps *qarū* might be a distortion of *sarū*, which is the Arabic name for cypress (Nehmé 2000: 96). Such timbers have an enduring tradition in Mediterranean boatbuilding since antiquity (See Meiggs 1982; Guibal & Pomey 1998; Guibal & Pomey 2002).

East African woods might also have been available in the Red Sea for boatbuilding, even if direct literary evidence is absent. There was an increase in commercial activity in the middle medieval period, between the two regions, mediated particularly by Yemeni trading networks (Lewis 1973: 259; Rougeulle 1996: 173). Yāqūt (1988: V.173) says that ebony, sandalwood, and amber were exported from *Maqdashū* (Modern Mogadishu) in East Africa (Ar. *Bilād al-Zanj*), but this should not rule out the possibility of timber for boatbuilding as well. The Red Sea also played a middleman's part with transiting South Asian products and manufactures and acquiring increasing amounts of timber among other goods from East African harbours (McPherson 1993: 115). This continued to be the case until the 18th century (Barendse 2000: 175-176).

Literary evidence so far, as scarce and indirect as it is, have provided us with a broad idea of the types of wood that were being used in boatbuilding in the Red Sea. Local timber species were employed along with timbers imported from three major areas: the Mediterranean, India and East Africa. These were brought through harbours located on the Mediterranean coast of Egypt and through the Red Sea and Arabian Sea, of which only a few are mentioned by the middle medieval literature. Al-Idrīsī (1989: I.54) tells us that Aden was a renowned harbour where ships bound for Sind, India and China would sail, and to where products from China and India were imported such as coconut, ebony, camphor, and cloves, to name but a few. Of these products, coconut and ebony are suitable for boatbuilding, as previously stated. In the course of the 8th/14th century, the port of Aden was frequented by Indian and Egyptian wealthy merchants most of whom owned large cargo vessels (Agius 2002: 183; Margariti 2007: 146-148). Aden was also a centre for boatbuilding activities in middle medieval times, with several boatyards, according to Ibn al-Mujāwir (2008: 153). The 6th/12th century Geniza letters mention the desire of Madmun, the superintendent of the port of Aden, to "fit out a ship to sail from Aden" (Goitein 1980: 51). Goiten (1980: 56) explains this passage as either "buying or building a ship and fitting it out". Even if the type wood used at the boatyard is not mentioned we can safely assume not only that wood of Indian origin was probably used, but also that boatbuilders might also have exploited local Yemeni timber species.

Meanwhile, prominent harbours in the Red Sea including Aydhab, Quseir, Suakin and Jeddah were partly eclipsed at the end of the 8th/14th century by the foundation of a new harbour at Tur on the Gulf of Suez (Rougeulle 1996: 173; Agius 2008: 98). The latter was a trading centre for merchant ships sailing between the Hijaz, Yemen and Egypt, according to al-Qalqashandī (1963-1970: III.465). He adds that the site also functioned as a temporary boatyard when the Egyptian vizier Ṣalāḥ al-Dīn b. ᶜArrām built vessels there in 780/1378. However, this should not dismiss the fact that boatbuilding also took place at other times and was not only related to military purposes. We also get other one-off mentions of boatbuilding during the middle medieval period in the Hijaz on the east coast of the Red Sea. These are also related to warfare. Al-Nuwayrī (1992: XVIII.279) tells us that in 512/1118, al-Sharīf Abū Muḥammad Qāsim b. abi Hāshim (d. 517/1123) prince of Mecca, built warships and loaded them with fighters sending them to Aydhab on the Red Sea. Ibn Jubayr (1907: 59, 2008: 52), copied later by al-Maqrīzī (1956: I.1.78-79), informs us that in 578/1182, Reynaud De Châtillon built several ships in the Hijaz, which were dismantled and transported on camels to the Red Sea for the naval battle against al-Ḥājib Ḥusām al-Din LuᵓLuᵓ's forces. Such evidence however only relates to two punctual events in time and are not indicative of an indigenous boatbuilding industry, which starkly absent from our middle medieval sources when speaking about the Red Sea.

Apart from the Red Sea, there is some information about a few boatbuilding sites in Lower and Middle Egypt where Mediterranean timbers must have been used along with local species, at: al-Rawḍa, 'Egypt's shipyard', Damietta, Alexandria, and Arwa. Damietta still functioned as a naval yard from its foundation until the 7th/13th century. Alexandria at that time was an important starting place for raids (Fahmy 1966: 28). As such, the Ayyūbid sultan Ṣalāḥ al-Dīn (r. 569-570/1174–588-589/1193) and the commander of his fleet al-Ḥājib Ḥusām al-Dīn LuᵓLuᵓ used a shipyard in Alexandria to build warships to confront Reynaud of Châtillon (r. 547-548/1153-554-555/1160) in the Red Sea in the 6th/12th century (Abū Shāma 1962: 289-290; al-Maqrīzī 1956: I.1.78-79). The yard was still in use in the 8th/14th century, when governor Yalbughā used it to build a fleet following the invasion of Alexandria in 767/1365 by Crusaders led by Peter

I of Cyprus (r. 1358-1369) (al-Nuwayrī al-Iskandarānī [fl.8th/14th century] 1969: II.208, 1970: III.231-233; Ibn Taghrībirdī 1963-1971: XI.35). Meanwhile, the only textual evidence attesting to the presence of a naval shipyard on the island of Arwa in Middle Egypt is provided by al-Maqrīzī (1970: III.1.129). He says that Yalbughā built a fleet there in the 8th/14th centuries to face the Crusaders. Al-Maqrīzī (1970: III.1.129) seems here to contradict al-Nuwayrī and Ibn Taghrībirdī, who located these boatbuilding activities in Alexandria. Perhaps both naval yards were used at the same time for the same event. Most of these boatyards have a military character. This is due to the fact that the middle medieval period witnessed political and economic changes in the Eastern Mediterranean and the Red Sea regions. There was general decline in international commerce from the 5th/11th century affected the trade in Indian goods (Goitein 1967: 148). When the Ayyūbids succeeded the Fāṭimīds in 567/1171, they were faced with a political and economic crisis with family rivalry and battles against the Crusaders (Arenson 1988: 247). This entailed a loss of control over the maritime commerce of the East (Arenson 1988: 247). Power (2012: 143) argues that as a consequence several Red Sea ports were abandoned between the mid-eleventh and mid-thirteen centuries. However, with the advent of the Mamlūk sultanate of Egypt (r.1250–1517) maritime activity flourished again. The Mamlūk caliphs established strong economic policies in the Red Sea and close trading partnerships with the Sultans of Delhi, and later on, the Bahmani Sultans of western India (r. 1347-1527) who controlled maritime trade on the other side of the Arabian Sea (Lewis 1973: 258-259). In addition to an increase in the importance of the pilgrimage routes to Mecca and Medina, these politico-socio-economic parameters increased the maritime traffic and trade in the Red Sea. The 7th/13th century witnessed a flowering of maritime activity along the Gujarati coast and in southern India where Arab and Persian trading communities were growing (McPherson 1993: 107, 109). This must have positively influenced the volume of the timber trade in the Red Sea and the wider Indian Ocean, even if our sources lack information on the subject.

Subsequent to investigating timber sources and exploitation in the Red Sea as well as points of import and boatbuilding during the middle medieval period, I will look at what the contemporary sources tells us about the situation in the Persian Gulf at that time. Sources indicate teak import to and through the Persian Gulf not particularly for boatbuilding. It was used in buildings on the island of Abadan[106] in the Persian Gulf (Nāṣir-i Khusraw 1986: 96), in Baghdad (Ibn al-Athīr 1987: VIII.302), and in a residence built by a sea-captain in Sohar (Ibn al-Mujāwir 2008: 280). Ibn Saᶜīd ([d.685/1286] 1970: 119) relates that teak was exported to Persia, Iraq and the rest of the Islamic world from valleys east of Qandabīl in Sind (modern Gandava in Baluchistan, Pakistan) where it grows. This is the first attestation of a source of teak other than India. It perhaps reflects new routes and exploitation areas of boatbuilding. However, Indian teak was still exported as well, according to al-Qazwīnī (1960: 128). Sources tells us also about several harbours through which Indian goods were transiting. Siraf as well as several sites on the coast of Fars were in decline while the Island of Qais (Kish) rose as an important warehouse for the Persian Gulf until its submission to the ruler of Hormuz in 626/1229 (Rougeulle 1996: 169; Agius 2008: 79-81). Subsequently, there was a commercial revival in the Persian Gulf in the 7th-8th/13th-14th centuries with the rise of prominent harbours such as Hormuz on the Iranian coast, and Zafar (modern Dhofar) and Qalhat in Oman (Rougeulle 1996: 174; Agius 2002: 181-184). From these harbours, goods of the India trade reached Middle Eastern markets (Rougeulle 1996: 170-171; Agius 2002: 181; Facey 2009: 170). Thus, these harbours most surely accommodated timber import from India for their local and regional use, as well as for re-exporting.

Finally, whilst sources tell us mostly about boatbuilding activity in the Red Sea in the middle medieval period, they do not mention such activities in the Persian Gulf. Perhaps the wood trade in this area was not substantial at this time in the Gulf, even though Lewis (1973: 241-242) argues that major coastal and open-sea routes in the Indian Ocean did not substantially change, nor did the products exchanged at the end of the 8th/14th and beginning of the 9th/15th century. McPherson (1993: 121-122) sums up the situation of trade as follows: "The commercial world of the Indian Ocean by the fourteenth and fifteenth centuries was more dynamic than ever, and it was worked by merchants and mariners from all the ports which stretched from the Mozambique coast

[106] The island of Abadan is located in the Abadan County, Khuzestan Province in southwestern Iran. It lies along the eastern bank of Shatt al-Arab river, 53 kilometres from the Persian Gulf, near the Iraqi-Iran border. It is bounded on the west by the Shatt al-Arab and on the east by the Bahmanshir, which is an outlet of the Karun River (Hoiberg 2010: 6).

to the Moluccas on the edge of the Pacific". Perhaps this also applies to the timber trade, but it is difficult to confirm this with the present state of data.

6.2.4 Late Medieval period (9th/15th century)

Literary sources from the late medieval period indicate that endemic species such as acacia, lebbeck, tamarisk, sycomore/Egyptian fig, and poplar were employed in Egypt for boatbuilding purposes, while imported species included teak and other tropical woods from India and Sudan, as well as pine and other species from the Mediterranean (see 12.3.3 Table 3). Textual sources from this period suggests that the boatbuilding industry was concentrated in the Red Sea at Tur, Aden, Jeddah, and in Lower Egypt at Alexandria and Bulaq. Surely other boatyards, perhaps more modest, existed at that time as well in the Red Sea, which we know nothing of due to gaps in the 9th/15th century Islamic literature.

Evidence for wood use in boatbuilding in the late medieval period comes from works by major historians of that time who, quite often, repeated statements made by their preceding fellow scholars. A prominent 'copier' was the Egyptian historian al-Maqrīzī, and he is the historian who mentions a great deal of information related to timber species used in boatbuilding. As an Egyptian, his statements apply mostly to local woods used in Egypt. He quotes Ibn Mammātī when detailing the exploitation of acacia wood in Egypt[107] (al-Maqrīzī 2002: I.298, 736); and the 9th century botanist Abu Ḥanīfa Dīnawarī (d. 282/ 895). when mentioning the use of lebbeck for hull planking (al-Maqrīzī 2002: I.555, 2004: IV.2.1039), just as early and middle medieval sources indicated before him (See Footnote 97, and sections 6.2.2 and 6.2.3). We cannot determine whether the practice of using lebbeck at the time of al-Maqrīzī due to the dwindling of the stands by the 5th century AD. Al-Maqrīzī (2002: II.130) also mentions tamarisk (Ar. *athl*, *Tamarix aphylla*; Provençal 2010: 96) (Figure 12.48) as an endemic wood along with acacia as woods that are suitable for shipbuilding. He is the first Muslim author who mentions tamarisk. However, tamarisk was used in boatbuilding since antiquity and recorded archaeologically as Pharaonic planks at Lisht and Abydos (12.3.1 Table 1; Ward 2000: 19, 107, 110, 139; 2006: 125); in fastening elements in the

[107] Acacia wood was also used in on-land constructions in Egypt in the 15th century as we are informed by Ibn Taghrībirdī ([d. 815/1412]; 1963-1971: XI.213), and in Mecca following al-Maqrīzī (1942: II.2.362-363).

Dahshur boats (12.3.1 Table 1; Ward 2000: 84) and at Mersa Gawasis (Bard and Fattovich 2007: 185, Table 12); as brail rings from Myos Hormos (12.3.4 Table 4; Gale & Van der Veen 2011: 221, 223, 225; Van der Veen *et al.* 2011: 206, 207 Table 5.1, 210, 223-224); and wood shavings analysed from Quseir al-Qadim (12.3.4 Table 4; Van der Veen *et al.* 2011: 207, Table 5.1, 212). Al-Maqrīzī (1957: IV.2.688) also attests the use of local sycomore/Egyptian fig (Ar. *Jummayz,* Lat. *Ficus sycomorus* L.; Nehmé 2000: 120; Provençal 2010: 79) (Figure 12.28); and poplar (Ar. *Ḥawr*,[108] Lat. *Populus* spp.) for building *aghriba* warships (Ar. s. *ghurāb*; Agius 2008: 348-351) in the year 828/1425 under the sultanate of Al-Ashraf Sayf-ad-Dīn Barsbāy (r. 825-841/1422-1438), the 9th Burjī Mamlūk sultan of Egypt. Sycomore/Egyptian fig was previously described by al-Baghdādī (1998: 65) as a light wood, durable and resistant to water and sun: these characteristics explain its use in building war vessels, which needed to be swift and light in order to be easily manoeuvred during battle. The same practice is found in other Mediterranean warships in antiquity, with the use of light softwoods such fir and pine timbers (Meiggs 1982: 56, 338; Arenson 2007: 91).

When speaking of imported woods for boatbuilding, al-Maqrīzī (2002: I.551), copying Ibn Jubayr (1907: 70, 2008: 65), mentions the use of teak from India for the Red Sea *jalba*. Teak and other tropical woods might also have been brought from areas south of Egypt at that time. Al-Maqrīzī (2002: I.520, 522, 524) states an earlier account by the 10th century Egyptian diplomat Ibn Salīm al-Aswānī according to which: teak logs were floated in large smoothed beams down the Nile from an unknown location, to Old Dongola in Nubia where they were used as roof timbers in buildings (See Burckhardt 1819: 496). We can perhaps here speculate that if such logs made it to Upper Nubia then perhaps they could have also been floated down all the way to Egypt. As to their origin, Sudan cannot be a possibility since teak was first introduced there under British rule in 1920 (Gorashi 2001: 12). Thus, it was either imported to Sudan from India; or Ibn Salīm al-Aswānī confused the identification of a wood physically similar to teak.

India was not the only source of timber for export during the late medieval period, wood resources from the Mediterranean were also imported to Egypt. Even before the conquest of Egypt by the Ottomans (921-922/1516–922-923/1517), the latter, profiting from their monopoly over Anatolian and Levantine wood, traded with the Mamlūks in

[108] Not to be confused with *Indigofera tinctoria* L. which is a plant used for dying (black henna) and its vernacular name is from Yemen (Mabberley 2008: 430, Provençal 2010: 68).

exchange of Egyptian grain and other foodstuff (Brummett 1994: 144). In the 9th/15th century, Ibn Taghrībirdī (1963-1971: XI.29-30) reports that pine (Ar. *snūbar*, Lat. *Pinus* sp.), (Ar.) *qarū* (unidentified) and other wood species were felled in the mountains near Antioch for export to Egypt. The timbers were destined for the building of warships for the Baḥrī Mamlūk sultan al-Malik al-Ashraf Shaᶜbān (r. 764-778/1363-1377)[109] for his battle against the Crusaders in the year 767/1365. In the 10th/16th century, the Andalusian traveller Leo Africanus ([d. 959/1552] 1896: I.25) says that the Ottomans sustained a boatyard in Suez. He adds that the Ottomans had to fetch their timbers from the Caramania on the southern Anatolian coast, through both maritime and caravan routes. Indeed, under the Ottomans, Egypt's timber needs were essentially provided for from Anatolia, some areas in the Black Sea and the Levant (Mikhail 2011: 124, 146, 149-151). Mikhail (2011: 151) suggests that once at Alexandria, ships loaded with timber cargo had to sail east along the Mediterranean coast to reach the mouth of the Rasheed branch of the Nile. From there they would transfer their cargo to riverine boats called *al-jarīm* that would sail to Cairo. Once in Cairo, in its commercial centre at Bulaq, the wood load would be transported on camel's back and moved overland to Suez (Mikhail 2011: 151-155). Such operations were quite tedious as they necessitated multiple transfers which made timber exposed to damage, theft, and exposure. "The wood could have been dropped, lost, chipped, stolen, or damaged in any number of ways. This work was furthermore undertaken in late spring, and although it was not yet the peak of summer, the desert between Bulaq and Suez was surely not a hospitable place at that time of year. And, of course, the transport involved great financial expense: the price of ships and sailors, customs, camels and camel drivers, food for sailors, and so on" (Mikhail 2011: 154).

The boatyards of the 10th/16th century probably witnessed a continuous naval activity at Alexandria with the advent of the Ottoman Turks in Egypt: Alexandria is described by the modern historian al-Jabartī ([d.1240/1826] n.d.: II.313, III.363-364, 1994: III.133, IV.212-213)[110] as a site where boatbuilding and repair work would take place. From what al-Jabartī describes, it could be inferred that boatbuilding was flourishing in

[109] http://www.brillonline.nl/subscriber/uid=1963/entry?result_number=3&entry=islam_SIM-6718&search_text=shaban+II&refine_editions=islam_islam#hit [Accessed 22nd May 2011].

[110] Although a later source al-Jabarti is mentioned here for the crucial information he provides about boatbuilding activities in Egypt.

Alexandria under Ottoman rule mainly due to the import of various timbers from "the lands of the Rūm"[111] (al-Jabartī III.363-364, IV.212-213). Bulaq, located on the Nile near Cairo, had also a boatyard at that time. al- Jabartī erroneously dates its foundation to the 13th/19th century by the Wāli Muḥammad ᶜAli for the construction of river boats and warships (al-Jabartī n.d.: III.363-364, 1994: IV.212-213). Indeed, we are informed of its foundation much earlier in the 9th/15th century by al-Maqrīzī (1972: IV.2.686). Here two scenarios are possible: either the Bulaq boatyard fell in disuse in these four centuries between the times of al-Maqrīzī and al-Jabartī; or al-Jabartī indicates the foundation of a different boatyard at Bulaq. The latter author states that: "The naval arsenal at Bulaq held large quantities of wood and other material for shipbuilding. When any wood imported from Turkey and Syria arrived, a small amount was consigned at a high price to wood merchants, and the rest was delivered to the shipyard. All commerce in imported wood, including firewood was handled by the Pasha except for the small amount he consigned to merchants" (al-Jabartī n.d.: 526-527, 1994: IV.361). This testimony by al-Jabartī shows that the government owned the shipyard, and separately had some kind of monopoly over imported wood from the Mediterranean.

In the 9th/15th century there was an increasing demand from Renaissance Europe from luxury goods from India, which transited mainly through the Red Sea port of Aydhab. The trade routes were controlled by the Circassian Mamlūks in Cairo and their Venetian allies in the Mediterranean (Facey 2009: 170; Abulafia 2011: 379). Tur and Aden were also important economic centres in the late medieval period (Arenson 1988: 247; Agius 2008: 98). By 905-906/1500, Jeddah had regained its economic and strategic importance, especially amid the rivalry between the Mamlūks and the newly arrived Portuguese, who entered the Indian Ocean trade scene in 903-904/1498 (Facey 2009: 170).

6.2.5 Final discussion

Direct information on the types of wood used in boatbuilding in the western Indian Ocean in the Classical and medieval Islamic periods is quite scarce. In short, it is clear that numerous endemic species, along with imported ones, were employed for boatbuilding purposes, despite the reputation of the Red Sea and Persian Gulf regions

[111] Turkey (Philipp and Perlmann 1994: 212).

that both are denuded of trees (see 12.3.2 Table 2 and 12.3.3 Table 3). These species include acacia, fig, palm, lebbeck, tamarisk, sidr and poplar. Acacia appears as the principal wood, with extensive exploitation in the classical Islamic period and the late medieval period. The use of lebbeck spans from the early medieval period perhaps to the late medieval period. Other species were less commonly exploited, or perhaps only perfunctorily mentioned, such as palm, tamarisk, sidr and poplar. The exploitation of these local species must have represented a certain economic gain for the Red Sea and the Persian Gulf areas since they were most probably cheaper to acquire.

Textual sources for imported woods used for boatbuilding in the Red Sea and Persian Gulf areas are very diverse during the classical and medieval Islamic periods encompassing origins from India, South Asia, East Africa and the Mediterranean basin. Imported timber was shipped in the state of raw logs that were either loaded onto ships or towed in rafts behind them. In terms of imported species, references to teak are predominant in both the Classical and Medieval Islamic periods. It is no surprise that most contemporary studies on boatbuilding practices in the western Indian Ocean speak of teak exports from India for boatbuilding in the Red Sea and Persian Gulf (Lewis 1973: 247-250; Arenson 1988: 248; Hourani 1995: 89-91, 100; Gopal 1999: 88; Chakravarti 2002: 47; Ray 2003: 17; Agius 2008). Other species include juniper, fir, and pine, which were mainly used for producing long hull planks. They also indicate that regions of the Red Sea and Gulf could access wood resources through maritime commerce during the classical and medieval Islamic periods. However, sources do not tell us if such a trade was sustained throughout these periods. It is also quite challenging to determine the greater percentage of timber species used between the imported types and the local ones. The importance here would be to stress on the availability and use of local timbers in order to counter the mainstream modern narratives, which rather focus on imported timber.

Information about boatbuilding sites from the literature provides us with insights as to the location of some of the boatbuilding activities in the Islamic period in the Red Sea and the Persian Gulf regions. Indeed, the available literary evidence creates a somehow distorted image by not providing information of all actual boatyards that might have existed in these regions. Medieval Islamic sources provide most information about boatbuilding yards in Egypt. These were located in Lower Egypt, for example al-Rawḍa, 'Egypt's Shipyard', Bulaq, and Damietta; at Arwa in Middle Egypt; at

Alexandria on the Mediterranean coast; and at al-Qulzum and al-Tur on the Red Sea coast. Other Red Sea locations also witnessed boatbuilding and boat repairing activities such as the Hijaz area and Aden in Yemen. In the Persian Gulf, the sources tell us that boatbuilding practices were situated on the banks of the Tigris, and at Basra. They fail to mention other Gulf potential boatyards such as Sur, Qalhat, Balid, Shihr, etc.

Medieval Islamic literature provides us a feel for the duration of boatbuilding activities at these sites. In a few locations, there is a sense of an on-going industry lasting over several centuries. For example: the boatyard at al-Rawḍa was active from at least the $2^{nd}/8^{th}$ century and continued for six centuries throughout, until at least the $9^{th}/15^{th}$ century. The same applies to 'Egypt's shipyard' and Alexandria. While other boatyards get a one-off mention, and appear as occasional yards such as Bulaq, Arwa, Qulzum, Tur and the Hijaz area. Thus, medieval Islamic texts indicate a seemingly important concentration of boatbuilding activities in the Nile Delta and on the Egyptian Mediterranean coast. Meanwhile, they fail to mention areas in the Red Sea which almost certainly sustained some boatbuilding activity, at least for the needs of local fishing communities. This apparent boatyard concentration might be explained by the fact that, during the medieval period, Egyptian ruling dynasties were based in Cairo, at the proximity of the shipyards. It was probably necessary for boatyards to be close to the Mediterranean Sea since Egyptian Islamic dynasties were in constant confrontation with their Mediterranean-based Byzantine, and later on Crusader rivals. Indeed, the Islamic historical encyclopaedias provide detailed accounts of the naval preparations of Egyptian Muslim forces in their sea battles against their Mediterranean counterparts, where they would organize their arsenal and fit their warships. This hypothetical centralisation of shipyards in Lower Egypt during the Medieval period is also stressed by the fact that Egyptian ships destined for the Red Sea were built at sites such as Cairo, Bulaq and Alexandria. They were subsequently dismantled and carried on camelback to Red Sea harbours. This practice was also attested in the Pharaonic period.

Reasons for the existence of boatyards, as per the medieval Islamic sources, were not solely political but also economic, since several boatyards were located in harbour towns that acted as import centres for timber destined for boatbuilding, such as at Tur and Aden. Indeed, as Agius (2008: 143) states, the suitability of establishing a boatyard also depends on available material at hand, with timber obtained from India, East Africa and the Mediterranean for long planks, and local woods for structural components and joints. Pearson (2003: 104) argues that "there certainly seems to be some connection between flourishing trade and stable empires, albeit one hard to quantify [...] a strong, stable empire obviously has advantages for economic activity in general , including sea trade... the decline of empires was detrimental to trade". In trying to apply this logic to the available data on wood trade and nautical timber use, it seems that most of the wood shipped was commanded by rulers for their warships. The need for warships indicates a rather unstable political situation in the Red Sea. Thus, one wonders whether the wood trade, on the contrary of mainstream trade, was stimulated by periods of war and not peace.

Indeed, textual data points to boatyards hosting naval construction, rather than for commercial or fishing purposes. It aims at documenting nautical activities of the elite rather than the masses at most, if not all, the boatyards mentioned in this chapter. However, boatyards or commercial and fishing needs must have existed at the time to answer the needs of the peoples living in the Red sea coastal regions.

Meanwhile it seems that wood was subjected to governmental monopoly, and most of the best quality timber supplies kept first for shipbuilding. This is most probably due to the fact that most of the medieval Islamic authors were documenting large scale operations or historical and political facts rather than being interested in more common or modest trends of boat construction by fishermen, merchants, and mariners. These were probably regarded as less compelling events. Since these authors do not reference local scale building and timber supply, it is very hard to estimate the development of private businesses in relation to the economic demand at the period; and how to determine the shares of the market owned by the ruling elite and those of private entrepreneurs. These latter did exist in the western Indian Ocean and operated in the shadows of governmental monopoly (Margariti 2007: 145-150).

The subsequent section will deal with archaeological evidence for the use of wood in boatbuilding in the western Indian Ocean from classical antiquity through to the late medieval period.

7 Archaeological evidence for nautical wood in the Red Sea and the western Indian Ocean

It is commonly believed that the Red Sea region lacked suitable timber sources for building large seagoing vessels, and therefore these areas relied on imported logs of substantial size (Ward 2000: 15-24; McGrail 2001: 16; Blue 2009: 8-9). However, a closer look at the archaeological evidence from sites adjacent to the Red Sea — and from further afield in the Indian Ocean — sheds light on the importance and the exploitation of local arboreal resources (see 12.3.4 Table 4).

The aim here is to assess and analyse the extent to which archaeological data can inform us about past practices of nautical wood use, and what it can tell us about boat narratives, wood exploitation processes, timber trade, boatbuilding sites, and social networks interwoven in such practices. Indeed, little is known of the lives of people exploiting arboreal resources for boatbuilding, their perception of such resources, their relationship to the landscape, and their enskilment, craftsmanship and apprenticeship.

No wooden shipwrecks from the Greek period have been excavated so far in the Red Sea, thus archaeological evidence from Egypt's Mediterranean coast and the Nile is the only source for nautical wood for the period. I have looked at a 5th century BC river boat from Matariya in Lower Egypt and 6th-2nd century BC shipwrecks from Heracleion-Thonis (Figure 7.1). As for later periods in the Red Sea, archaeological evidence consists of nautical wood from two sites on Egypt's Red Sea coast: the port of Quseir, known as Myos Hormos in the Roman period and Quseir al-Qadim in the medieval Islamic period,[112] and the Roman port of Berenike (Figure 7.1). Finally, although falling outside the Red Sea region, the sites of al-Balid in Oman (Figure 7.1), and the Belitung shipwreck in Indonesia (Figure 7.2) are considered because they contribute to expanding our quite limited general knowledge about nautical wood in the medieval Islamic period of the wider Indian Ocean. Al-Balid lies on the Arabian Sea coast of Oman, where recycled hull planks were reused as construction material in

[112] Since these two names apply for the same site at two different periods, and for the sake of clarity, I will refer to Myos Hormos for the Roman period, and Quseir al-Qadim for the medieval Islamic period. When both periods are concerned I will be mentioning the site under the name of Myos Hormos/Quseir al-Qadim.

buildings in the Islamic citadel dating from the 10th-15th centuries AD (Belfioretti & Vosmer 2010). The 9th century AD wooden Indian or Arabian/Persian vessel that wrecked in Belitung, Indonesia, is the only shipwreck discovered from that period (Flecker 2000, 2008).

Figure 7.1: Map of some of the archaeological sites mentioned in the text (Modified from Google Earth [Accessed on 5th July 205]).

Figure 7.2: Map showing the location of the Belitung Island, South-East Asia (Modified from Google Earth [Accessed on 5th July 205]).

This chapter is divided broadly in three parts. The first part (Section 7.1) introduces the historical and geographical context of the above-mentioned sites, along with information on the excavations and wood sampling studies. Section 7.2 presents a list of tree species identified in the archaeological record of these sites arranged in alphabetical order by species so they can be easily cross-referenced with species from ethnographic data (See Chapter 8). For a deeper understanding of the historical and geographical contexts of each species, the associated reference in primary sources, if any, is re-appraised here, along with the species' botanical distribution, in order to identify the provenance of nautical timbers. The botanical information associated with each tree species follows the common methodological approach adopted by major works pertaining to the analysis of archaeological wooden artefacts (See Lucas 1989; Gale & Cutler 2000; Gale et al. 2000; Van der Veen 2011). Section 7.2 also draws upon nautical wood evidence from Pharaonic Egypt (see 12.3.1 Table 1 and Section 6.1) and from the 18th century Sadana and Sharm al-Sheikh wrecks (Figure 7.1), for a wider historical context testifying to the use of both local and imported species. Comparative material on the use of wood in boatbuilding in the eastern Mediterranean is also considered, since the same species found in archaeological contexts of the Red Sea were also used in the eastern Mediterranean, and most probably belonged to boats built in Lower Egypt. The related non-maritime uses, if any, of each species is also considered in order to provide an in-depth comprehension of the utilitarian aspects of its exploitation as wood material since antiquity. Section 7.3 explains how wooden boat-related material from archaeological contexts informs this research. This discussion also relies on investigating technical issues of analysing archaeological wood samples, their implication in conferring an identity or provenance to the boat they constitute, and what they can tell us about boat narratives and timber exploitation patterns. Also, Mediterranean timbers, such as cedar, were used in boatbuilding in Egypt, mainly on the Mediterranean coast and the Nile Valley, especially at Coptos (Blue 2009: 8-9; Fabre 2004: 82-83). Boats were built there, then dismantled and carried over land to the Red Sea coast where they were rebuilt and launched (Fauconnier 2012: 80). Alternatively, boats would sail from the Mediterranean coast of Egypt and/or the Nile Valley to the Red Sea, through canals that were active at different periods from at least the Ptolemaic period in the 3rd century BC (Cooper 2009; Fauconnier 2012: 81-82). I will also explore further ways through which Mediterranean timbers made it to boatbuilding sites on the Red Sea (see Section 7.3.2). As Adams (2001: 303) argues, availability of materials necessarily influences the construction of vessels. He rightly adds that environment, cultural attitudes and preferences, and technological abilities influence the choice of materials.

7.1 Historical and geographical contexts

The relevant archaeological evidence pertaining to the use of wood in boatbuilding from the classical antiquity and medieval Islamic period is geographically distributed between Egypt, Oman, and Indonesia. Thus, reaching an all-encompassing and conclusive interpretation for the use of nautical wood in the past in the whole of the Red Sea or the western Indian Ocean becomes quite challenging.

Evidence from Egypt includes: the site of Matariya, Cairo; the site of Heracleion-Thonis in the Bay of Abukir; and the port sites of Myos Hormos/Quseir al-Qadim and Berenike.

A Late Period (664 BC-323 BC) vessel, constructed with the shell-first technique, was discovered in 1987, in the Cairo suburb of Matariya in Egypt, during excavations for utility construction (Ward 2000: 129-135) (Figure 7.3). Almost one-third of the boat was destroyed during the process, while the rest was excavated, salvaged and preserved by the members of the Egyptian Antiquities Organization and the conservation department of the Egyptian Museum. It consisted of a 11-metre-long hull fastened with mortise-and-tenon joints, some of which were locked with pegs (Ward 2000: 129, 131; 2004: 14). The identification of wood samples taken from the wreck were published by Ward (2000), who obtained those results from Dr. Shawki Nakhla, the now-retired chief conservator of the Supreme Council of Antiquities (SCA). It seems that the conservation was unsuccessful and remains deteriorated,[113] and no further related publications were produced.

[113] Dr. Emad Khalil personal communication by email on 24th April 2010.

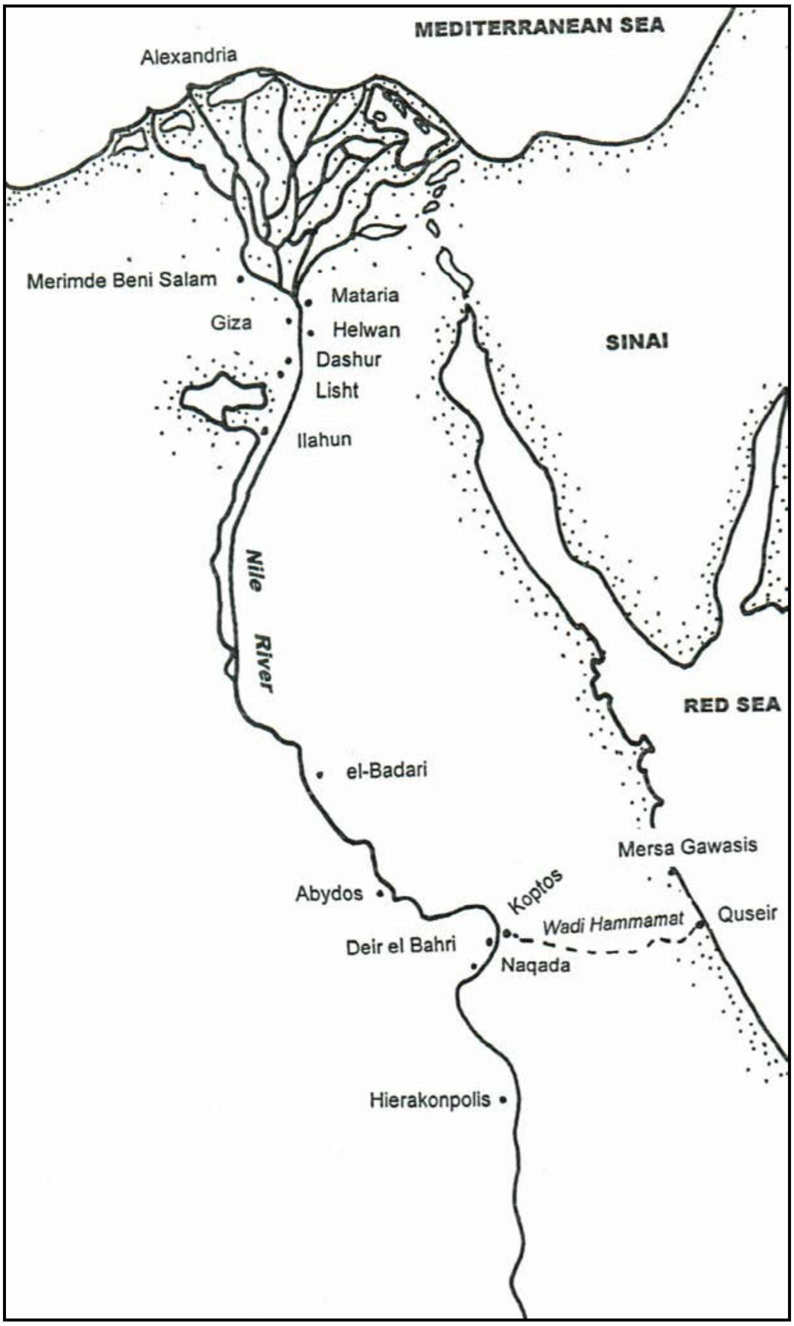

Figure 7.3: Map of ancient Egypt showing the location of Matariya (Ward 2000: 145, Appendix I).

Evidence ranging from the Late Period to the early Ptolemaic period in Egypt consist of over 60 shipwrecks that have been identified at Heracleion-Thonis, and date from the 6^{th} to the 2^{nd} centuries BC (Fabre 2011; Belov 2013) (Figure 7.1, Figure 7.4, Figure 7.5). Topographical surveys and soundings in the Bay of Abukir since 1996, by the Institut Européen d'Archéologie Sous-Marine (IEASM), under the direction of Franck Goddio, have revealed the now submerged ancient port-city of Heracleion-Thonis.

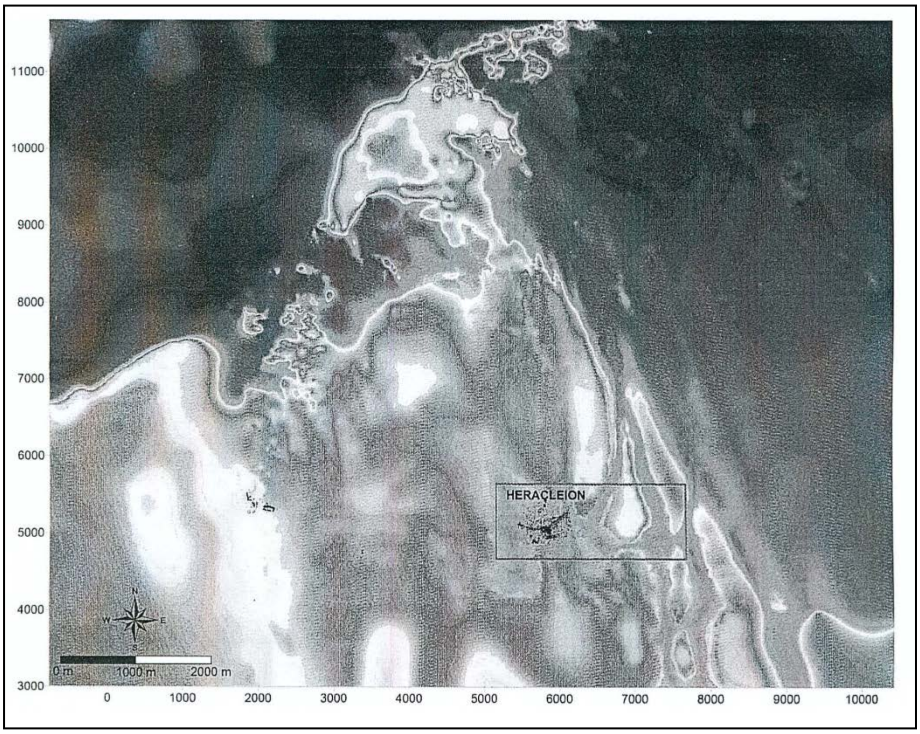

Figure 7.4: The location of Heracleion-Thonis in the submerged Canopic Region (© IEASM in Fabre 2011: 14, Figure 1.1).

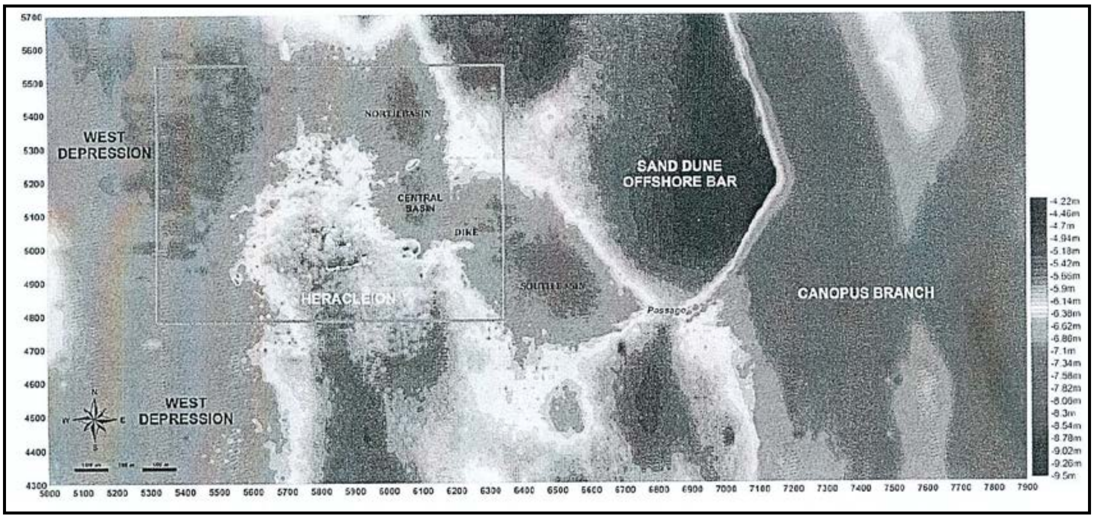

Figure 7.5: The town of Heracleion-Thonis, situated between port basins to the east and a lake to the west. Sand dunes separated it from the mouth of the Nile's Canopic channel (© IEASM in Fabre 2011: 14, Figure 1.2).

The site covers an area of 1,000 by 1,200 metres and comprises a peninsula that was separated from the Nile by the 'Southern Basin' and a narrow passage between the sand dunes. The central part of the city is located on this peninsula, which is surrounded by features identified as the 'Central Basin', 'North Basin' and 'Western Lake'. The 'Central Basin' and the 'Western Lake' are connected across the peninsula by a large canal. Several remains of quays have also been discovered (Fabre & Belov 2011: 107). The hulls are located in the 'Central Basin' and in the 'Grand Canal' (Fabre & Belov 2011: 109) and seem to be well-adapted to several watery environments, being sea-worthy as well as able to ply interior waterways such as rivers and lakes (Fabre 2011: 28). Fabre & Belov (2011) took wood samples from a few hulls to determine the wood types used for the different boat components, and the potential origin of these species. However, since Fabre & Belov's research was at its initial stage, they explained the shortcomings of their wood sampling methodology: "As the quantity of material is overwhelming, it was not possible [...] to collect more than a few samples from each shipwreck, and thus dates and especially paleobotanic studies, are still subject to change" (Fabre & Belov 2011: 108). Also, Fabre (2011: 17) adds that: "The samples were taken as part of a preliminary investigation of the vessels and were consequently limited in number; multiple samples were not taken from every architectural element of every ship. The majority of the samples were taken from planking, while a few were also taken from tenons. Consequently, it is possible that the results [...] may be skewed by the issue of different kinds of wood being used for different constructional purposes".

For the Roman period, evidence for nautical wood comes from Myos Hormos and Berenike; whereas, evidence for the medieval Islamic period consists of recycled wooden hull remains from Quseir al-Qadim.

The port site of Myos Hormos/Quseir al-Qadim is situated 8 km north of the modern town of Quseir, and about 500km south of Suez on the Red Sea coast of Egypt (Peacock and Blue 2006: 1). It lies at the eastern end of the Wadi Hammamat which connects the Nile Valley with the Red Sea (Figure 7.6). Thus, it occupies a strategic location deriving from its connection to both the Indian Ocean across the Red Sea, and to the Mediterranean through the Nile. Excavations by the Oriental Institute of the University of Chicago (1978-1982) and the University of Southampton (1999–2003) (Figure 7.7) revealed two major phases of occupation: the Roman period (late 1st century BC-beginning of the 3rd century AD) and the medieval Islamic period (the late 12th to early 16th centuries AD) (Bagnall 2001: 236; Blue 2006: 277; Whitewright 2007: 282-283).

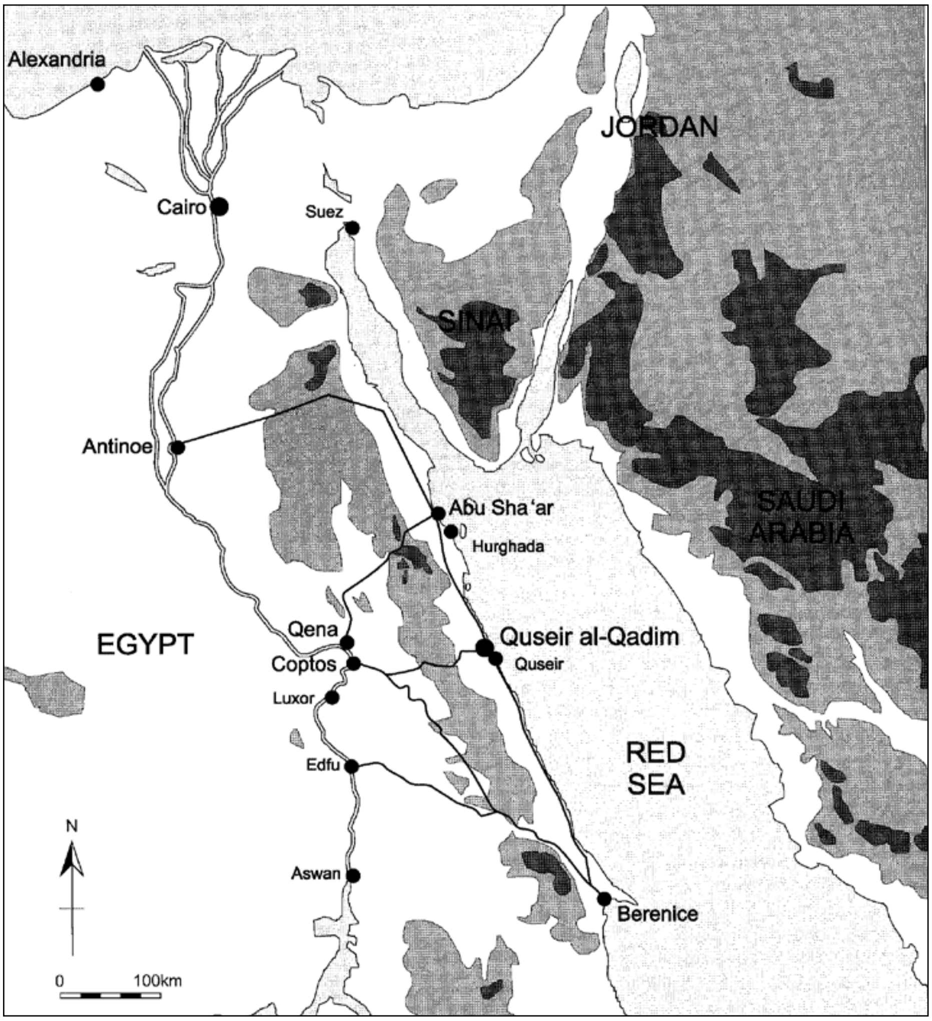

Figure 7.6: The location of Quseir al-Qadim and Berenike (Blue 2006: 278, Figure 45.1).

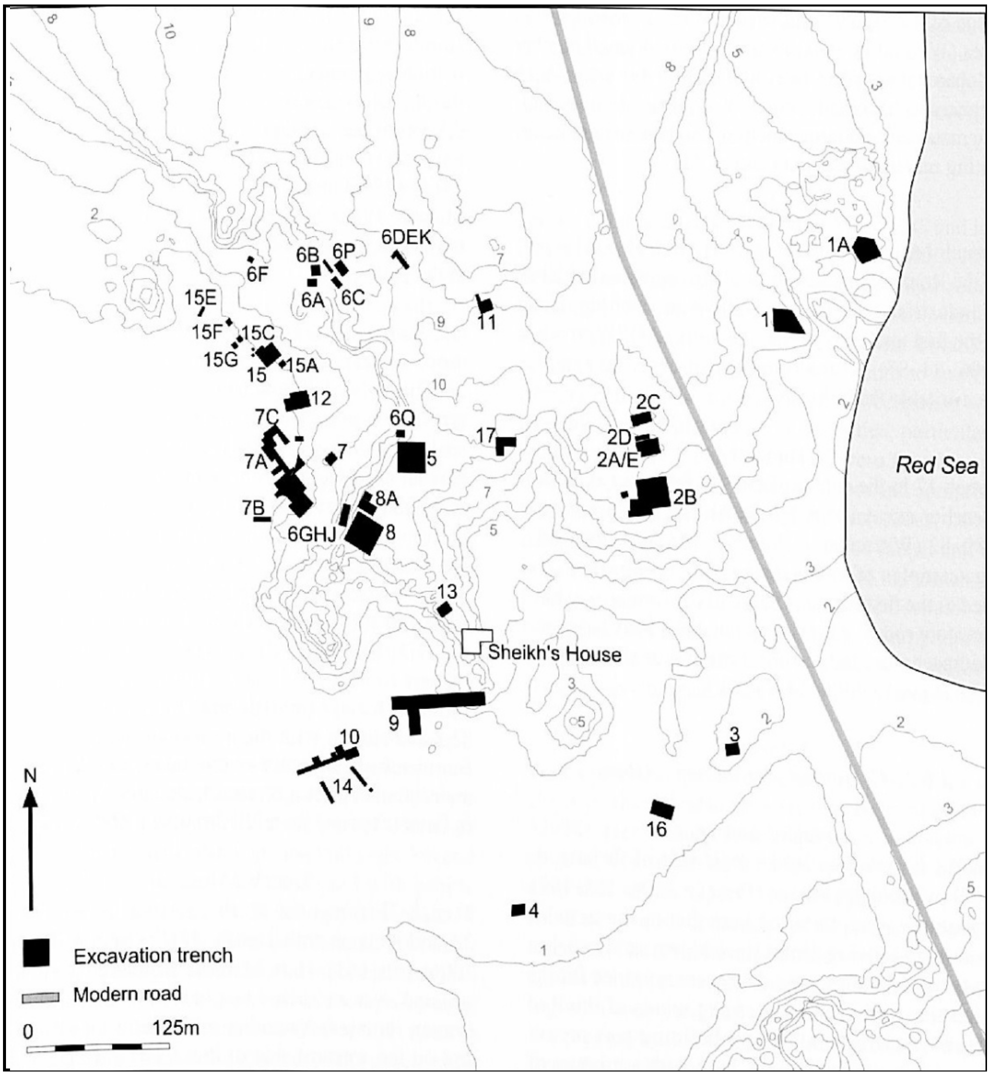

Figure 7.7: Location of excavation trenches by the University of Southampton between 1999-2003. The medieval ship finds are located in trench 1A (Peacock & Blue 2011: 4, Figure 1.3; Van der Veen 2011: 33, Figure 1.14).

Myos Hormos is mentioned by several ancient authors such as Strabo (II.5.12, XVII.1.45) and the Periplus (Chapters 1 and 19). It was a major trading centre during the Roman period, for trade between the Mediterranean, the Red Sea and the Indian Ocean (Whitewright 2007: 283). An ostrakon from Krokodilô (K315) in the Eastern Desert, on the road between Coptos (modern Quft) on the Nile and Myos Hormos, records a wagon transport of timber for shipbuilding to Myos Hormos (Bülow-Jacobsen 1998: 66; Wild & Wild 2001: 218; Cohen 2006: 333). This written evidence adds to the maritime material culture discovered on site and indicates that Myos Hormos was either a boatbuilding/assembly site or a transit place involved in the timber trade between Egypt, the Red Sea and the western Indian Ocean. During the medieval Islamic period, not only did Quseir al-Qadim play a role in the Indian Ocean trade but also in the hajj of pilgrims on their way to the holy cities of Mecca and Medina in the south-western Arabian Peninsula.

Wood samples from the maritime artefacts discovered at Myos Hormos/Quseir al-Qadim have been analysed in order to determine their species (Gale & Van der Veen 2011; Van der Veen 2011: 206-210). These artefacts can be divided into three main groups: Roman period rigging artefacts; Islamic period ship timbers; and some pegs and wood shavings from both periods, possibly linked to nautical activities. The rigging material essentially comprised 169 brail-rings (51 made of wood), a deadeye, and seven sheaves from rigging-blocks, all dating from the late 1st century BC to the mid- 3rd century AD (Whitewright 2007; Gale & Van der Veen 2011: 189-197; Van der Veen et al. 2011: 206-211). More specifically the deadeye dates to the to the mid-to-late 2nd century BC (Blue et al. 2011: 189). The sheaves all date to the latter half of the 2nd century AD with the exception of one (W0198) which is Early Roman in date (Blue et al. 2011: 190). In the medieval Islamic period, evidence of boat-related timber include recycled wood hull planks that covered the late 12th- early 15th centuries tombs of a necropolis (Burial 61) in the eastern part of Quseir al-Qadim (Figure 7.8). One of the timber planks, made of an exotic wood covering Tomb 1 gave a radiocarbon date of 913 ± 45 BP (cal AD 1030- 12 10) (Van der Veen 2011: 30).

Figure 7.8: Timber planks sealing Tomb 1 at Quseir al-Qadim (Blue et al. 2011: 183, Figure 15.3).

Further south from Quseir, lies Berenike on the Red Sea coast of Egypt, about 825 km south of Suez and 260km east of Aswan in the lee of the Ras Banas Peninsula (Sidebotham & Wendrich 1998: 85; 2007: 1; Wild & Wild 2001: 211) (Figure 7.6, Figure 7.9, Figure 7.10). From 1994 to 2001, eight joint excavation and survey seasons were carried out by the University of Delaware, Leiden University and University of California (UCLA) at and around this Ptolemaic-Roman port. These revealed a period of occupation from the 3rd century BC until the 6th century AD with the existence of an early Ptolemaic settlement and more substantial Roman ruins (Sidebotham & Wendrich 1998: 86-87; Wild & Wild 2001: 211; Sidebotham & Zych 2010: 8). The harbour area was investigated during the University of Delaware and the University of Warsaw 2008-2010 season through geophysical survey and excavation. It revealed a late Roman-era temple, rubbish dumps and industrial quarters as well as organic remains: a bollard and timbers from the hulls or superstructure elements of ships testifying to the maritime activities in the harbour quarter (Sidebotham & Zych 2010).

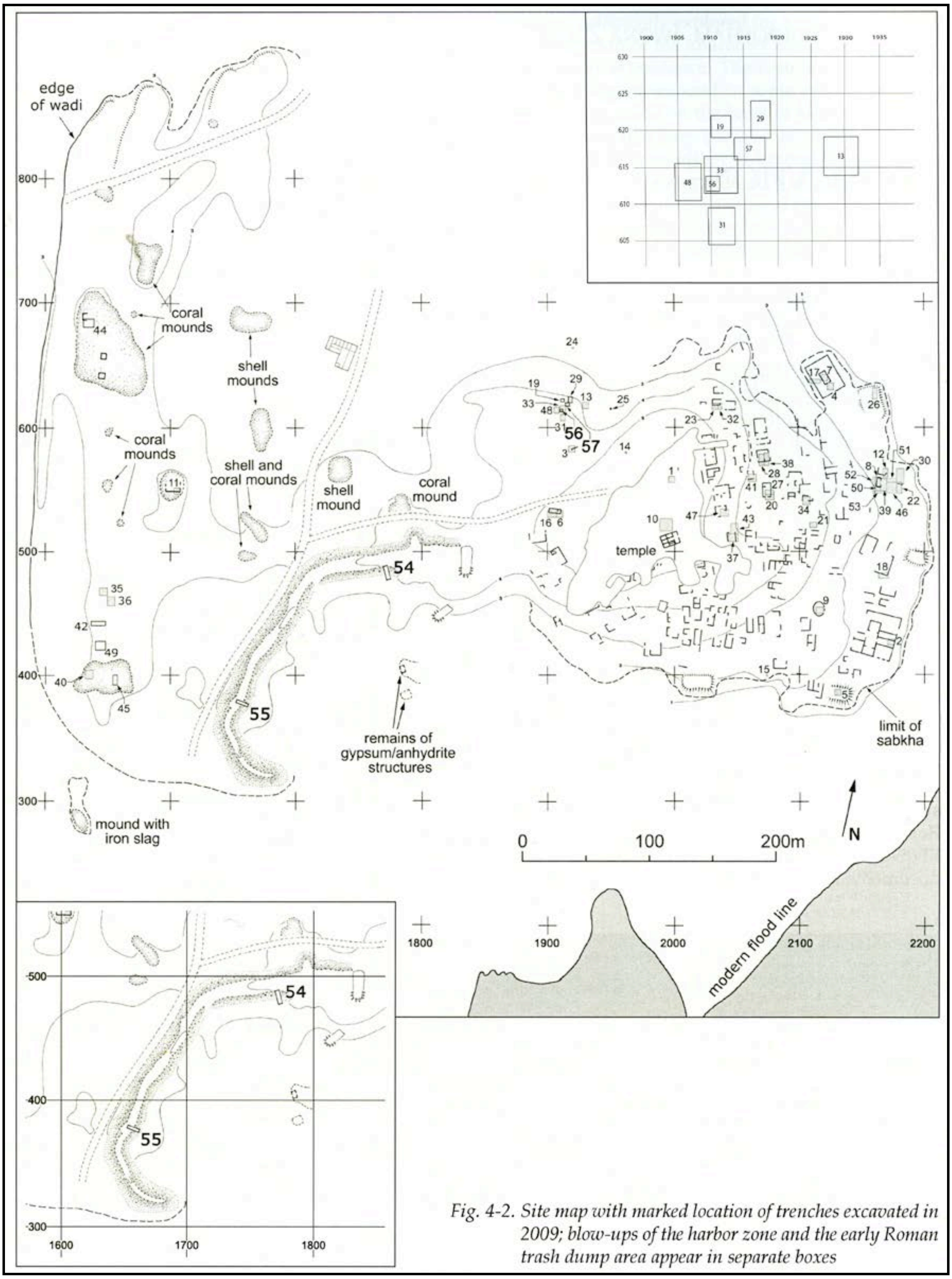

Figure 7.9: Berenike Site map. The Harbour area is in the lower left corner (Sidebotham & Zych 2011: 26, Figure 4.2).

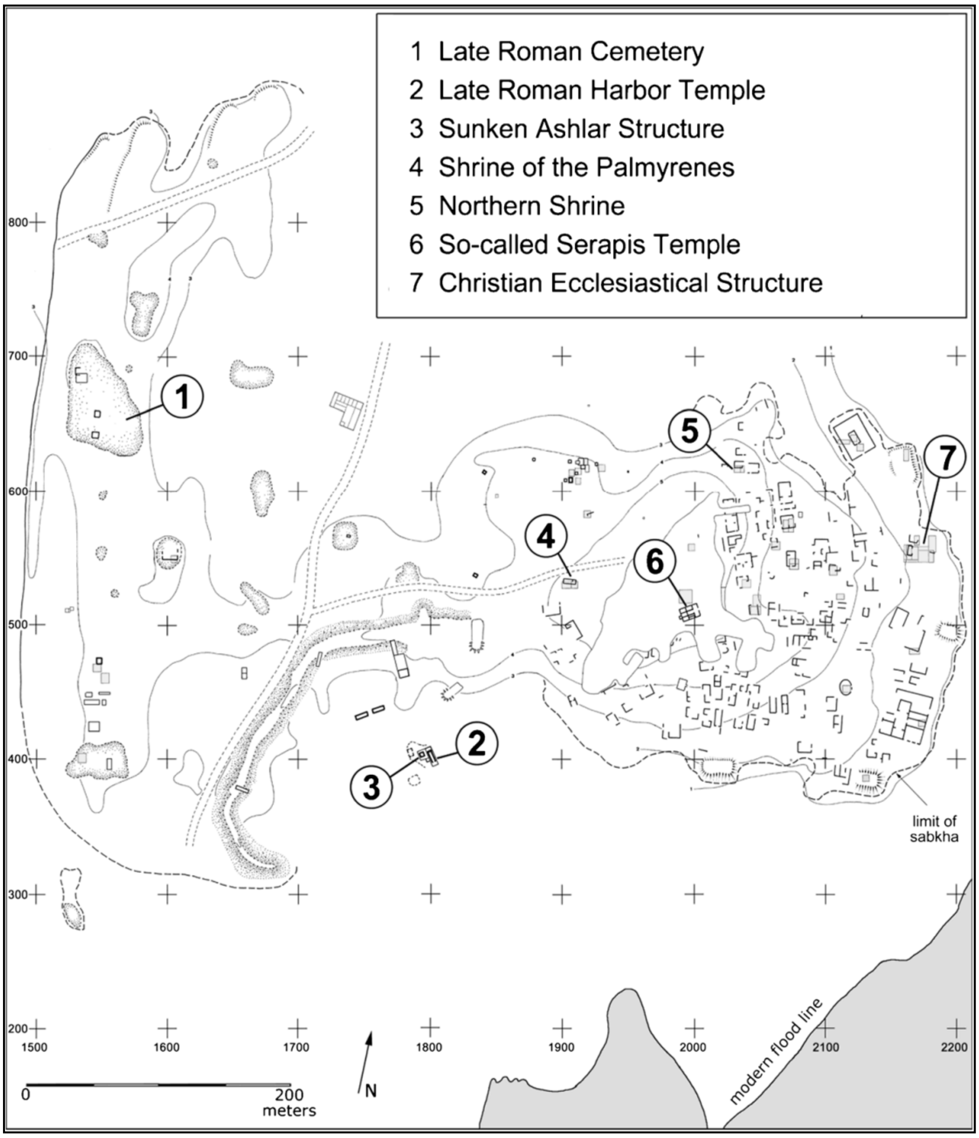

Figure 7.10: Plan of Berenike locating major religious structures where recycled timbers were found (Sidebotham 2014: 603, Figure 2)

Berenike is mentioned repeatedly in the classical sources: According to Pliny (VI.33.168), the town was founded around 275 BC by Ptolemy II Philadelphus (309 BC–246 BC). He also refers to its harbour (Pliny VI.26.103) (Sidebotham & Wendrich 1998: 86; Cappers 1998: 75; Wild & Wild 2001: 211). However, Strabo (XVII.1.45) reports that Berenike had no harbour. In fact, the harbour had been silted up by the 1st - 2nd centuries, and was transformed into trash dumps and industrial areas (Sidebotham & Zych 2010: 7). The Periplus (Chapters 16, 22, 29, 30) mentions Berenike several times as an important port of trade. The last ancient mention of the site, in the Martyrium Sancti Arethae, suggests that it was still a functioning port in the early 6th century (524-525 AD), contributing two ships to an Aksumite expedition to South Arabia against the Himiyarites (r.115 BC- 520 AD) (Acta Sanctorum Octobris X, VII (29)). Soon after this, the town must have been abandoned permanently (Wild & Wild 2001: 211). In total, 341 wood samples from the sites were studied by Vermeeren (1999: 316; 2000a: 2; 2000b: 311). These include brail rings, hull planks and beams. Among the planks, ship timbers from near the Serapis temple made with cedar were not dated, but the ones from the harbour area dated between the first to second century AD (Sidebotham & Zych 2010: 12).

Further east from the Red Sea, evidence from the 10th-15th centuries contexts at al-Balid, Oman also includes hull planks reused as construction material in buildings in the Islamic citadel of the site (Belfioretti & Vosmer 2010). The site, known to Islamic historians as Ẓafār/Dhofar, is located 100 metres from the Arabian Sea Coast on the south-eastern corner of the Salalah Plain in the Mahra area, Dhofar, South Oman (Zarins 2007) (Figure 7.1, Figure 7.12, Figure 7.11). The site extending along the coast over an area of 64ha was investigated in the 1952 by an American Foundation for the Study of Man expedition. Subsequent excavations in the1980s and 1990s are detailed by Zarins (2007: 311) who surveyed and directed excavations at al- Balid in 2005. The survey revealed around 55 mosques, as well as remains of a palace, houses, city walls, and nearby cemeteries. The main occupational phases at the site extended from 500 AD to 1700 AD, although there are also materials reported from the Bronze Age (2500-1200 BC) and the Iron Age (800 BC- 300 AD) (Zarins 2007).

Figure 7.11: The geomorphology of the Salalah Plain including al-Balid, al-Robat, Raysut and Khor Rori (Modified from Zarins 2007: 310, Figure 1).

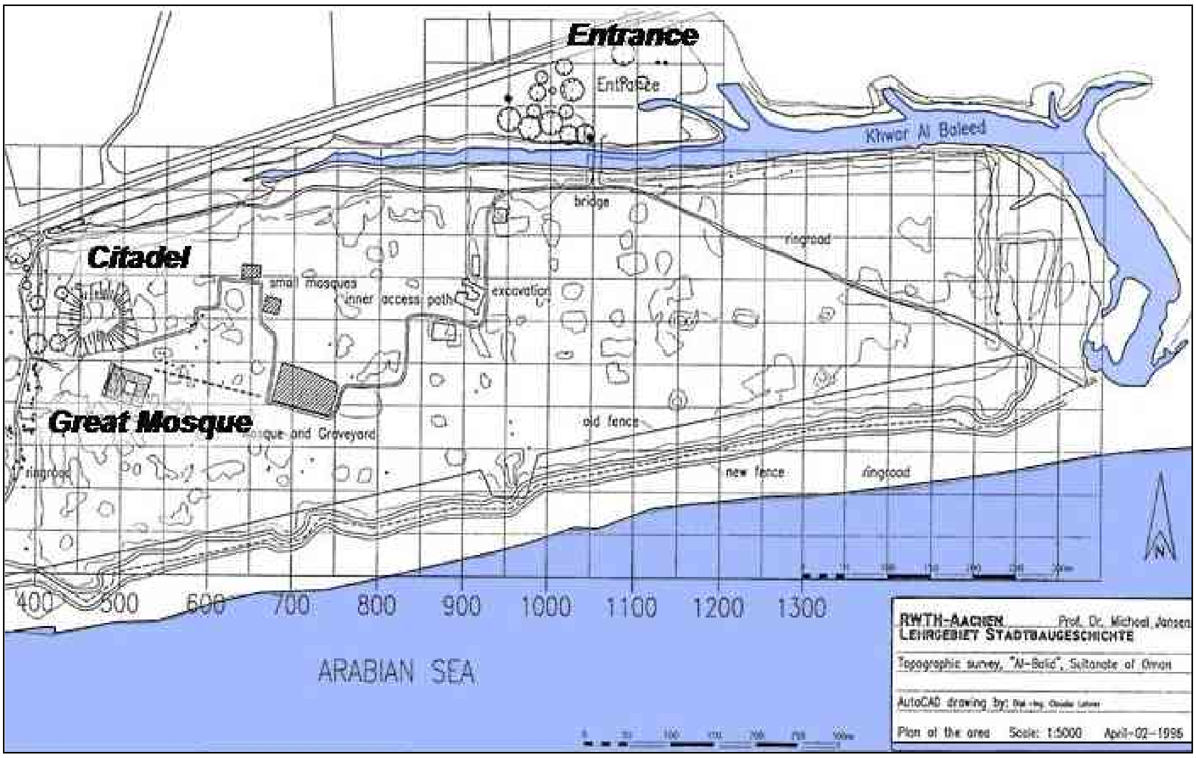

Figure 7.12: Al-Balid site map with main ruins (RWTH University of Aachen, Germany, Available at http://home.kpn.nl/janm_schreurs/AlBaleed.htm [Accessed on 5th July 205]).

Lastly, a ninth century AD shipwreck off the island of Belitung, lying at a depth of 17 metres in Indonesian waters between Sumatra and Borneo, is, thus far, the only piece of evidence for a wooden boat from the medieval Islamic period in the Indian Ocean (Figure 7.2, Figure 7.13). The site was firstly surveyed and excavated by Sea bed Explorations in 1998 before they employed an archaeologist to continue the work in 1999. The well-preserved hull has a 15.3 metre long keel, sewn planking over wadding both inboard and outboard, and stitched-in frames (Flecker 2000, 2001). A sample of the wooden chock that was located beneath the keelson was dated in the range cal. AD 710-890 (Flecker 2000: 210, 211;Flecker 2001: 344). Data from this wreck is included here since it is relevant in terms of wood identification and the vessel's sewn construction technique, both of which point to a western Indian Ocean vessel and more precisely to an Indian or an "Arab" vessel according to Flecker (2000, 2001). He explains that he uses the term "Arab" in his articles for both terms Arabian and Persian "for the sake of convenience" since "it is impossible to differentiate between ancient Arab [sic] and Persian ships based on historical evidence" although "Arabia and Persia must certainly be regarded as two distinct and independent trading nations" (Flecker 2000: 216, note 2). I will analyse this attributed identity in Section 7.3.3.2. A first set of wood sampling results was published by Flecker (2000, 2001). A later publication details a second set of results and their interpretation as to determining the origin of the ship (Flecker 2008).

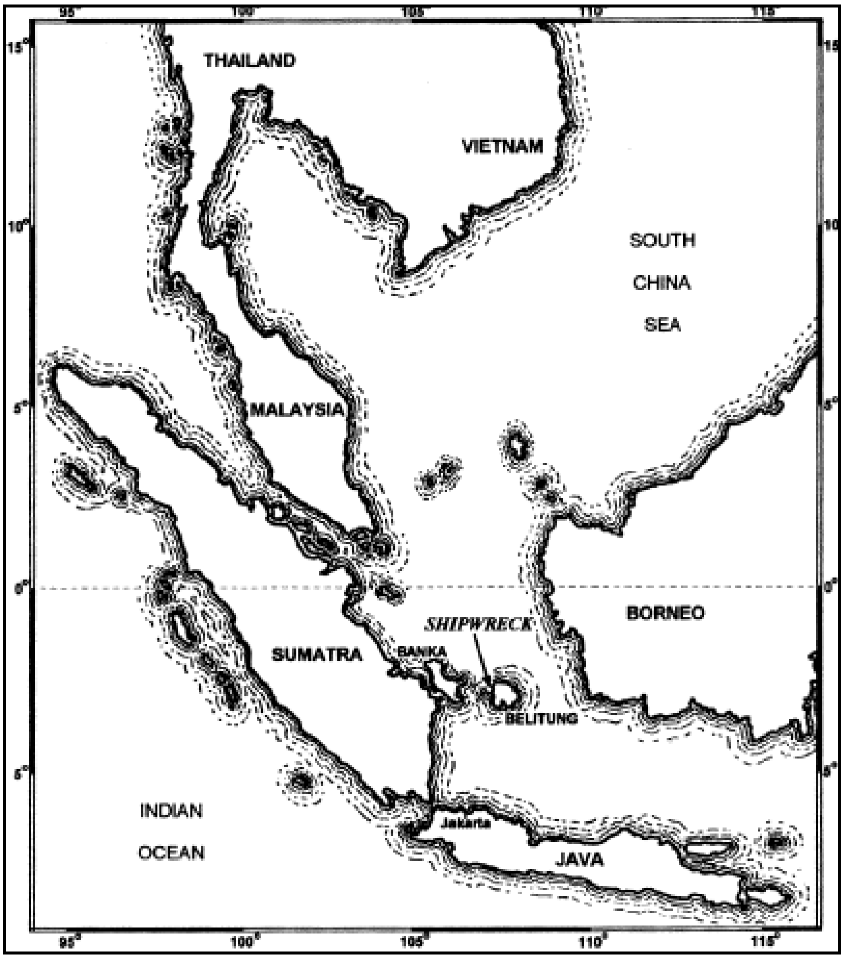

Figure 7.13: Location of the Belitung shipwreck (Flecker 2000: 200, Figure 1).

7.2 Trees species

Several tree species were identified in the sites presented above (see 12.3.4 Table 4). These are arranged in alphabetical order of the scientific name. Each entry includes finds of the classical and medieval periods at each site; information on the botanical classification; the native distribution; some physical properties of the wood; other nautical uses; general non-maritime uses; as well as related textual data if any for a comprehensive understanding of each species. I have omitted species of solely woodchips at Myos Hormos and Berenike, since these woodchips are only tentatively linked with boatbuilding practices. They will be included in the subsequent section when I discuss the archaeological material (Section 7.3.5).

7.2.1 Acacia Mill.

Evidence for the use of acacia in boatbuilding dates from classical antiquity, as well as from the medieval Islamic period. *Acacia* (Eng. Acacia) was used in structural elements of forty-three[114] out of sixty shipwrecks dating from the 6th to the 2nd centuries BC at Heracleion-Thonis. These were identified at genus level, as well as the more specific species of *Acacia tortilis* ((Forsk.) Hayne.) subsp. *raddiana* (Savi) (Fabre 2011: 17; Belov 2013). However, Belov and Fabre (2011: 109) do not say from which exact boat components they took the samples. Nile acacia (Lat. *Acacia nilotica* (L.) Delile) was identified at Quseir al-Qadim in Plank 1, one of the recycled hull planks covering Tomb 2, located south of Burial 61 in the medieval Islamic necropolis dated from the early 12th to the late 15th century (Gale & Van der Veen 2011: 223; Van der Veen 2011: 34; Van der Veen et al. 2011: 210). These planks denoted a recycled terrestrial context since they were previously nailed boat timbers (Blue 2006: 280; Blue et al. 2011: 182-184). Acacia was also identified as pegs and wood shavings at Myos Hormos/Quseir al-Qadim and Berenike (Vermeeren 2000a: Table 1; Van der Veen et al. 2011: 212).

The above-mentioned uses go back to the Pharaonic period, where acacia was used for tenons found at the Khufu pyramid, Lisht, Ayn Sukhna, and Mersa Gawasis; for hull planks at Lisht and deck planks at Mersa Gawasis; and in a steering oar at Mersa Gawasis. Also, acacia's use for boatbuilding is mentioned by classical authors such as Herodotus (II.96), Theophrastus (IV.2.6, 8) and Pliny (XIII.19.63) (see Section 6.1); as well as by a few medieval Islamic sources such as the Egyptian historians Ibn Mammātī and al-Maqrīzī (see Section 6.2.3).

There are more than one thousand species of the acacia genus that belongs to the Leguminosae family, growing in Tropical and sub-tropical regions worldwide (Titmuss 1965: 18; Wood 1997: 167-171; Gale & Cutler 2000: 24; Mabberley 2008: 3-4). *Acacia tortilis* subsp. *raddiana* (Figure 12.6) and *Acacia nilotica* (Figure 12.5) are native to Egypt, and their wood is very hard, durable, and resistant to termites and water (idem). Botanical and physical descriptions of this genus are attested in a few medieval Islamic sources. The Andalusian lexicographer Ibn Sīdah ([d. 458/1066] 1965: XI.181, 183-184) says that acacia belongs to "the thorn trees" classification and grows mainly in

[114] Shipwrecks 2, 3, 4, 6, 7, 8, 12, 13, 21, 22, 23, 24, 27, 28, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59 (Fabre 2011).

Yemen[115] and Egypt.[116] Acacia was also associated with myth of creation as described by the historians al-Ṭabarī (1989: I.277) and Ibn al-Athīr ([d. 630/1233] 1987: I.32). This denotes the importance of such wooden resources in countries where wood is relatively scarce. Generally, acacia has a wide array of uses such as in houses, coffins, tanning and dyeing, furniture, tools, wheels, charcoal, firewood, fodder, and gum, mainly in Egypt (Usher 1974: 11-12; Hiebert 1991: 139; Lucas 1989: 442; Gale & Cutler 2000: 24; Gale et al. 2000: 335-336; Ward 2000: 15-16). Meanwhile, non-maritime uses of acacia specifically mentioned by medieval Islamic sources include: bridges,[117] buildings,[118] tannin,[119] and firewood.[120]

7.2.2 Afzelia Sm.

The nautical use of *Afzelia* sp. (Eng. Afzelia) seems limited to the medieval Islamic period, as there is no archaeological evidence so far for this wood from classical times. It was identified to genus level in the Islamic tombs at Quseir al-Qadim (12th- 15th century), and to species level as *Afzelia africana* Sm. ex Pers. (Eng. African Mahogany) and *Afzelia bipindensis* Harms (Eng. Boanga, Mupwenge) in the 9th century Belitung wreck. At Quseir al-Qadim, a sample taken from Plank 7, one of the eight recycled hull planks covering Tomb 1, from Burial 61, was provisionally identified with the genus cf. *Afzelia*, by Van der Veen et al. (2011: 210; Gale & Van der Veen 2011: 223). These eight timbers, covering the top of the grave, were once sewn boat timbers before they were reused in a terrestrial context (Blue 2006: 280-281; Blue et al. 2011: 181-182). Several timber components from the 9th century Belitung shipwreck were made from *Afzelia* , as identified by Nili Liphschitz of the Institute of Archaeology, Botanical Laboratories, Tel Aviv University (Flecker 2008): *Afzelia africana* was identified in samples taken from structural elements of the hull such as the stempost, the frames (Figure 7.15), the hull planks (Figure 7.14), the anchor shank, as well as from dunnage twigs; while *Afzelia bipindensis* was used in the keelson (Figure 7.15). Some 15 tons of *Afzelia africana* imported from Ghana to Oman were used in the reconstruction of the

[115] al-Bakrī ([d.487/1094] 2003: I.279); Abū l–Fidāʾ ([d.732/1331] 1840: 9).

[116] al-Maqrīzī (2002: I.114, 298, 736).

[117] Ibn Taghrībirdī ([d. 815/1412] 1963-1971: XI.213).

[118] Ibn Khaldūn ([d.808/1406] 1956: I.629, II.159); al-Maqrīzī (1942: II.2.362-363).

[119] Abū l –Fidāʾ (1840: 9); al-Baghdādī (1998: 72); al-Qalqashandī (d.821/1418; 1963-1970: III.222).

[120] Ibn Zūlāq ([d. 386/996] 1999: 101); al-Maqrīzī (2002: I.75, 85); al-Nuwayrī ([d.733/1333] 1954: I.355).

Jewel of Muscat, a modern replica inspired by the Belitung shipwreck (Anon 2009; Jackson 2012: 29).

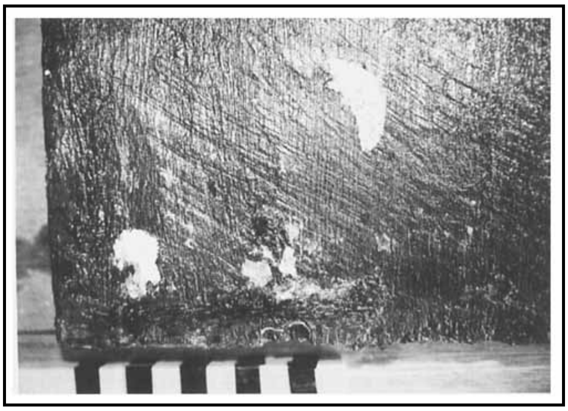

Figure 7.14: *Amoora* sp./*Afzelia africana* recovered hull plank (Flecker 2000: 206, Figure 12).

Figure 7.15: *Amoora* sp./*Afzelia africana* curved frame underlying the keelson made of *Afzelia bipindensis* (Flecker 2000: 203, Figure 7).

Afzelia sp. belongs to the Leguminosae family and consists of thirteen tree species native to tropical Asia and Africa, some of which are commercial timbers known as Malacca Teak (Gamble 1902: 280; Titmuss 1965: 245; Burkill 1966: 61; Usher 1974: 24; Mabberley 2008: 18). *Afzelia africana* grows in central and western tropical Africa, within which region Sudan is the closest to the Red Sea (Usher 1974: 24; El Amin 1990: 191) (Figure 12.7). *Afzelia bipindensis* grows mainly in central and south-western tropical Africa with Uganda being the main closest to the Red Sea (Usher 1974: 24; African Regional Workshop 1998) (Figure 12.8). *Afzelia* timber is hard, durable, and is used for furniture-making, construction, small carpentry, handles of spears, walking sticks, and cabinet work (Usher 1974: 24-25). Usher (1974: 24-25) mentions *Afzelia cuanzensis* Welw. whose trunks are used for canoes in East and South Africa where it is native.

7.2.3 Alnus Miller

Alder was used for rigging and is the first ancient record of this species, and a first from Egypt. One sheave sample of *Alnus* (Eng. Alder), numbered W0275, was identified at Myos Hormos (Gale & Van der Veen 2011: 223; Van der Veen et al. 2011: 209). The wood is light, soft and easily worked, and is quite stable when immersed in water. Thus, it was commonly used in ancient Mediterranean boatbuilding for structural elements such as the keelson, half-frames, futtocks and floor timbers, and fastening elements such as tenons, pegs and treenails (Guibal & Pomey 1998: 163, Figure 1, 2002: 96, Table I, III and V, 2003: 39, 39, Figure 8.4; Wicha & Girard 2006: 113, Table 19.1).

Alnus is a genus of 35 species of trees from the Belulaceae family, and is distributed from mediotemperate Europe to low elevation Mediterranean areas as well as North Africa, extending east to Assam in Northeast India and South-East Asia (Usher 1974: 34; Mabberley 2008: 25, 30) (Figure 12.11). Such a vast geographical context makes it very hard to pin-point the origin of the alder sheave from Myos Hormos. Alder was also used for non-maritime purposes such as piles, revetments, clogs, writing tablets, tool handles, bowls, musical instruments, fish traps, arrow shafts, wheels and sword handles from several European sites of difference periods (Gale & Cutler 2000: 34).

7.2.4 Cedrus libani A. Rich.

The only evidence for the use of *Cedrus libani* (Eng. Cedar) in boatbuilding the Red Sea comes from the Roman site of Berenike, where cedar wood beams with dowel holes and iron nails were reused in an unidentified building near the Serapis temple (Sidebotham & Zych 2010: 21) (Figure 7.16a) (Figure 7.9, trench 10). Evidence was inconclusive in order to determine "if these beams were directly associated with the temple itself or whether they served in an architectural capacity for some abutting structure" (Sidebotham 2014: 615).

In the harbour area, other *Cedrus libani* hull planking from the 1st to 2nd century AD was uncovered with mortise-and-tenon joinery, some reaching 3.15 metres in length

(Figure 7.16b). Northwest of these, a bollard made also of cedar was found (visible height: 66 cm, diameter: 24-31 cm) (Sidebotham & Zych 2011: 29-32), along with ropes and other maritime equipment.[121] The cedar bollard was previously thought to serve for the mooring of ships in the easterly part of the harbour in the 1st -2nd century AD (Sidebotham & Zych 2010: 21). However, in the 2009 excavations it seemed more to have been part of "some temporary shelter construction that was raised over the platform and was used seasonally at best" (S. E. Sidebotham & Zych 2011: 42). Also, during the 2009 excavations, thick shavings and minor cuttings of cedar wood (*Cedrus atlantica* ssp. *libani*) were recorded in Trench BE09-54 located in the north-eastern part of the south-western bay of Berenike dating from the early Roman period; Trench BE09-55 located in a section of the bay on the opposite, western side dating to the late first to second century AD; and Trenches BE09-56 and 57 laying in the early Roman trash dump at the northern edge of the city, with the assemblage from number 57 dated to the first century AD whereas number 56 was a recent backfill of another trench (Zielinski 2011: 61). These shavings in the form of "waste from mechanical processing suggest their provenance from a carpenter or shipwright's workshop" (Zielinski 2011: 65).

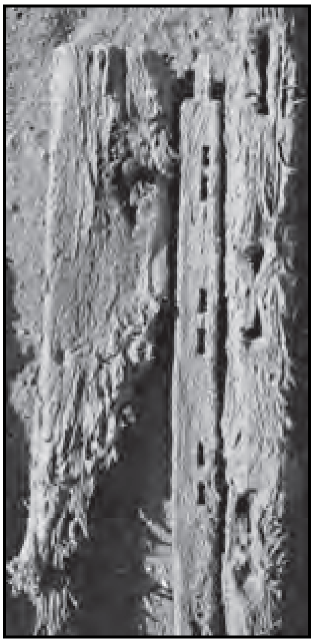

Figure 7.16: a-To the left, cedar boat timbers from near the Serapis temple. b-To the right, cedar boat timbers from the harbour area (Sidebotham & Zych 2010: 20, Figures 43 and 45).

[121] The report does not however precise what this equipment is.

Cedar was widely used in boatbuilding throughout Egyptian history since at least the 3rd millennium BC, if not earlier (Meiggs 1982; Lucas 1989: 432; See Semaan 2007). Evidence for the use of cedar in vessels in Egypt is substantial from the Old and Middle kingdoms: planks of the Khufu I & II vessels (Ward 2000: 21, 61, 142; Ward 2006: 123, 125; Gale et al. 2000: 349, 367); hull planks and one cylindrical baton of Ayn Sukhna (Pomey 2012: 43), possibly a timber frame from Lisht (Ward 2000: 119); planks of the Carnegie and Field Dahshur boats (Ward 2000: 21, 84-85); hull planks and deck beams from Mersa Gawasis (Ward 2006: 126; Bard & Fattovich 2007: 185, Table 12; Ward & Zazzaro 2010: 31). Much later, Theophrastus (V.1.7) and Pliny (XVI.76.203) attest the use of *Cedrus libani* for boatbuilding in Syria, Phoenicia and Egypt.

Cedrus Trew. is a genus of evergreen trees from the Pinaceae family. There are four identified species of cedar: *Cedrus deodara* (D.Don) G.Don growing the Himalayas, *Cedrus brevifolia* (Hook.f.) Henry in Cyprus, *Cedrus atlantica* (Endl.) Carr. in the Atlas mountains of the Maghreb and *Cedrus libani* A. Rich. in Mount Lebanon, Taurus (Turkey), and the Amanus Mountain in Syria (Mikesell 1969: 9, 14 (footnote 28); Lucas 1989: 432; Ward 2000: 20; Mabberley 2008: 163) (Figure 12.19). Cedar trees can grow to great heights reaching 40 metres in high forest areas (Gale & Cutler 2000: 377). This pinkish brown wood is easily worked and very durable against insect and rot attacks (Usher 1974: 134; Gale & Cutler: ibid). Archaeological records of cedar in Egypt encompass dowels, model boats, shrines, stele, mummy labels and writing tablets (Lucas 1989: 433-434; Gale & Cutler: ibid; Gale et al. 2000: 349).

7.2.5 cf. Dalbergia L.f.

Evidence for the use of *Dalbergia* for nautical purposes in the Red Sea consists of rigging elements found at Myos Hormos. Samples from twelve brail rings (Figure 7.17), two from sheaves (Figure 7.18), a deadeye (Figure 7.19),[122] and a peg were identified as *Dalbergia* sp.. Two other brail rings were tentatively identified as cf. *Dalbergia* (Figure 7.20) (Gale & Van der Veen 2011: 222; Van der Veen et al. 2011: 208).

[122] A round thick wooden disc with one or more holes through it used in the standing or running rigging of traditional sailing ships.

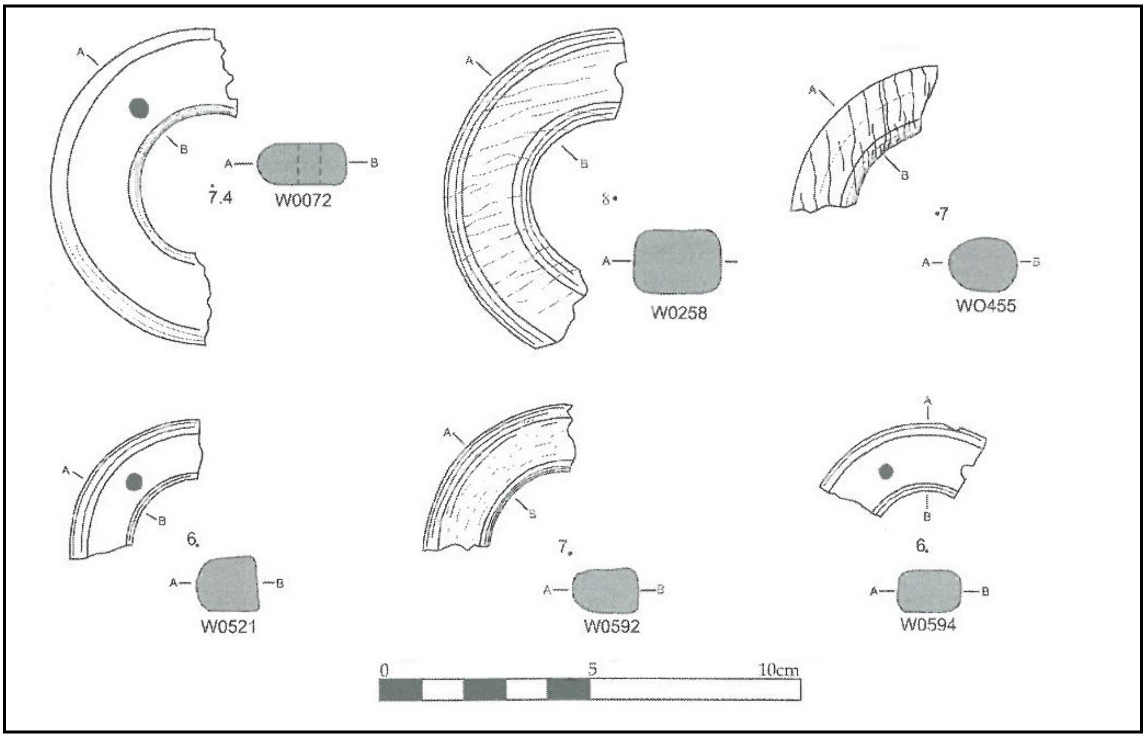

Figure 7.17: Some of the *Dalbergia* sp. brail rings from Myos Hormos (Blue et al. 2011: 192, Figure 15.12).

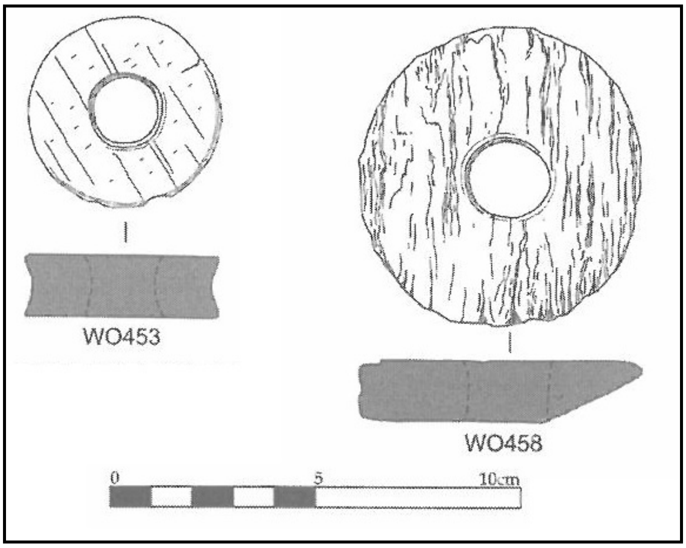

Figure 7.18: Two *Dalbergia* sp. rigging sheaves from Myos Hormos (Blue et al. 2011: 190, Figure 15.10).

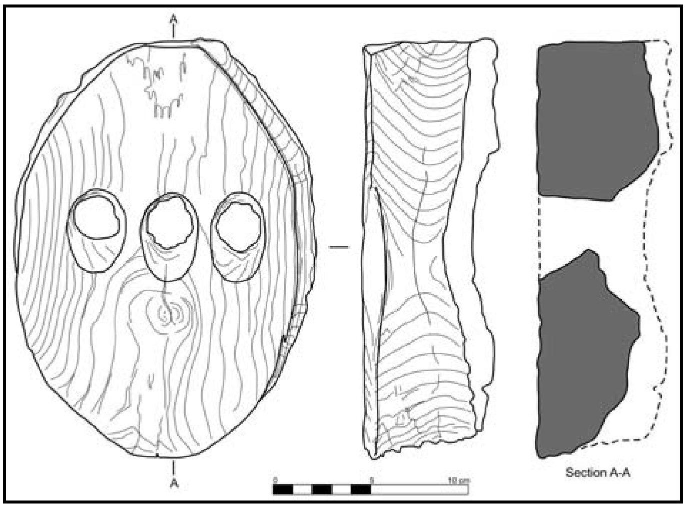

Figure 7.19: ***Dalbergia*** **sp. deadeye from the Myos Hormos (Blue et al. 2011: 189, Figure 15.9).**

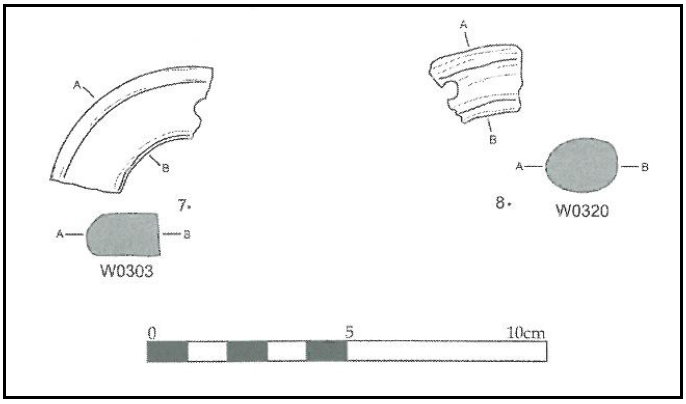

Figure 7.20: Two brail rings tentatively identified as cf. ***Dalbergia*** **from Myos Hormos (Blue et al. 2011: 192, Figure 15.12).**

Dalbergia sp. could possibly be African blackwood (*Dalbergia melanoxylon* Guill. and Perr.) also known as African ebony, on the basis of the structure and the very dark colour of the identified samples (Gale & Van der Veen 2011: 222; Van der Veen et al. 2011: 208). *Dalbergia melanoxylon* is a shrub or short tree growing to a maximum height of 8 metres with a frequently fluted trunk and often misshapen (Gale & Cutler 2000: 95), thus not quite suited to fashion hull planks. Also, the wood is very hard, heavy and difficult to work (Gale & Cutler 2000: 95; Gale et al. 2000: 339), this explains why it was used for rigging elements.

The genus *Dalbergia* L.f. from the Leguminosae family holds around 250 tropical trees shrubs and lianes (Mabberley 2008: 253). It originates from tropical Africa, Sudan, and Western India. In classical literature, Egyptian ebony figures as tribute from ancient Ethiopia (Herodotus III: 97) where it grows (Strabo XVII: 2.2). The ancient Egyptian records state that ebony was procured from lands situated south of Egypt, which to

Lucas (1989: 435), does not necessarily means that ebony grew in these places but that it was brought to Egypt from the South. Indeed, it was widely used in Egypt from Pharaonic times for objects, arrowheads, statuettes, chests, coffins, shrine doors, footstools, and chairs to name a few (Lucas 1989: 435-436; El Amin 1990: 231; Gale et al. 2000: 338; Ward 2000: 22). It is still generally used for furniture, carving and musical instruments (Usher 1974: 198).

7.2.6 Ficus L.

Several species of *Ficus* (Eng. Fig) are attested in the related archaeological record from Egypt and the Belitung wreck. Some wooden samples taken from the Matariya wreck were identified as the local Egyptian wood sycomore fig (Lat. *Ficus sycomorus* L.) (Ward 2000: 129), although it is not clear from which parts of the boat these were sampled. Sycomore fig was also identified in one of the boats (Shipwreck 11) at Heracleion-Thonis (Fabre 2011: 18), but the related boat component(s) remain unknown. A wood sample taken from the keelson chock of the 9th century Belitung shipwreck was identified as probably belonging to the *Ficus* genus (Eng. Fig) by Dr Jugo Illic of the Forestry and Forest Products Division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia (Flecker 2001: 347). Two of the planks (Planks 4 & 5) from the medieval burial Tomb 2 at Quseir el-Qadim, Egypt were made from *Ficus sycomorus* (Gale & Van der Veen 2011: 223; Van der Veen et al. 2011: 211, 224). One of the eight wood shavings from the medieval Islamic period was identified as *Ficus* sp. and another as tentatively of fig (cf. Moraceae) by Van der Veen et al. (2011: 212).

Evidence for sycomore fig from the Pharaonic period includes tenons in the Khufu I vessel (Ward 2000: 50) and for superstructure elements at Mersa Gawasis (Bard & Fattovich 2007: 186, Table 12; Ward & Zazzaro 2010: 31). In addition, an inscription from Hatshepsut's temple at Deir al-Bahari (c.1478/72-1458 BC) (Breasted 1906a: II.163 §326) and one of Zenon's papyri (P.Cair.Zen. 2.59270),[123] dating from 251 BC, mention the use of sycomore fig to build a boat. Much later, sycomore fig is attested in the medieval Islamic sources: It is mentioned in the 9th/15th century by the historian al-Maqrīzī (1957: IV.2.688), and is described by the 7th/13th century traveller and historian

[123] http://papyri.info/ddbdp/p.cair.zen;2;59270 [Accessed on 4th November 2014].

al-Baghdādī (1998: 65) as a light long-lasting wood, resistant to water and sun, and used in houses and doors.

Ficus sycomorus is one of the species of the genus *Ficus* sp. from the Moraceae family.[124] This genus also includes over 800 to 1000 species of deciduous and evergreen shrub and tree growing in tropical areas, mainly the Indomalay region and Polynesia (Usher 1974: 254; El Amin 1990: 259-275; Gale & Cutler 2000: 113; Zohary & Hopf 2000: 163; Mabberley 2008 : 336-338). *Ficus sycomorus* reaches up to 15 metres in height and is found in Southern and Eastern Mediterranean, Tropical Africa, Sudan, the Nile Valley, and the eastern coast of the Red Sea including Yemen and Oman (El Amin 1990: 271-273; Wood 1997: 71-72; Gale et al. 2000: 340; Gale & Cutler 2000: 113; Zohary & Hopf 2000: 165; Mabberley 2008: 338) (Figure 12.28). It is a pale, light, coarse wood of poor quality (Gale et al. 2000: 340; Gale & Cutler 2000: 113). Despite this and due to the scarcity of timber resources in Egypt, it was used for roof timbers, coffins, wagons, stele and statues from at least from the Predynastic period (Usher 1974: 256; Lucas 1989: 443; Gale et al. 2000: 340, 367; Gale & Cutler 2000: 115; Ward 2000: 18, 129).

7.2.7 Juniperus procera Hochst. ex Endl. (?)

Relevant archaeological evidence for *Juniperus procera* (Eng. African Cedar) is quite scarce, and only relate to the 9th century Belitung shipwreck. Two identifications have been assigned for a ceiling plank from the wreck: Liphschitz says it is *Juniperus procera*; while CSIRO says it is *Cupressus* sp. (Eng. Cypress) (Figure 7.21, Figure 12.22). These two genera, *Juniperus* and *Cupressus*, belong to the same Cupressoideae subfamily of the Cupressaceae family. Thus, their close wood anatomy might justify these two different results.

[124] For more information on Moreaceae see Heywood (1993: 96-97) and Mabberley (2008:557).

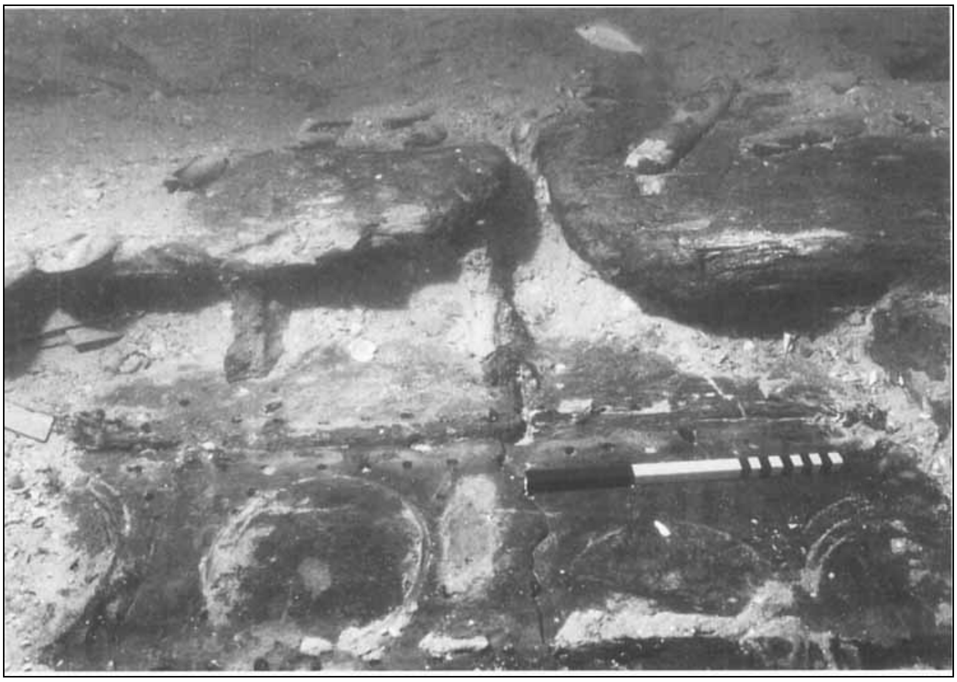

Figure 7.21: The ends of two ceiling planks of Cupressus/Juniperus, with hull planks in the foreground (Flecker 2000: 206, Figure 11).

Juniperus procera belong to the *Juniperus* sp. genus, which also includes 50 to 60 species of evergreen tree or shrub from the Cupressaceae family, growing in the northern hemisphere to a height of 25 metres, at altitudes between 500 to 2,700 metres (Usher 1974: 329; Lucas 1989: 437; Gale & Cutler 2000: 382; Mabberley 2008: 447) (Figure 12.30). *Juniperus procera* grows mainly in Africa and the Mediterranean region. Regions of growth in East Africa include: north-east Sudan near the Red Sea, the Ethiopian Highlands, Djibouti, Somalia, Kenya, Uganda, Tanzania, the eastern Congo Republic, Malawi, and north-eastern Zimbabwe. It is also found in the mountains adjoining the Red Sea in Arabia. The wood is insect resistant and is used in boatbuilding, building construction, and furniture (Usher 1974: 329; Wood 1997: 63; Mabberley 2008: 447).125

7.2.8 Luehea divaricata Mart. (?)

There is no relevant archaeological evidence thus far for this wood (Eng. Estribeiro) in the Red Sea, but it was identified in a terrestrial context at al-Balid, Oman by CSIRO. The related sample was taken from a degraded and re-used plank (numbered BA0604159.73) in one of the site's buildings (Belfioretti & Vosmer 2010: 112, Figure 5) (Figure 7.22).

[125] http://www.thewoodexplorer.com/maindata/we674.html [Accessed 6th January 2011].

Figure 7.22: Estribeiro plank BA0604159.73 in situ.

Luehea divaricata Mart. is one of the nine species belonging to the genus *Luehea* from the Malvaceae family (or Tiliaceae family) (Mabberley 2008: 504). This species grows in Latin America, mainly in Argentina and Brazil (Usher 1974: 364). The trees reach a height of 20-30 metres (Figure 12.32). The wood is pinkish-brown in colour, and not very durable as it is susceptible to insect and termite attack. It is also not-resistant to marine borers. Some of Estribeiro's common uses include: boxes, handles, furniture, musical instruments, posts, and structural work (Usher 1974: 364; Mabberley 2008: 504).[126]

7.2.9 cf. Olea L.

This genus is only attested in the Roman period in Egypt. One of the brail rings found at Myos Hormos (Numbered W0142 from Trench 6A-4025) was provisionally identified as cf. *Olea* sp., also known as the generic olive wood (Gale & Van der Veen 2011: 221, 223; Van der Veen et al. 2011: 206, 209). Olive wood is hard, heavy, strong and durable

[126] http://www.thewoodexplorer.com/maindata/we736.html;http://news.ai/build/woods.html [Accessed 6th January 2012].

thus it was used for fastening and joinery elements such as mortise and tenon joints and dowels in ancient Mediterranean boats (Frost 1975: 228; Gale et al. 2000: 343; Gale & Cutler 2000: 173). Indeed, Theophrastus (IV.2.9, V.3.9) and Pliny (XVI.78, 79) spoke about the hardness of olive wood, its durability and resistance to moisture and teredo worms.

Olea is a genus of 33 species of evergreen tree and shrub belonging to the Oleaceae family and essentially found in temperate zones bordering the Mediterranean basin (Mabberley 2008: 598) (Figure 12.57). It is not native to Egypt, but was probably cultivated in Egypt by the time of the New Kingdom (Hepper 1990: 16). The brail ring from Myos Hormos could therefore have been made of any of the Olea species present in Egypt such as *Olea chrysophylla* Lam., *Olea europaea* L. with its two subspecies europaea and cuspidata, with subsp. europaea having two variants growing in Egypt: var. *europaea* and *sylvestris* (Täckholm 1974: 405; Boulos 2000: 202-204). Non-maritime uses of olive wood include small decorative items, carvings, furniture, and fuel (Usher 1974: 422; Gale & Cutler 2000: 171-173).

7.2.10 Pinus L.

Pine is a Mediterranean wood that is highly attested in the related archaeological record and primary sources, from both the classical period and the medieval Islamic period.

Nautical evidence for pine in the classical period relate to two shipwrecks (numbers 18 and 29) from Heracleion-Thonis (Fabre 2011: 18), and to recycled hull planks and beams unearthed in Berenike (Vermeeren 2000a: 5; 2000b: 334-335). At Berenike, pine planks and beams were unearthed in trenches number BE98-10, 16, 21, and 23, and might have been reused in buildings as was teak along with other high quality Mediterranean and central European wood species such as oak, beech, elm and silver-fir (Vermeeren 2000a: 5, 8; 2000b: 334-335, 341). Samples of wood shavings from both Roman and Islamic levels at Quseir were identified as a type of Mediterranean pine by Van der Veen et al. (2011: 211- 212). Van der Veen et al. (idem) explain that since the level species could not be identified, this wood belongs to the *Pinus pinea* (stone pine)/*P. pinaster* (cluster pine) group.

The suitability of pine for boatbuilding is attested by the Greek botanist Theophrastus (V.7.1, 5). Also, Strabo (XV.1.29) tells us how pine was felled for the fleet of Alexander the Great in the Emodi Mountains at the border between modern-day Pakistan and India. The durability of pine against decay and woodworm is attested by Pliny (XVI.81.42). Later, medieval Islamic authors described the nautical uses of pine such as the 9th/15th century historian Ibn Taghrībirdī (1963-1971: XI.29-30), who reports the felling and export of pine from Syria to Egypt for the construction of warships.

There is also substantial archaeological evidence for the use of different pine species in Mediterranean boatbuilding at several periods, and for any boat component. For example, pine was identified in planks and ram of the 3rd-2nd century BC Punic Marsala Sister ship (Frost 1975), and in other western Mediterranean shipwrecks from the Roman period (Wicha & Girard 2006: 113, Table 19.1). Several pine species are attested also in wrecks from the Eastern Mediterranean, such as: The Dor/Tantura lagoon wrecks found in Israel, which are thought to be of Egyptian origin (Kahanov et al. 2004; Barkai & Kahanov 2007; Barkai 2009, 2010). These date from the early sixth-century AD to the first quarter of the ninth century AD; and the 11th century Serçe Limani cargo vessel found in Turkey (Steffy 1982). Pine exploitation for boatbuilding in the Eastern Mediterranean continued until the Modern period as attested by the 19th century Dor 2002/2 vessel (Cvikel 2009; Liphschitz 2012: 101).

Pine was also used in two modern-period ships that wrecked in the Red Sea: in the hull timbers of the 18th century Sadana shipwreck (Ward 2004: 170); and in the keel of the 18th century Sharm el-Sheikh shipwreck (Lat. *Pinus aula*), and its frames and hull planks (Lat. *Pinus sylvestris* L.) (Figure 12.39) (Raban 1971: 150). I could not find any information for *Pinus aula* in botanical references, nor has Rainer Gerisch.[127] Thus, this prevented me from obtaining details on the phytogeography and potential provenance of this wood. Other Mediterranean timbers were also identified such as some wooden blocks part of the ship's gear made with ash and a part of a pulley made with dogwood (Raban 1971: 150). Raban (1971) suggested that since no distinctive species was identified, the exact origin of the ship cannot be pinpointed. Indeed, the genera identified are widely distributed across Southern Europe and Asia Minor (Raban: 1971). Raban (1971: 151, 154-155) conferred a Turkish origin to the wreck considering the

[127] Personal communication by email on 7th August 2014.

construction method and part of the ship's cargo. It might be suggested that the Sharm el-Sheikh ship and the Sadana ship were constructed in Egypt. Indeed, both wrecks echo the words of al-Jabartī (n.d.: 363-364, 375, 526-527, 1994: 4.212-213, 221, 361) who repeatedly mentions that under Ottoman Egypt, timber was imported from the lands of the Rūm for the construction of the Pasha's fleet in Egypt. It should be kept in mind too that a boat made with Mediterranean species does not mean it was constructed in the Mediterranean but could have been built anywhere Mediterranean species were exported to.

Pinus sp. is a genus belonging to the Pinaceae family of 93 to100 species of evergreen trees growing mainly in the temperate regions of northern hemisphere but also in Central and South America, Sumatra and Java (Usher 1974: 460-463; Gale & Cutler 2000: 391). Meanwhile, medieval Islamic sources tell us that pine was distributed in Ethiopia,[128] the Bilād el shām,[129] and the Byzantine Empire.[130] They say it was imported to Egypt from Mediterranean countries,131 and to Sudan from Morocco.[132]

Ancient non-maritime uses for *Pinus* species comprise: resin pitch, resin, tanning, ropes, structural elements, coffins, kitchen utensils, and medicinal applications (Usher 1974: 461; Gale & Cutler 2000: 391, 392; Gale et al. 2000: 352). Lucas (1989: 438) reports pine artefacts in Egypt from the Predynastic period, the 3rd and 18th dynasties. *Pinus pinea* L. (Eng. Stone pine) and *Pinus pinaster* Aiton (Eng. Cluster pine) grow on coastal stands (Gale & Cutler 2000: 391). *Pinus pinea* is distributed from Italy to Cyprus and in gardens in Egypt (Lucas 1989: 439; Gale & Cutler 2000: 391; Gale et al. 2000: 351). It grows up to 16 metres in height. It produces good quality timber, and belongs to the group of hard pines (Gale & Cutler 2000: 391; Gale et al. 2000: 351). *Pinus pinaster*, also called *P. maritime*, is a Mediterranean species (Usher 1974: 462), that grows taller, straighter and produces stronger wood than the other coastal pines (Gale & Cutler 2000:

[128] Al-Qalqashandī (1963-1970: V.306).

[129]Ibn Zūlāq (1999: 59, 64, 67).

[130] Al-Qazwīnī ([d. 682/1283] 1957: 153).

[131] Al-Nuwayrī l-Iskandarānī ([fl.8th/14th century] 1970: IV.7).

[132] Al-Qazwīnī (1960: 19); Yāqūt ([d.626/1229] 1988: II.12).

391). Pine was also used for buildings,[133] and bridges,[134] as attested in a few medieval Islamic sources.

7.2.11 cf. Pomoideae Juss.

Nautical evidence for *Pomoideae* is only attested in Egypt during the Roman period. A brail ring from Myos Hormos, numbered W0058 from Trench 2B (1553), was provisionally identified as cf. *Pomoideae* (Gale & Van der Veen 2011: 221, 223; Van der Veen et al. 2011: 206, 209). This brail ring is the only maritime use I could locate in the literature.

Pomoideae is a subfamily of the Rosaceae, with tree or shrub mostly widespread through temperate regions of Europe and Asia (Gale & Cutler 2000: 184-189). The genera of this subfamily are non-endemic to Egypt, but have been cultivated there for an unknown period. Generally, the wood of the Pomoideae genera is hard with a close, compact grain (Gale & Cutler 2000: 184), making it suited for rigging elements. Gale & Cutler (2000: 184) explain that archaeological artefacts made from wood genera belonging to *Pomoideae* are usually identified under this subfamily name. Indeed, the wood structure of such genera is so similar that it is very hard to separate them through anatomical methods. Non-maritime uses include tool handles, stoppers, bungs and domestic items (Gale & Cutler: 2000: 184).

7.2.12 Quercus L.

The genus *Quercus* (Eng. Oak) is attested in planks and rigging elements, at Egyptian sites from the Graeco-Roman period. Oak was identified in the planking of four shipwrecks (numbers 16,17, 19, 20) at Heracleion-Thonis (Fabre 2011: 18). The species level was apparently not reached. Meanwhile, Fabre (2011: 18) describes two types of oaks: the sclerophyllous oak and the deciduous oak. This opens the possibility of two scenarios: these oak types could be either endemic species or imported ones. An oak cleat used in rigging was identified at Myos Hormos, as well as pegs and wood shavings

[133] Ibn Saᶜīd ([d.685/1286] 1970: 122); al-Bakrī (2003: I.277); Al-Qazwīnī (1960: 518, 599, 612); al-Nuwayrī (1984: XXII.284).

[134] Ibn Taghrībirdī (1963-1971: VI.364-365).

(Van der Veen et al. 2011: 206). At Berenike, an oak boat (?) plank was found in a reused context as building material (Vermeeren 2000a: 5; Vermeeren 2000b: 335, 341).

Oak has been a timber source for boatbuilding since antiquity. Indeed, evidence from Pharaonic Egypt shows it was used in the hull planks of a 12th-13th dynasties carbonised boat found in Cave 2 in Ayn Sukhna (Pomey 2009: 10). Archaeological evidence for the use of Turkey oak (*Quercus cerris* L.) is found in a dowel from the 18th Dynasty (1539–1292) used in a gilt shrine holding the sarcophagus of Tutankhamen (Lucas 1989: 438; Gale & Cutler 2000: 209, 424 ; Gale et al. 2000 : 344). Oak was also used in classical antiquity for keels of triremes and cargo boats, as it can sustain hauling tensions (Theophrastus V.4.3., V.7.1-3; Gale & Cutler 2000: 205; Gale et al. 2000: 344). It was also used for frames in Mediterranean boatbuilding such as in the Punic Marsala sister ship dating from the 3rd-2nd century BC (Frost 1975) and Roman shipwrecks found in the western Mediterranean (Wicha & Girard 2006: 113, Table 19.1). In later periods, various species of oak were identified in planks, structural components, and treenails of boats wrecked in the Tantura lagoon, and which date from the 5th century AD to the 19th century Byzantine coaster (Kahanov et al. 2004: 119; Cvikel 2009; Kahanov & Mor 2009; Liphschitz 2012: 98, 101). In the Red Sea, *Quercus* sp. was identified in the 18th century Sadana shipwreck (Ward 2004: 170), but the related boat component remains unknown.

From the Fagaceae family, the *Quercus* genus has around 530[135] to 600 species (Gale & Cutler 2000: 204) of evergreen and deciduous tree, and a few shrubs, growing in northern temperate regions, mainly Europe and North America, and in southern parts such as North Africa, Malaysia and Colombia (Mabberley 2008: 722-723) (Figure 12.43). Some species such as *Q. aliena* Blume, the wood of which is used for boatbuilding (Usher 1974: 492), grow in East Asia such as regions of China, Korea and Japan. The Egyptian historian Ibn Zūlāq (1999: 59, 64, 67) mentions that oak trees grow in Syria. Oak trees have long lives, and could reach large dimensions. The yellowish-brown heartwood timber is durable, but the sapwood is prone to insect and fungal action. Most oak species produce high quality strong timber that is easily worked, and thus explains its extensive use as a building material. However, when exposed to

[135] Mabberley (1998: 723) reports the following species as used in shipbuilding: *Q. macrocarpa* in East and North America, and *Q. virginiana* in South-East USA. The latter species is also mentioned by Usher (1974: 494) for building ships.

humidity, oak might corrode iron fastened to it due to the acetic acid it contains (Titmuss 1965: 160; Gale & Cutler 2000: 204-205). Other common uses include building construction, furniture, coffins, medicine, bark for tanning and dying, wood for cork, barrels, fuel and charcoal (Titmuss 1965: 160; Usher 1974: 492-494; Gale & Cutler 2000: 204-209; Gale et al. 2000 : 344; Mabberley 2008: 722-723).

7.2.13 Salix L./Populus L.

Related archaeological evidence for these two genera consist mainly of fastening elements dating from the medieval Islamic period in Egypt. A peg found at Quseir al-Qadim in Plank 6 of Tomb 1 from Islamic Burial 61 was identified as belonging to the Salicaceae family, and either to the genus *Populus* sp. (Eng. Poplar) or *Salix* sp. (Eng. Willow), since their anatomical structure is very similar (Gale & Cutler 2000: 190, 236, 241; Gale & Van der Veen 2011: 223; Van der Veen et al. 2011: 211). Also, five of eight Islamic-period pegs associated with boatbuilding and repair work at Quseir were made with willow (Van der Veen et al. 2011: 211). Meanwhile, the use of poplar in boatbuilding is attested in the medieval sources in the $9^{th}/15^{th}$ century by al-Maqrīzī (1957: IV.2.688).

Belonging to the Salicaceae family, the *Salix* genus has 400 to 500 species growing in cold and temperate regions (Heywood 1993: 117-118; Wood 1997: 118; Gale & Cutler 2000: 236; Mabberley 2008: 760-761). Two of these are native to Sudan (El Amin 1990: 249-251), and 26 to India (Gamble 1902: 685-690). Ibn Baṭṭūṭa (1971: III.644) reports that willow trees grow in India near Delhi. The trees can attain 30 metres in height, but the genus has also shrubs. The wood is soft, light-weight, varies in colour from reddish brown to pinkish-white, and is not very durable when exposed to the weather (Gamble 1902: 685; Titmuss 1965: 263; Usher 1974: 519; Gale & Cutler 2000: 236; Mabberley 2008: 760-761). Considering the scarcity of willow finds from the Red Sea, it can be speculated that willow could have also been used for structural elements, and not only for fastening. Indeed, willow was used in the frames of a 2^{nd} century merchant ship called Roche Fouras that wrecked in southeast France (Wicha & Girard 2006: 113, Table 19.1).

As for other maritime objects, two fishing gorges possibly made from willow (*Salix* sp.) were found in Islamic contexts at Quseir al-Qadim. These were probably made from local species growing on the Nile (*S. subserrata* Willd.[136] and *S. tetrasperma* Roxb.) (Gale & Van der Veen 2011: 225; Van der Veen et al. 2011: 219) (Figure 12.61). Non-maritime objects made with willow wood and found at Quseir include a spinning whorl from 12^{th}-13^{th} centuries Islamic contexts (Hiebert 1991: 139). The species *S. alba* L., growing in Europe, North Africa and temperate Asia, is reportedly used for boats (Usher 1974: 519). The willow wood is also used for charcoal, statues, tooth picks boxes, matches; its pliable branches are used in basketry, and the bark has medicinal uses and tanning (Usher 1974: 519; Heywood 1993: 118; Gale & Cutler 2000: 236; Mabberley 2008: 760-1). Archaeological examples of the small willow tree, *S. subserrata*, include: leaves used in garlands in the tomb of Tutankhamen; wood for chariot parts, stele, bowls, knife handles, and boxes (Gale et al. 2000: 344-345; Ward 2000: 20; Mabberley 2008: 761).

Populus sp. is a genus of around 35 species of tree growing in northern temperate regions (Usher 1974: 478; Gale & Cutler 2000: 190; Mabberley 2008: 693). Gamble (1972: 690-692) states that there are five or six indigenous species growing in India. He also says that *P. euphratica* Oliv. is used for boatbuilding on the Tigris and the Euphrates (Gamble 1902: 691) (Figure 12.58). Ancient Roman scholars were aware of the qualities of poplar. Pliny (XVI.76.40, 81.42) tell us that poplar wood is hard and strong. The wood is "pale creamy-white to grey, fine- textured, tough, non-splintering and fire resistant" (Gale & Cutler 2000: 190). The use of poplar is similar to that of the willow, for example: statues, shields, matches, boxes, pulp, and for construction (Usher 1974: 478; Heywood 1993: 117; Gale & Cutler 2000: 190).

7.2.14 Salvadora persica L.

Salvadora persica does not figure among the archaeological nautical wood from classical antiquity, nor is it mentioned by primary sources as useful for boatbuilding. What little evidence we have is two wooden pegs from Quseir al-Qadim (Van der Veen et al. 2011: 211). While non-maritime uses from the site include brushes (Van der Veen et al. 2011: 218, 220, 225).

There are four species of *Salvadora* sp., belonging to the Salvadoraceae family, shrubs growing in warm regions, from Africa to tropical Asia (Usher 1974: 520; Mabberley

[136] For more on this species refer to Gale *et al.* (2000: 344-5) and Gale & Cutler (2000: 236-241).

2008: 762) (Figure 12.47). It is also found in the Eastern Desert of Egypt (Van der Veen et al. 2011: 218), Sudan (El Amin 1990: 287), and in Yemen (Wood 1997: 178-179). The Toothbrush shrub twigs are used as chewing-sticks by Bedouins and others as toothbrushes with antiseptic and medicinal benefits for teeth and gums. The leaves are eaten locally and used as camel fodder, and the wood as fuel. The ashes produce salt, and the oil of the seeds is used to make candles and skin oil (Usher 1974: 520; Mabberley 2008: 762).

7.2.15 Tamarix L.

The nautical use of *Tamarix* (Eng. Tamarisk) stretches back to the Pharaonic period. It is attested in both the Graeco-Roman and the medieval Islamic periods, at Egypt's Red Sea coast. Nautical applications include hull planking, rigging and fastening elements.

At Myos Hormos/Quseir al-Qadim, two brail rings, three pegs and two wood shavings from the Roman period, and four Islamic wood shavings were identified as tamarisk (Gale & Van der Veen 2011: 221;Van der Veen et al. 2011: 206, 207, 209, 211, 212, Table 5.1). Some wood chips of *Tamarix* cf. *nilotica* (Eng. Nile Tamarisk) were also found at Berenike (Vermeeren 2000a: Table 2).

The use of tamarisk in boatbuilding is widespread both spatially and chronologically. It was employed in the Eastern Mediterranean for repairing frames of the 5th-6th century Dor 2001/1 Byzantine coaster (Kahanov & Mor 2009; Liphschitz 2012: 98). It was found in frames and central longitudinal timbers of the 8th century AD Tantura F boat, also at Dor, testifying to the use of this wood in shipbuilding in the early medieval period (Barkai & Kahanov 2007). The species level could not be reached, but Barkai (2010) suggested that it might be *Tamarix smyrnensis* Bunge, which grows in Turkey or any other tamarisk species local to Palestine. This indicates a boat constructed either in Turkey or "southern Levant". However, it should be considered that the Tantura F boat could have also been built or repaired in Egypt, where tamarisk is abundant and has been used for frames since Pharaonic times. Moreover, the cargo of Tantura F exhibits evidence for a boat plying a route between Egypt and Dor. Thus, an Egyptian origin should be considered as well. Indeed, the oldest use of tamarisk in Egyptian boatbuilding goes back to the early 3rd millennium BC. The Abydos vessels were tentatively identified as made with tamarisk (Ward 2006: 125). Some of the Lisht timbers were also made with tamarisk (Ward 2000: 19, 107, 110, 139). In later periods, its use for boatbuilding during classical antiquity and the middle Medieval period in Egypt is attested by Herodotus (II. 96) and al-Maqrīzī (2002: II.130) respectively.

There are 54 species of tamarisk according to Gale & Cutler (2000: 251-254) and Mabberley (2008: 840), 90 species according to Heywood (1993: 109-110) and Usher (1974: 565). Tamarisks belong to the Tamaricaceae family of evergreen tree and shrub growing in Eurasia, Africa, and the Mediterranean through to India and northern China (Usher 1974: 565; Heywood 1993: 109-110; Gale & Cutler 2000: 251; Mabberley 2008: 840). Tamarisk is described by Ibn Sīdah (1965: XI.187) as a tall tree with no thorns. Other medieval Islamic sources say that it grows on the river banks of the Nile in Sudan,[137] and in Yemen.[138] One of the most commonly used species is *Tamarix aphylla* L. is a 10 metre tall evergreen tree, which grows along water courses and sandy or dunary places in desert regions in Egypt, Arabia, Iraq and southern Iran and Pakistan (Figure 12.48). Its trunk produces good-sized timber and is larger than the *Tamarix nilotica* (Ehrenb.) Bunge, another species endemic to Egypt that is not suitable for timber production (Gale et al. 2000: 345; Van der Veen et al. 2011: 209). Although the wood is coarse and dense (Gale et al. 2000: 345; Van der Veen et al. 2011: 209) it was an important wood resource in arid areas.

There are numerous tamarisk artefacts from as early as the Predynastic period in Egypt; mainly stele, boat models, coffins, sculptures (Lucas 1989: 447-448; Gale & Cutler 2000: 251; Gale et al. 2000: 345). Several wooden artefacts for everyday use from both the Roman and Islamic period at Myos Hormos/Quseir al-Qadim were made of tamarisk, the most common wood used for that purpose (Hiebert 1991: 139; Van der Veen et al. 2011: 213, Tables 5.2 and 5.3, 220, 225). Tamarisk was also used at Quseir al-Qadim as fuel as shown from charcoal samples (Van der Veen et al. 2011: 222, 225). The Islamic medieval literature reports non-maritime applications of tamarisk such as construction,[139] containers, and utensils.[140] Meanwhile, general uses of tamarisk include: construction, tanning, medicine, fuel, and basketry (Usher 1974: 565; Heywood 1993: 110; Mabberley 2008: 840).

[137] Al-Idrīsī ([f. 548/1154]; 1989: I.20)

[138] Al-Bakrī (2003: I.279).

[139] Ibn Baṭṭūṭa (1972: I.173); Ibn al-Mujāwir ([d.690/1291] 2008: 90-91, 164)

[140] Ibn Sīdah (1965: XI.187).

7.2.16 Tectona grandis L.f.

Archaeological evidence for the maritime use of teak in the Red Sea regions is attested in the classical period, not in the medieval period. Evidence from the latter period originates from the site of al-Balid, and from the Belitung shipwreck.

At Myos Hormos, rigging elements made of teak such as a sheave (Figure 7.23) and pulley which dated from the mid to late 2nd century AD were identified, as well fastening elements such as pegs (Gale & Van der Veen 2011: 221, 225; Van der Veen et al. 2011: 206, 207). A visual inspection of a few planks, which were used as a door threshold at the site, suggests they might be made of teak (Figure 7.24). However, this has not been scientifically verified thus far through wood sampling (Whitewright pers.com).[141]

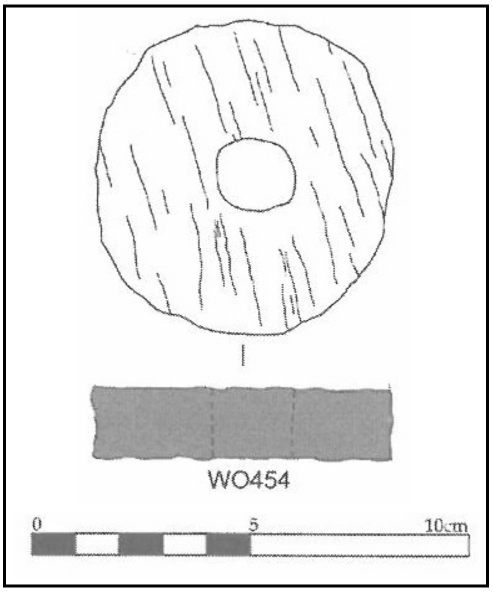

Figure 7.23: Teak rigging sheave from Myos Hormos (Blue et al. 2011: 190, Figure 15.10).

[141] Personal communication with Dr. Julian Whitewright by email on 13th October 2010.

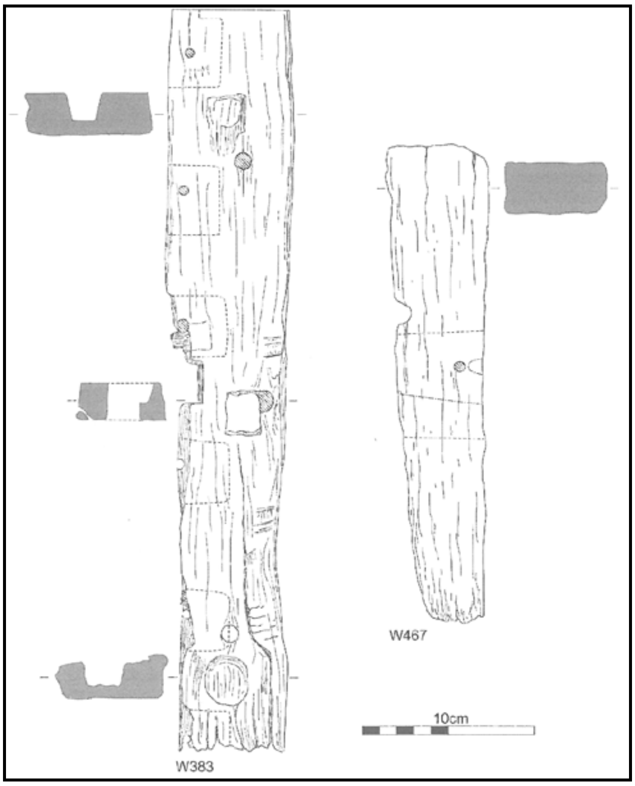

Figure 7.24: Reused planks from Myos Hormos that might be made of teak (Blue et al. 2011: 180, Figure 15.1).

At Berenike, a substantial number of teak planks and beams have been found in excavation trenches (mainly numbers BE98-10, 21, 23, and 25) (Figure 7.9). Trench BE98-10 is located in a structure near the Serapis temple (Figures 7.8 and Figure 7.9).Trench 21 is located on the eastern part of the site, southwest from the Christian Ecclesiastical Structure (Figure 7.8 and Figure 7.10). Trench BE98-23 was excavated inside the Northern Shrine, a Late Roman-era cult sanctuary located in the northern/north-eastern part of the city, with two phases of occupation (Sidebotham & Wendrich 2007: 6, 82-83) (Figure 7.8 and Figure 7.10). Trench 25 is located to the north of the Shrine of the Palmyrenes (Figure 7.8 and Figure 7.9).

These teak planks and beams are most probably recycled parts of dismantled ships or driftwood reused to stabilise walls in the late Roman city. They are not the result of wood import for boatbuilding at the site (Sidebotham & Wendrich 1998: 91, 92; Vermeeren 1999: 201-202; 2000a: 5, Table 2; 2000b: 315-328, 334-335; Sidebotham & Zych 2010: 21). In many of the teak planks, notches, mortises with or without teak pins, metal nails and cross laths were found (mainly in trenches number BE98-10, 19, 21, and 23). In addition, a layer of pitch or tar was found on one of the teak planks discovered in trench number BE98-10 (Vermeeren 2000a: 9, Table 2, catalogue numbers 10, 11 and

12, 2000b: 315) (Figure 7.25). A fair quantity of teakwood survived inside the Northern Shrine edifice in both phases. More specifically, in trench BE98-23.032g (locus 32g), there was a beam placed on the floor of the earlier phase west of the columnar shaped altar, the ostrich egg, and the temple pools. This beam ran north-south from under the northern to under the southern exterior walls of the shrine. Measuring 3.68 m long x 0.07-0.08 m wide x 0.06 m high, and pierced with multiple rectilinear shaped dowel holes, this beam had clearly been recycled from a dismantled ship (Sidebotham 2014: 616, and Sidebotham pers.com.).[142]

The teak planks seem foreign to the buildings where they were found (Vermeeren 2000a: 4, 9, 2000b: 335, 341). This could point to a previous maritime use of these teak timbers which have been recycled subsequently in the building process.

Figure 7.25: Teak plank with nail (left), cross lath (hole on right) and layer of pitch or tar (bottom) (Vermeeren 2000a: Figure 14).

In addition, two teak rings found in trench number BE98-21 might have been used in ships: one with a tapered hole probably to block a rope (Figure 7.26) and the other one could have been a brailing ring (Figure 7.27) (Vermeeren 2000a: Tables 2, 4, and 9; 2000b: 324, catalogue numbers 141 and 144, 332, 341). A large number of teak woodchips were found in situ (Vermeeren 2000a: 5, 8; 2000b: 335, 341) and could support the hypothesis of dismantled ships' timbers being refitted and recycled.

[142] Personal communication by email on 5th July 2015.

Figure 7.26: Teak wood object with tapered hole (Vermeeren 2000a: Figure 8a).

Figure 7.27: Teak brail ring (Vermeeren 2000a: Figure 9).

For the Islamic medieval period, recycled teak planks, numbered BA 0604145.175 (Figure 7.28) and BA 0604148.70 (Figure 7.29), were found in a terrestrial context at al-Balid (Belfioretti & Vosmer 2010: 112). Teak plank BA0604148.70 was dated to 930±50 BP by radiocarbon analysis at the Beta Analytic Radiocarbon Dating Laboratory, Miami, Florida (Belfioretti & Vosmer 2010: 114, Table 7). Previous excavations at al-Balid by Paolo Costa had revealed other evidence for teak on site (Costa 1979: 146 and pl. 76/a-c in Belfioretti & Vosmer 2010: 116).This consists of a boat beam reused in the largest mosque on the site.

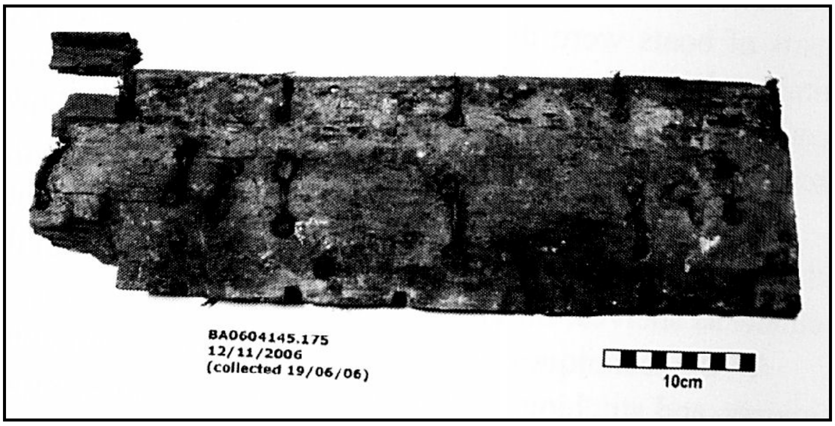

Figure 7.28: Teak plank BA 0604145.175, the outside surface of the hull (Belfioretti & Vosmer 2010: 112, Figure 3).

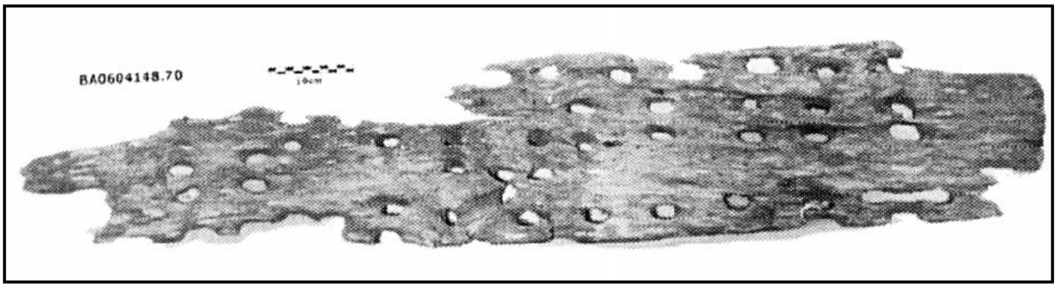

Figure 7.29: Teak plank BA 0604148.70 (Belfioretti & Vosmer 2010: 113, Figure 4).

Also, samples from through-beams of the Belitung shipwreck were identified as Indian teak by both CSIRO and Liphschitz (Flecker 2008: 385) (Figure 7.30).

Figure 7.30: The remnants of a through-beam penetrating a hull plank and a beam shelf (Flecker 2000: 208, Figure 16).

Medieval Islamic sources also mention the use of teak in boatbuilding for sewn vessels plying the Red Sea and the wider western Indian Ocean according to al-Maᶜsūdī (1986: 365), the geographers al-Bakrī ([d.487/1094] 2003: I.144), and al-Dimashqī ([d.727/1327] 1923: 157); and for the war galley *qurqūr*[143] as described by Ibn Sīdah (1965: X.26).

Tectona grandis is one of three species in the genus Tectona sp. from the Verbenaceae family, growing in India144 to Laos; it was introduced to Indonesia 400-600 years ago (Mabberley 2008: 845; Usher 1974: 568) (Figure 12.49). In addition to India,[145] teak is reported in the medieval Islamic sources as growing in some islands of the western Indian Ocean,[146] in the regions of the Indian and Chinese Seas,[147] in the Silver-Island identified with Sumatra or Java[148] and in the Eastern Ocean identified with the Pacific Ocean. Al-Qazwīnī (1960: 10) wrongfully reports Yemen as a region where teak and ebony grow. Teak is a heavy wood and sinks in water unless dried, therefore in India and Burma the trunk is girdled, whereby the bark and living tissue near the base are removed and left to dry for two years before the trunk is felled (Gamble 1902: 528; Mabberley 2008: 845). Teak is a large deciduous tree that can reach 40 metres in height and 6.7 metres in girth. The bark is light brown or grey with shallow longitudinal cracks. Indeed, the wood is described as a "black" (dark?) wood by Ibn Sīdah (1965: XI.18), and taller than the palm tree and more voluminous than the chestnut tree according to al-Masᶜūdī ([d. 345/956] 1970: III.12). It is moderately hard, strong, very durable, water and shipworm-resistant, and scented (Gamble 1902: 526; Heywood 1993: 237; Titmuss 1965: 243; Usher 1974: 569); the heartwood colour is dark golden yellow turning dark brown or black with age (Gamble 1902: 526; Titmuss 1965: 243). Gamble (1902: 532) states that "the wood is exported [from India and Burma] chiefly for shipbuilding especially for the backing of armour plates in battleships and for the

[143] Agius (2008: 289-292, 332-334)

[144] For a detailed geographical distribution in India and Burma, and information on the sylviculture of teak see Gamble (1902: 526-534).

[145] Ibn Khurradādhbih ([d.300/911] 1889: 63); Ibn Faqīh al-Hamadānī [fl. end of 3rd/9th century] 1973: 303); al-Qazwīnī (1960: 107, 128).

[146] Yāqūt (1988: I.343) and al-Qazwīnī (1957: 80)

[147] Al-Maᶜsūdī (1917: III.56).

[148] *Ḥudūd al-ᶜĀlam* ([c. 372/983] 1970: 56, 146.4.A.I, 179. 3.1)

decks of most vessels". He adds that it is also used locally for shipbuilding. Teak wood appears to have been highly valuable in medieval times and to have had symbolic connotations. Indeed, the 4th/10th century historian al-Ṭabarī (1989: I.359-361) and the 7th/13th century historian Ibn al-Athīr (1987: I.56) state that God ordered Noah to build his ark from teak planks. Teak was also used in non-maritime objects in the Red Sea: Four everyday teak artefacts were unearthed at Myos Hormos/Quseir al-Qadim: two bungs and lids and a spatula from the Roman period, and a bung and lid from the Islamic periods, (Van der Veen et al. 2011: 213, Table 5.2, 3).

Teak was identified as charcoal in both periods as well (Van der Veen et al. idem: 221-222). It was also found used in construction at Khurshid Efendi's house at Ottoman Suakin (Mallinson et al. 2009: 479). Teak wood applications, mentioned throughout the Islamic medieval period, encompass buildings,149 coffins,150 bridges,151 beds,152 tracks,153 in Egypt, the Arabian Peninsula (Saudi Arabia, Yemen and Oman), Iran, Iraq and South East Asia (see Section 6.2). Meanwhile, general uses of teak include house construction, railway sleepers, bridges, flooring, furniture, and dying; and its sawdust was used for medicinal purposes (Gamble 1902: 532; Titmuss 1965: 243; Usher 1974: 568-569; Heywood 1993: 237; Mabberley 1998: 845).

7.2.17 Terminalia L.

Nautical evidence for *Terminalia* for our periods in the Red Sea is non-existent, while the only evidence for this wood is attested at al-Balid. A boat plank reused in a building

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[149] Al-Balādhurī ([d. 279/892] 1916:I.20; 1924: II.6; 1978: 20-21, 342); Ibn Faqīh al-Hamadānī (1973: 20); al-Muqaddasī ([d.380/990] 1906: 71, 92, 426); Nāṣir-i Khusraw ([d.465 or 471/1072 or 1078] 1986: 76, 96); Kitāb al-Istibṣār ([c.587/1191] 1986: 16, 22); Ibn Jubayr ([d.614/1217] 1907: 311; 2008: 20); Yāqūt (1988: III.295, 393, 479- 480, V.187); Ibn al-Athīr (1987: II.493, V.167, VII.52; 1987: VIII.150, 302); Abū Shāma [d.666/1268] 1956: 503); Ibn al-Mujāwir (2008: 224, 247, 280); al-Masᶜūdī (1970: IV.253); Abū l–Fidāᵓ (1840: 326-327); al-Nuwayrī l-Iskandarānī (1969: II.168; 1970: 146 ft.7, 149; 1973: VI.14); al-Nuwayrī (1954: I.383; 1984: XXII.91); Ibn Baṭṭūṭa (1962: II.323; 1972: I.195); Ibn Khaldūn (1956: I.363); Ibn Taghrībirdī (1963-1971: III.16, 54); al-Maqrīzī (2002: I.520, II.86, 88; 2003: IV.1.13, 22, 74); al-Iṣtakhrī (1927: 127); Ibn Ḥawqal (1964a: 54, 248, 1964b: I.47, II.77); Ibn Saᶜīd (1970: 160); al-Qalqashandī (1963-1970: IV.346); al-Qazwīnī (1960: 96); al-Yaᶜqūbī ([d.897] 1892: 258).

[150] Al-Maqrīzī (2002: I.667).

[151] Al-Ṭabarī (1987: XXXVII.99); Ibn al-Athīr (1987: VI.320); and al-Nuwayrī (1984: XXV.170).

[152] Al-Nuwayrī (1975: XIX.129).

[153] Al-Bakrī (2003: I.194).

context there was identified as *Terminalia* sp. by CSIRO. This genus belongs to the family and subfamily of Leguminosae Caesalpinaceae[154] according to the Instituto per la valorizzazione del legno e delle specie arboree, Italy (IVALSA) (Belfioretti & Vosmer 2010: 111-112). This sample (BA 0604172.69) dates to 690±50 BP and fits together with another wooden plank (BA0604159.263) identified to the same family and sub-family by IVALSA, and not to species or genus levels (Belfioretti & Vosmer 2010: 111-112) (Figure 7.31).

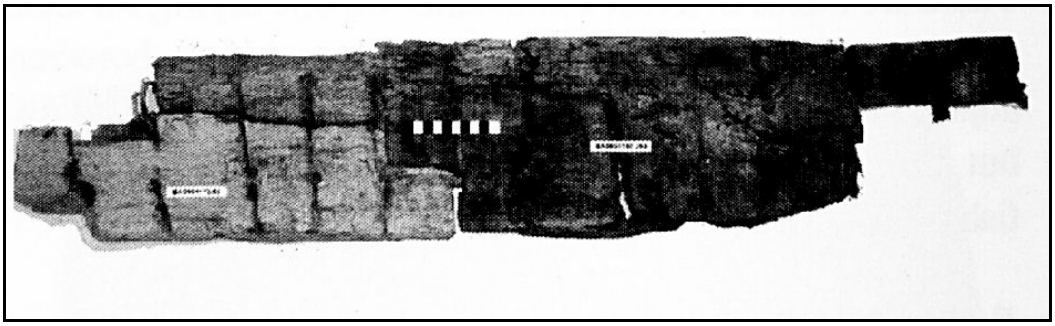

Figure 7.31: *Terminalia* plank BA 0604172.69 9 (to the left) joined with plank BA0604159.263 which was identified as belonging to family and subfamily of Leguminosae Caesalpinaceae (Belfioretti & Vosmer 2010: 114, Figure 8).

Terminalia is a genus of around 200 to 250 species growing in tropical areas such as Latin America, West Africa, Sudan, Yemen, India, Sri Lanka, and the Indo-Malay peninsula (Usher 1974: 570; El Amin 1990: 91-95; Wood 1997: 174-175; Mabberley 2008: 846-847). Gamble (1902: 337) mentions sixteen tree species of large size growing in India and valuable for their timber "and of considerable importance in the sylvicultural management of Indian forests". In India, *Terminalia* sp. exists in four subgenera following the characters of the fruit (Gamble: 1902: 337). Certain species are used in boatbuilding such as: *T. arjuna* (Roxb.) Wight & Arn. distributed from central, eastern, and southern India to Malaysia (Gamble 1902: 341; Usher 1974: 570, 571); *T. tormentosa* (Roxb.) Wight & Arn. growing in northern India (Gamble 1902: 343); *T. myriocarpa* Van Heurck and Mull.Arg growing in northeast India for canoes (Gamble 1902: 345); and *T. bialata* Steud. growing in Burma and the Andaman Islands for oars (Gamble 1902: 345). *T. superba* Engl. and Diels growing in tropical West Africa is also used for canoes (Usher 1974: 570, 571). This latter species is known under its commercial name of White Afara (Titmuss 1971: 39). Titmuss (1971: 39) adds that *T. superba* is not naturally resistant to decay or insect attack and large logs of the species

[154] It is the family and subfamily.

may have a defect called 'brittle-heart' which reduces the strength of the wood. Indeed, these characteristics do not encourage Usher's above-mentioned statement. Only one *Terminalia* species is recorded in Yemen *T. brownii* Fresen., a 15-metre-high tree (Wood 1997: 174-175). There are nine *Terminalia* species growing in Sudan which were introduced from tropical Asia as shade trees (El Amin 1990: 91-95). *Terminalia* sp. wood is hard but easily worked, used as timber for construction and furniture, and the bark and fruits for dyes, tannin, gums and some medicinal uses (Usher 1974: 570-571).

7.2.18 cf. Wrightia R.Br.

Maritime applications for the *Wrightia* genus in the Red Sea archaeological record is very scarce and dates only from the Roman period. One brail ring from Myos Hormos, numbered W0361 and found in Trench 6H-4085 (Figure 7.32), was provisionally identified as cf. *Wrightia* sp. from the Apocynaceae family (Gale & Van der Veen 2011: 221, 222; Van der Veen et al. 2011: 206, 207). This genus comprises 23 species of tree and shrub native to tropical Africa and Asia including two (*W. arborea* Dennst. and *W. tinctoria* Rottler) from India (Figure 12.51). This genus is used for construction timber, carving and dyes (Usher 1974: 611; Mabberley 2008: 913). This is the only attestation of such wood for maritime use in classical and medieval antiquity.

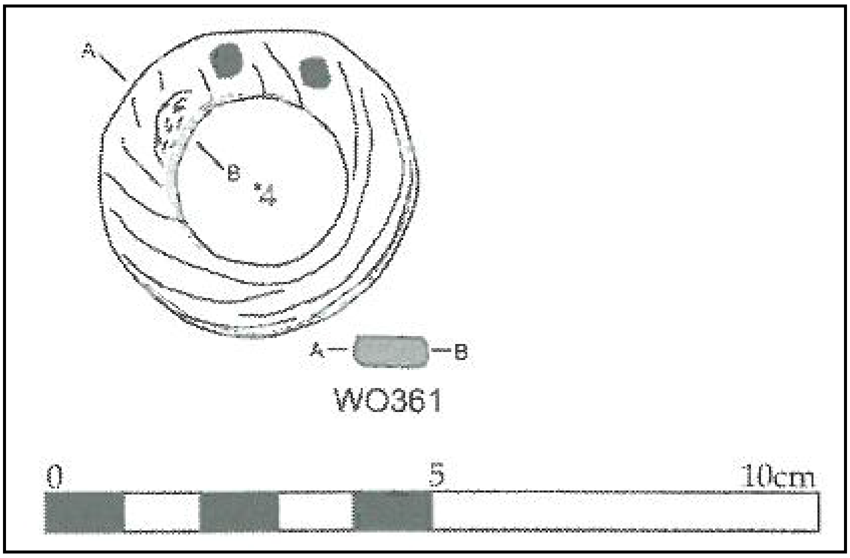

Figure 7.32: Cf. *Wrightia* brail-ring W0361 from Myos Hormos (Blue et al. 2011: 192, Figure 15.12).

7.2.19 Ziziphus spina-christi (L.) Willd.

Related evidence for this species consist of a fastening element from Egypt in the Late Period. A tenon of 9.7 x 4.2 x 1.2 cm was identified as "sidder (Lat. *Ziziphus* sp.)" from the Matariya wreck (Ward 2000: 129). "Sidder" tenons from earlier periods were identified in the Khufu I hull (Ward 2000: 18, 50, 129). Even if Ward (2000: 129) puts forward an identification on the genus level i.e. *Ziziphus* sp. , she uses the name "sidder", i.e. sidr which is the vernacular name for *Ziziphus spina-christi* (Eng. Christ's Thorn Jujube). Such wood is quite hard and durable and commonly used in boatbuilding for fasteners (Lucas 1989: 446; Gale & Cutler 2000: 286). It was also employed in the Eastern Mediterranean, and was used for repairing some of the frames of the 5th-6th century Dor 2001/1 Byzantine coaster (Kahanov & Mor 2009; Liphschitz 2012: 98).

Ziziphus spina-christi (L.) Willd. belongs to the genus *Ziziphus* Mill. from the Rhamnaceae family consisting of 100 species of shrub and small tree up to 5 metres in height. It grows in the tropics and warm temperate regions, while being native to the Mediterranean region including Egypt and to Tropical Africa (Lucas 1989: 446; Gale & Cutler 2000: 286; Mabberley 2008: 924). The trunk is well developed and provides reasonably large pieces of timber (Gale et al. 2000: 347) (Figure 12.53). General archaeological evidence for this wood includes boatbuilding, dowels, coffins, mummy labels, stele and clubs (Lucas 1989: 446; Gale & Cutler 2000: 286; Gale et al. 2000: 347).

This concludes the list of species and genera found in archaeological context in Egypt, the Red Sea, Oman and Belitung. The following discussion pertains to the implication of such archaeological datasets for our understanding of ancient wood exploitation for boatbuilding.

7.3 Discussion

The high state of preservation of wooden maritime artefacts from Heracleion-Thonis, Matariya, Myos Hormos/Quseir al-Qadim, Berenike, al-Balid and Belitung has provided significant information regarding the use of wood in boatbuilding in antiquity. Both endemic and non-endemic wood species have been found at these sites (Section 7.2), indicating substantial exploitation of wood resources. The exploitation of local species indicate that the environments of these sites offered several arboreal species suitable for boatbuilding. By the same token, wood merchants and boatbuilders of the past saw in these trees the potential of fashioning long planks from tall trunks and curved boat components from crooks. When long planks could not be obtained boat builders used short tree sections to fashion equally short planks. Thus, timber agents and boatbuilders interconnected with their environment through such sets of affordances, as these pertain to both the environment and the perceiver (Gibson 1986: 127-128).

This discussion starts by investigating the exploitation of both endemic and non-endemic wood species, its implications for wood trade and economy, and the agencies involved. Subsequently, it examines the potential provenance of related species, site by site. Indeed, the native distribution of relevant timber-producing trees can inform us on the location of boatyards. However, this is not a straightforward process, since the timber trade flow in the western Indian Ocean, as well as repairs of vessels should also be considered. These latter can be inferred from the presence of timber species in boat components fashioned from trees which grow in a different region than most of the boat's timbers (Liphschitz 2012: 96). Finally, this discussion looks at the significance of recycled timbers and wood shavings.

7.3.1 Exploitation of local wood species in the Red Sea

It is commonly thought that local arboreal species in countries adjacent to the Red Sea are of low quality for boatbuilding and quite rare. However, the archaeological data investigated here has shown that a substantial number of native trees were used in boatbuilding from both the classical antique period and the medieval Islamic period (12.3.2 Table 2 and12.3.3 Table 3). Local genera and species include: *Acacia*, *Ficus*, *Olea*, *Quercus* (?), *Salix*/*Populus*, *Salvadora persica*, *Tamarix*, and *Ziziphus spina-christi*. Uses of these woods vary greatly, from planks, to structural components, fastening and rigging elements. Some were found as woodchips at Myos Hormos/Quseir al-Qadim and at Berenike. These testify to repair, refurbishment and dismantling practices at these sites and perhaps boatbuilding (Sidebotham & Wendrich 1998: 91, 92; Van der Veen et al. 2011: 206). However, I believe this testimony to be highly speculative since these woodchips could be associated to any other on-site carpentry work. Thus, a nautical use of such species can only be inferred from comparative archaeological data, and textual and ethnographic evidence (See Chapters

6, 7, and 8). Most, if not all, of the above-mentioned species grow in the Nile Valley which has been acting as a wood provider since Pharaonic times. Breasted (1906: I. 145-149) has shown that Middle and Upper Egypt were rich in timber resources during the Old and Middle Kingdoms. In the classical period, Theophrastus (IV.2.8) later copied by Pliny (XIII.19), both mention stands of acacia, oak, and olive in the Thebaid, the southernmost area of Upper Egypt. Such state-owned forests seem to have survived until at least the 12th century AD, since these were described by Ibn Mammātī (see Section 6.2.3). Apart from some economic information provided by Ibn Mammātī about local wood procurement, little is known about the price of local timber species in the past. When discussing prices of local timber in Pharaonic Egypt, Janssen (1975: 374) argues that tamarisk was quite cheap due to it being a common tree.

The present-day landscape of Egypt still holds tree stands, mainly in the Nile Valley and the Nile Delta where contemporary boatbuilders seek their wood. The present author agrees with Lucas (1989: 448) who states that: "There have always been, as there are today, plenty of comparatively small indigenous trees, such as acacia, sidr, sycomore fig, tamarisk and willow that could have been used for making boats [...] The need was not for timber [from abroad] of any kind, but for timber of better quality and larger size than that obtainable locally". The archaeological evidence I discussed in Section 7.2 sheds light on the importance of the exploitation of local species for boatbuilding in the Red Sea, which is otherwise obscured by an apparent general consensus stressing a greater reliability on imported wood. Ward (2000: 24) rightly stresses the sturdiness of Egyptian boats made with local tree species: "Local woods played a vital role in the waterborne commerce of the nation, and the abilities of ancient shipwrights to deal successfully with local materials and resources, are reflected at every site where worked and unworked stones were brought by boats."

In conclusion, the archaeological record studied here sheds light on the use of local wood species for boatbuilding in Egypt, but does not do so for other Red Sea areas. However, our ethnographic data155 and those of others (e.g. Madani 1986; Prados 1996), related to these areas mitigates this gap, since it informs us that the same endemic species to Egypt such as acacia, tamarisk and sidr are also used locally in present-day boatbuilding. Thus, it can be inferred that such species were also used in the

[155] I mean by this here Agius, the MARES Project team and myself.

past. Aside from local species, foreign timbers were also used for boatbuilding as the archaeological record from the Red Sea sites indicates. These are now discussed below.

7.3.2 Exploitation of non-endemic species to the Red Sea

Non-endemic tree species were found used for boatbuilding at Myos-Hormos/Quseir al-Qadim and at Berenike. These comprise species and genera originating in India such as *Tectona grandis,* and cf. *Wrightia*; tropical Africa such *Dalbergia*; and the Mediterranean such as *Cedrus* and *Pinus*. The uses include planks, rigging and fastening elements. Meanwhile, species such as *Afzelia* and *Alnus* are hard to pinpoint geographically, since they have a wide distribution which ranges respectively from tropical Africa to Asia; and from the Mediterranean, to tropical Africa and Asia. The same goes for cf. Pomoideae which spreads across north temperate Europe and Asia.

The presence of these species at Myos Hormos/Quseir al-Qadim and Berenike can either indicate import, or more likely, following the archaeological recycling contexts of these finds, a result of dismantled boats which were refurbished. In the case of import, drawing a comparative framework for the Roman and Medieval Islamic period in the Red Sea is an impossible task due to the lack of evidence. All of the abovementioned timbers date to the Roman period while only one plank of *Afzelia* sp. at Quseir al-Qadim dates from the middle medieval period. With such a circumstantial dataset, it would be simplistic, albeit erroneous, to assume that the volume of import of timbers to the Red Sea has decreased from the Roman to the Medieval Islamic period. We know from textual evidence that this was not the case (see Section 6.2).

In the case of recycled timbers, there is substantial evidence at both Myos Hormos/Quseir al-Qadim and Berenike to suggest ship refitting, repair and dismantlement (Sidebotham & Wendrich 1998: 91, 92; Blue et al. 2011). Similar practices at these sites indicate that they were unlikely centres for regular large–scale ship construction, but rather for occasional boatbuilding, and more for maintenance and repair works. The main hindrance to regular boatbuilding was most probably the lack of resources for tall suitable wood in the area, and the high cost of transporting the raw materials across the Eastern Desert route from the Nile Valley, or by sea from the northern Red Sea/Levant harbours or India (Sidebotham & Wendrich 1998: 91; Wild &

Wild 2001: 218; Fauconnier 2012: 80). Long-distance import of wood in antiquity must have been quite expensive. This can be inferred from textual evidence describing achievements by royal elites building boats of non-local wood (See Chapter 6). It was also the case in earlier periods. For example, when discussing prices of imported timber for boatbuilding during the Ramessid period (1290-1075 BC), Janssen (1975: 370-382) argues that prices varied with the size and quality of an imported log, and whether the log had been worked or not. It seems that imported finished boat components were pricier that raw wood (Janssen idem: 377). Function also plays a role, since it appears that a keel costs double a mast of the same length, perhaps owing to the fact that the wood of a keel was of better quality than a mast (Jansen idem: 380). Timber species — whenever mentioned in papyri and ostraca from Deir al Madina that Janssen studied — is indicated by the glyphic word ‘š which Janssen translates as pine or fir (Janssen idem: 375). However, other translations of ‘š exist and the most common is cedar, being Cedar of Lebanon (Meiggs 1982: 55; Mikesell 1969: 13-14). Other papyri mention the import of logs of *hbn* commonly translated as ebony, but it does not seem that this was for boatbuilding purposes (Janssen idem: 372). Janssen (idem: 382) also noticed the rise in prices of ‘š wood between the Nineteenth (1292–1191 BC) and Twentieth Dynasties (1190–1077 BC), possibly due to political circumstances at the time. At that time, Egypt was in turmoil due to inner political problems in the dispute of Egypt's throne, a series of droughts, famine and civil unrest, as well as the external threat of invasion by seafaring tribes coming from the Aegean Sea and known as "the Sea People" (Shaw & Nicholson 1995: 202). Such political unrest would have influenced Egypt's economy at that time, resulting in higher commodities prices; especially that local and foreign timber resources were subdued to royal control (Ward 2000: 24). An understanding of a politico-economical context, such as that of Ramessid Egypt and its influence on timber trade, is quite obscure for our periods and areas of concern due to the lack of related information from classical and medieval Islamic sources. Very little is known about the volume of such trade, and the political, and socio-economic implications of classical and medieval timber trade in the wider Red Sea. We can only broadly infer that the price of timber imported to the Red Sea would vary with quality, size, and function as it was the case during Ramessid Egypt. In the case of Roman Egypt, wood, especially large straight planks, was most probably an expensive commodity in Myos Hormos and Berenike since it has to be transported across the Eastern Desert and was submitted to taxation (Lewis 1983: 141; Bülow- Jacobsen 2003: 420; Sidebotham 2007). Still, imported Mediterranean, Indian and East African wood species testify to long distance trade between the Mediterranean and the Red Sea on the one hand and the Red Sea and the wider Indian Ocean on the other (Sidebotham & Wendrich 1998: 91; Vermeeren 1999: 201, 202; 2000a; 2000b). The provenance possibilities of non-local timbers are discussed exhaustively in Section 7.3.3.2.

As for the several agencies involved in the ancient timber trade and exploitation, there is no information directly pertaining to the social or ethnic context of wood merchants that is made explicit by the archaeological evidence. We do not know whether such a trade existed exclusively for timber exchange, or whether merchants trading in timber also traded with other goods. Despite state control over general trade in antiquity and medieval times, individual merchants also existed (Abu Lughod 1989: 227; Agius 2008), and they must have handled timber cargoes among other traded commodities. Textual evidence from classical antiquity, such as the Archive of Nicanor ostraca from Coptos (6-62 AD), indicates a firm of traders and financial investors operating at Myos Hormos and Berenike (Sidebotham 1986: 83; Peacock & Blue 2011: 348; Fauconnier 2012: 80). Interestingly, such private merchants did not seem to be exclusively male. A 2nd -3rd century BC inscription found at the Temple of Leto at Medamoud, south of Coptos, mentions two women who were merchants and owners of a fleet in the Red Sea (Sidebotham 2011: 219). I believe such evidence shifts gender-coloured assumptions (Ransley 2005) that Indo-Roman trade was an exclusive male domain, and opens the path to equally acknowledge the existence of women traders.

In the case of medieval Egypt, the government was involved in levying and regulating taxes on wood procurement as Ibn Mammātī and al-Maqrīzī tell us (see Section 6.2.3), but still private entrepreneurship existed (Peacock & Blue: ibid). However, there is no archaeological evidence for this but only textual. By the 7th/13th century, a prominent group of merchants called the Karīmi operating from Egypt, but also in Aden and the Hijaz, monopolized the trade with India and East Africa (Goitein 1958). In Yemen, teak and several other Indian commodities imported to Aden were also under taxation from Ayyūbid and Rasūlid sultans (r. 626-858/1129-1454) (Vallet 2010). Moreover, the presence of imported timbers in the Red Sea does not necessarily indicate the presence of a foreign population settled there, but just the presence of foreign shipbuilding materials (Peacock & Blue 2011: 346). Thus, it is highly probable that timber merchants were part of the cultural and ethnic melting-pot of the Red Sea where Indian, Arab, Persian, African traders together with indigenous populations were involved in commerce.

In conclusion, archaeological evidence presents a skewed picture of the species used in boatbuilding whether it concerns local timber or imported species. Generally speaking, it is assumed in boat studies that tall straight trees are exploited for boat components requiring length, and relatively shorter and twisted trees suit curved boat components. This hypothetical dichotomy is reappraised here in the light of the archaeological record studied in this thesis. Firstly, evidence from sites fails to always indicate the functional role of timbers, that is, knowing from which component the samples were taken for identification. Hence, we cannot draw systematic patterns for the use of wood in a boat from the present archaeological data. However, perhaps such categorisation of timber species is not so clear cut, for example: it is generally assumed that acacia was solely used for structural components, but textual and archaeological evidence indicates its use in hull planks as well. Indeed, Herodotus (II.96) attests the use of acacia for short hull planks in Egypt. Also pine is commonly thought of as timber suitable for planking only. However, comparative evidence from shipwrecks in the Eastern Mediterranean, and from the 18th century Sadana and Sharm al-Sheikh wrecks, also include pine structural components. Hence, we can only confer a general character of such a dichotomy while keeping an open mind to possible variations. Another shortcoming of the archaeological evidence is its restriction quantitatively, and its limited geographical distribution. Data is present for Egypt, although at only four sites, and otherwise absent for the rest of the Red Sea littoral due mainly to the lack of excavation works hindered by recurrent internal political and regional tensions. The organic nature of timber is also a factor since wood needs dry, and/or preferably anaerobic environments to be preserved. Another factor is the potentially ancient practice of using dismantled old parts of boats as firewood (Madani 1986: 28). Thus, ancient timber exploitation in countries such as Sudan, Eritrea, and Djibouti for example remains largely unknown.

If a few insights can be drawn from these archaeological timbers about boatbuilding techniques in the Red Sea and the western Indian Ocean, nothing can be said about the overall type, size, and function of ships that were dismantled at Quseir, Berenike, and al-Balid for example. To Sidebotham (2011: 196), vessels plying the Red Sea in the Roman Era were basically either cargo boats or military craft. We still cannot dismiss other functions such as fishing craft and freighters, which are almost absent from ancient and medieval literature (See Chapter 6). Moreover, the archaeological evidence investigated here does not inform us on the people who owned, felled, transported and shaped boat timbers. What it can provide us, albeit quite vaguely, is information on the narrative of the boats under study, as will be discussed next.

7.3.3 Provenance scenarios and boat narratives

This section explores how identifying species of boat-related archaeological wood can inform us about the narrative of the related boats. Conceptual approaches to studying shipbuilding and archaeological ship remains have been set-out by major works such as Muckelroy (1978: 157-225), Adams (2001), Hocker & Ward (2004), and Pomey & Rieth (2005). Even when these works discuss technological and material aspects of boatbuilding, they do not dedicate a section about wood identification and its significance as one of the many conceptual parameters dictating the study of boat or ship remains. For example, Adams (2001: 203) defines materials as: "the natural or manufactured materials available for construction". He goes on "Their availability will obviously have a strong influence on the vessels that can be constructed. In some situations the environment will limit the choice. In more bountiful regions, choice may indicate cultural attitudes and preferences or be related to the technological capability to exploit them". Thus, the following attempts to evaluate case by case the implications of wood identification in understanding the narrative of a boat, rather than a focus on the issue of the origin of a boat. As Kopytoff (1986: 67) says: "Biographies of things can make salient what might otherwise remain obscure". Thus, this section seeks to evaluate whether wood identification alone is suffice to determine the narrative of a boat , or other parameters needs to considered as well. These include the building technology; the ideology behind it; the relationship between the different agents involved (timber merchant, boatbuilder, owner); the cargo; the travels; the crew and passengers; and at the end of a boat's life, its final resting place after having wrecked or being dismantled.

Apart from the archaeological evidence from the Red Sea, evidence from al-Balid and Belitung is considered here on a comparative basis in order to forge a wider backdrop to nautical wood exploitation in the western Indian Ocean. But first I will explain the shortcomings of the scientific method of wood identification and how these influence the possible provenance scenarios.

7.3.3.1 Limitations of wood identification in interpreting provenance issue

The anatomic identification of the wood species of boat timbers assists the researcher in assigning a potential origin to the ships studied. More importantly, analysing archaeological wood provides an important source of information on wood exploitation and trade, especially when written sources fail to do so. As an example of this, Tengberg (2002: 75) argues that "in Eastern Arabia written sources are extremely rare before the Islamic period, and we therefore have to rely on other types of evidence in order to understand different aspects of the exploitation and use of wood in antiquity. The analysis of wood samples from several archaeological sites has now provided us with the first data on these issues from the beginning of the fourth millennium BC until the first centuries AD". However, this scientific method has its limitations, and these influence the interpretation of results when determining where a ship was built and/or repaired. Wood identification is not a straightforward process and is open to debate and re-consideration. The variation in results can lead to the possibility of assigning different origin scenarios to a boat, and thus lead to not one, but many interpretations of a single timber assemblage.

Generally speaking a tree genus has a wider geographical distribution than that of species. This can narrow down the possible origin of a timber. However, most publications on maritime wood identification fall short of determining species and only present identifications at genus level (See Van der Veen et al. 2011: 206). This generates several scenarios on the origin of a boat, particularly is if the latter is based solely on wood identification. For example, *Afzelia* was identified as the genus for a recycled plank covering Tomb 1 at Quseir el-Qadim. This could have originated from an area covering tropical Asia and Africa. In comparison, the domain of *Afzelia africana*, constituting the majority of the Belitung wreck timbers, is limited to central and western tropical Africa. More specifically, this species might have been resourced in Sudan for example (Usher 1974: 24; El Amin 1990: 191). Bearing in mind that there is no evidence yet for the export of *Afzelia africana* from East Africa to Indonesia for boatbuilding purposes, it can be suggested that the Belitung ship might have been constructed near wood sources on the Red Sea coast of Africa —perhaps in Sudan. In any case, wood identification, especially at genus level, should be considered alongside other elements whenever possible, such as the cargo of a ship, the construction period, and the operating area.

Another methodological problem in wood identification is that different studies of a same wood assemblage can produce diverse results. This occurred when scholars sought to identify woods from Quseir al-Qadim, and from the Belitung wreck. Blue (2006) mentions the presence of teak planks covering Tomb 1 in Burial 61; these once belonged to a sewn-planked vessel, thus indicating an Indian origin for the planks. However, subsequent publications and studies (See Blue et al. 2011: 181; Gale & Van der Veen 2011: 223; and Van der Veen et al. 2011: 210) rejected the teak identification, stating that the planks were made of an "unidentified hardwood possibly non-native to Egypt", rendering impossible the identification of the origin of these planks. In the case of the Belitung wreck, CSIRO and Liphschitz who analysed similar sets of samples, did not come up with the same identification to the samples they analysed (Flecker 2008). Wherever CSIRO provided either one or two potential species identification, or even none, for one sample, Liphschitz offered a single and what seemed a more secure identification (Flecker 2008: 385, Table 1).

These two different interpretations will be analysed below in more details. In the meantime, these examples show that any interpretation based on wood anatomy and the identification of timber species is quite tentative and might vary according to the laboratories involved and their practice. Therefore, whenever wood species vary from one identification to another, so does our interpretation of the provenance of these woods and the biography of the boat.

7.3.3.2 Case by case analysis

The discussion that follows will re-appraise recent scholarly interpretation on the origin and identity of boats the planks of which were recycled at Myos Hormos/Quseir al-Qadim, Berenike, at al-Balid, and Belitung. It focuses on how and to what extent the scientific identification of timbers and their species distribution affects such interpretations. It also suggests an alternative way of viewing origin scenarios and how these come at play when interpreting a boat's narrative.

7.3.3.2.1 Roman Myos Hormos and Berenike and Islamic Quseir al-Qadim

These three sites are taken here under the same heading since they indicate patterns of reuse and recycling. As seen previously in this chapter, reused boat hull planks found at Myos Hormos and Berenike indicate repair and maintenance works for boats visiting these sites during the Roman period, and the medieval Islamic period in the case of Quseir al-Qadim. The practice of recycling boat timbers in architectural contexts in Egypt stretches back to the Middle Kingdom (See Ward & Zazzaro 2010). It seems justified by the lack of available wooden resources in these arid Red Sea environments by which no piece of wood should go to waste. What if a dismantling yard existed at these sites comparable to the one which existed in Tyre, Lebanon during the Phoenician period (1200-332 BC) (See Aubet 2001:179). At the breakers yard at Tyre, old ships were broken down for their timber in an area where wood was readily accessible (Meiggs 1982: 50), in contrast with the aridity of the Red Sea adjacent areas. What the practice of recycling boat planks can tell us also is that it entails a more conscious and active response of people to their environment, rather than a passive one. The choice that people take to re-use boat planks does not so much depend on the availability, or the lack thereof, of arboreal resources, but more on taking the opportunity of what such environment as a whole affords to them. Indeed, most of recycled boat planks are discarded ones, which might have been damaged by high coral reefs while approaching the Red Sea coast, and/or the long distance open-sea voyages in the western Indian Ocean.

Generally, the boat timbers discovered in Roman contexts at Myos Hormos and Berenike seems to suggest mainly an Indian and East African origin for these vessels (Blue 2009: 10). Such origin scenarios are discussed here as well as the way in which such foreign timbers made their way to the Red Sea. This gives way to looking at dissimilarities between the Roman wood assemblages of Myos Hormos and Berenike, and the ones of Islamic Quseir al-Qadim, and how these inform us about the exploitation of wood for boatbuilding during these two periods.

In sum, the following local genera were found at Myos Hormos: *Acacia*, cf. *Olea*, and *Tamarix*; while *Acacia*, *Avicennia marina* and *Tamarix* were found at Berenike, as pegs (in the case of acacia) and as woodchips. The following non-local species found at Myos Hormos were: *Alnus* sp., *Dalbergia* sp., *Pinus*, cf. Pomoideae, *Tectona grandis*, and cf. Wrightia; and *Cedrus libani* and *Pinus* at Berenike (Whitewright 2007: 289; Gale & Van der Veen 2011: 221-223; Van der Veen et al. 2011: 209-210). Foreign nautical timbers at Myos Hormos and Berenike seem to have originated from three main sources: the Mediterranean, tropical Africa, and India. However, as I will demonstrate below, the same species might originate from one or more locations. From the Mediterranean, timbers include the following genera and species: *Alnus*, *Pinus*, *Cedrus libani*, and *Quercus*. However, *Alnus* is also present in North Africa and South East Asia. Other potential regions of import are north temperate Europe and South East Asia for the cf. Pomoideae subfamily. These two types of wood (*Alnus* and cf. Pomoideae) are found in the archaeological record of Egypt for the first time (Gale & Van der Veen 2011: 223; Van der Veen et al. 2011: 209). *Quercus* might be of local exploitation in Egypt, but it is also present in north temperate regions, North Africa and Malaysia. Neither the genus *Dalbergia* nor its origin were identified by Van der Veen to species level. It might be the African species *Dalbergia melanoxylon* Guill. and Perr. (Eng. African blackwood) or the Indian *Dalbergia sissoo* Roxb. (Eng. Indian rosewood) (Figure 12.23). The Periplus (ch.36) mentions what is probably the latter as a wood exported from India to the Gulf but not to the Red Sea. If needed be, perhaps such wood might have been re-shipped to the Red Sea areas. The most common export from India is teak which was found at Berenike and Myos Hormos.

The wide variety of geographical distribution of species leads to several scenarios as to where boats were built, repaired, and refurbished. These trees are an inherent part of the narratives of boats plying the Red Sea and the western Indian Ocean during the Roman Period. With such non-conclusive data it is difficult to indicate that one scenario is more valid than another. This leads us to consider the importance of the narrative itself rather than the origin story. Scholars have recently suggested several provenance scenarios which I summarize below while adding my own insights (See Vermeeren 2000a; Whitewright 2007; Tomber 2008: 73; Blue 2009: 8-9; Gale & Van der Veen 2011; Sidebotham 2011: 200-205; Fauconnier 2012). Moreover, it should be borne in mind throughout the discussion that planks and rigging elements found at Myos Hormos and Berenike do not probably belong to the same boat but might as well be the remnants of vessels involved in the India trade.

The first possible scenario is that vessels constructed in the Mediterranean and which subsequently sailed to India, underwent repairing in India either by indigenous craftsmen or westerner settlers in India known as Yavanas (Blue 2009: 9; Sidebotham 1986: 23; Fauconnier 2012: 94-101). Such ships travelled first to one of the Red Sea harbours and then sailed to India. Textual evidence from both the Roman and medieval Islamic period indicate two main ways for boats to reach the Red Sea from the Mediterranean (Blue 2009: 8-9; Cooper 2009). These were dismantled and hauled across the Eastern Desert for reassembly at Red Sea harbours (Garcin 1976: 209-210; Whitcomb & Johnson 1979: 3; Sayed 1980: 156; Bülow-Jacobsen 1998: 66; Wild & Wild 2001: 218; Cohen 2006: 333; Van der Veen et al. 2011: 223). Otherwise vessels would navigate the Nile-Red Sea canal depending on the historical period in which it was operational (Sidebotham 1986: 68; Ray 1994: 170; Young 2001: 67-69; Cooper 2009). Also, the canal would be navigable more likely by flat-bottomed Nile vessels rather than sea-going ships. Perhaps such vessels find their parallel in the boats that wrecked at Heracleion-Thonis, most of which indicate a Mediterranean origin of their timber species along with local trees to Egypt (12.3.4 Table 4). These vessels possess a flat lower hull suitable for plying rivers, but also had keels and thus were seaworthy (Fabre 2011). I suggest here other ways by which Mediterranean boat timbers made it to the Red Sea. Rougé (1988: 70 footnote 67) states that timber coming from the Syro-Phoenician coast arrived at the Gulf of Suez, and was floated south in rafts to Myos Hormos or Berenike. He does not himself explain how these timber logs made their way to Gulf of Suez, nor the logistics of floating them in rafts. Considering such a hypothesis as valid entails then were either transported overland to the Gulf of Suez, most probably to Clysma (See Sidebotham 1986: 68; 2011: 201; Ray 1994: 170; Young 2001: 67-69; Fauconnier 2012: 81) or floated on the Nile-Red Sea canal during the Nile flood. Floating timber logs on the Nile in the medieval Islamic period is attested by Ibn Mammātī (1998: 112) and al-Maqrīzī (2002: I.520, 522, 524) (See 6.2.3 and 6.2.4). River logging of timber is also attested from earlier centuries and in several other places such as the Eastern Mediterranean, Italy, and India (Meiggs 1982: 336-337, 345-346; Elayi 1988: 30-31; Semaan 2007: 60-64). Thus, floating Mediterranean logs destined for Clysma, Myos Hormos, Berenike and potential other port sites on the Red Sea in the Roman period seems a plausible hypothesis. Boats were most probably built at Clysma due to its location at the mouth of the Nile-Red Sea canal and the cost-effective transport of bulky goods along it, as Sidebotham (2011: 201) suggests. Otherwise logs destined for Myos Hormos and Berenike could have been towed in rafts behind freighters such as the ones found at Heracleion-Thonis for example. Comparatively, several scholars working in the Mediterranean argue for such a method (e.g. Meiggs

1982: 69, 337; Elayi 1988: 31). Floating logs in rafts behind boats is attested in I Kings 5: 8-9, when Hiram of Tyre (969-936 BC) sent cedar and cypress logs tied in rafts from Lebanon to Jaffa for Solomon (965-928 BC).

The practice of the dismantling of ships for transport should also be questioned. Such a practice is attested in the Pharaonic period in Egypt (Sayed 1977: 170), such as at Mersa Gawasis and Ayn Sukhna; in the Hellenistic period when Alexander the Great transported dismantled boats from the Phoenician coast to Thapsacus on the Euphrates for them sail south to Babylon (Arrian VII. 19.3; Strabo XVI.1.11); and much later in the 12th century when Reynaud De Châtillon built several ships in the Hijaz, which were dismantled and transported on camels to the Red Sea (Ibn Jubayr 1907: 59, 2008: 52; al-Maqrīzī 1956: I.1.78-79). These are one-off mentions and do not reflect a constant or common practice throughout places and periods. There is no direct textual or archaeological evidence of boatbuilding/dismantling/reassembly practice at Red Sea ports during the Ptolemaic and Roman periods (Sidebotham 2011: 201). The ostrakon from Krokodilô (K315) (See Section 7.1) records a wagon transport of uncut timber for shipbuilding to Myos Hormos (Bülow- Jacobsen 1998: 66). Hence, partially during the Roman period, Mediterranean logs were exported in raw state to Red Sea boatyards. In conclusion, terrestrial haulage appears as the main transportation method for dismantled Mediterranean ships and raw logs destined for Red Sea boatbuilding sites.

The second scenario suggests that vessels were built in Red Sea harbours using timber imported from India (Blue 2009). Such timber logs or pieces were probably transported as ballast in the boat hull. However, as I argued in Section 6.1 there is no direct textual evidence for a trade in timber between India and the Red Sea. That is not say that such trade did not exist, it most likely did, but the archaeological evidence from Myos Hormos and Berenike does not make it any less speculative.

Thirdly, vessels were built in India with Indian teak and other timbers by either Roman or Indian shipwrights, and could be refitted when needed using local materials or low-value bulk materials along the route (Blue 2009). These refitted pieces could be discarded following another re-fit on the Red Sea coast. Evidence from rigging elements shows that trading vessels sailed around many ports of the Indian Ocean and might have refitted their rigging at different places (Whitewright 2007: 289) argues. Whitewright adds that the variety of woods at Myos Hormos testifies to the diversity of locations visited and people involved in the production of rigging. Thus, it becomes quite challenging, as he says, to determine whether the brail-rings were made in overseas boatyards and acquired occasionally by visiting ships, or whether they were manufactured onboard from whatever wood was available at landfall. This multiplicity of scenarios and the different agencies and environments involved demonstrate the fluid world in which such boats operate. They become fluid things themselves since their narratives are far from being linear. They are constantly coming into being, through several patterns of transformation such as repair, refitting and refurbishment in the different places they accost, and the many wooden components these environments provide. The nautical timbers recycled at Myos Hormos and Berenike extend the boats biographies beyond the boats. As a result, boat narratives rather than being linear, "follow the multiple trails of growth and transformation that converge" in the constitution of things (Ingold 2007: 9).

Evidence from the medieval period includes ten ship timbers from Quseir al-Qadim, which were sampled for identification by Van der Veen. Seven of these are associated with Tomb 1, and three with Tomb 2. Six out of the seven planks from Tomb 1 appear to be a hardwood non-native to Egypt, but with no definite origin (Gale & Van der Veen 2011: 225; Van der Veen et al. 2011: 210-211); while the remaining plank might be of *Afzelia* sp. The three planks of Tomb 2 are made with acacia and sycomore fig. Evidence at Quseir al-Qadim also include eight pegs and eight woodchips. Two of the pegs belonged to Planks 5 and 6 of Tomb 1: one was unidentified and the other one was only tentatively identified to either genera *Salix* or *Populus*, both of which grow in Egypt (Gale & Van der Veen 2011: 224; Van der Veen et al. 2011: 211). The remaining six included four possible (cf.) *Salix* pegs and two made from *Salvadora persica*, both local species to Egypt (Van der Veen et al. 2011: 211). Seven of the eight wood shavings were also made of local species: one of possible (cf.) Acacia nilotica, one of *Ficus* sp., one possibly of (cf.) Moraceae, and four of *Tamarix* sp. (Van der Veen et al. 2011: 212).

I will interpret these results from Quseir al-Qadim by first looking at the two sets of timbers from the Tomb 1 and 2, in order to establish what these can reveal about nautical wood exploitation in the medieval period, the provenance of the timbers, and the construction place of the related boat(s). Secondly, I will consider whether similarities, or the lack thereof, in wood exploitation, use, and provenance can be drawn between the Roman period at Myos Hormos and Berenike on one hand, and the Islamic period at Quseir al-Qadim. This aims at investigating the development of nautical wood exploitation through time.

Firstly, there is a need to consider what the timbers from Tomb 1 and 2 can tell us about nautical wood use during this period. Even if the boat timbers from Tomb 1 were mostly unidentified (cf. *Afzelia* sp. and tentatively exotic), they attest to boats made outside Egypt and most probably to Indian Ocean ships, according to Blue (2009) and Van der Veen *et al*. (2011: 224). Meanwhile, timbers from Tomb 2, identified as *Ficus sycomorus,* indicate Egyptian built vessels. (Van der Veen et al. 2011: 224). I believe these two hypotheses by Van der Veen et al. are debatable, due to several caveats in the datasets. As most of the timbers from Tomb 1 remain unidentified, we cannot rule out the possibility of a boat or boats made in Egypt with imported wood. Thus, the boat(s) was(were) not necessarily made outside Egypt. We need to consider also if these planks are the results of repair work that the Egyptian built boat(s) undertook along the route. By the same token, these unidentified timbers from Tomb 1 might have originated anywhere in the western Indian Ocean. In the case of a non-Egypt origin, we also need to consider a Red Sea origin, more specifically a Sudanese origin, and even an Eastern African origin. This is implied by the *Afzelia* sp. plank of Tomb 1 since *Afzelia* grows in Sudan and more generally on the Eastern African coast. All this implies alternative origins to Van der Veen *et al*'s (2011) "Indian Ocean" origin.

The extent to which the timbers from Tomb 2 indicate Egyptian built vessels is questionable as well. These recycled planks constitute a small dataset, that is, three planks made of local woods: Nile acacia and sycomore fig. They do not provide the scholar with a complete image of the boat, its hull and structural elements. Therefore, it is impossible to know whether the totality of the hull was made with these two timbers, as Van der Veen et al. (2011: 224) suggest; especially when sycomore fig is not suitable for hull planks as my Egyptian informants have told me (See Chapter 8). We need to consider also whether these planks were perhaps part of western Indian Ocean boats which were repaired in Egypt.

Secondly, I investigate to what extent comparing Roman and medieval datasets inform us on the development of timber exploitation for boatbuilding through these periods. From first-hand observation Roman maritime artefacts from Myos Hormos and

Berenike are made from exotic woods such as teak. Meanwhile, the Islamic ones from Quseir al-Qadim are carved from locally exploited species such as acacia and sycomore fig (Van der Veen et al. 2011: 212). This suggests that in the Roman period, both Mediterranean and Indian Ocean vessels came to Myos Hormos and Berenike (Sidebotham & Zych 2010: 21;Van der Veen et al. 2011: 224); whereas boats from the Indian Ocean seem scarce in the Islamic period. Indeed, in medieval times Indian Ocean crafts may have stopped at Aden leaving Egyptian or Yemeni vessels to carry the goods up the Red Sea (Van der Veen et al. 2011: 224). However, I believe that it is quite hard, based on what little archaeological data there is, to ascertain that Indian Ocean ships were plying the Red Sea only during the Roman period. Consequently, identifying different patterns of timber exploitation during the Roman period, than those happening in the medieval Islamic period remains highly speculative and has many shortcomings.

In the medieval Islamic period, only one genus (*Afzelia* sp.) and two species (*Acacia nilotica,* and *Ficus sycomorus*) were identified by Van der Veen *et al.* (2011: 223). The species for the other six planks remains unknown. Such a small amount of identified planks is not representative enough of the types of woods related with boatbuilding, during the Islamic period at Quseir; since a hull is constructed with a mix of wood species. The local-wood timbers covering Tomb 2 appear to have been cut and shaped to fit the tomb dimensions so they are not in their original state of use (Blue et al. 2011: 182). They most probably derived from a wider assemblage of planks or structural boat components which might have included other woods. It is also very difficult to infer what species were used in which part of the hull, in other words the structural role of the timber species. We have no information about the choices of shipwrights when deciding which wood is suitable for which boat element.

Other types of wood remains linked with nautical activities were also analysed at Myos Hormos/Quseir al-Qadim. These were pegs and wood shavings. The wood species for the Islamic period are different from those of the Roman period (Van der Veen et al. 2011: 207: Table 5.1). The Islamic period pegs are made with locally available wood such as willow and toothbrush shrub, whereas those from the Roman period are made with non-native species such as teak and *Dalbergia* sp. This is open to several interpretations. First, it depends on the distribution of the wood species of these pegs, for example: the willow species could have originated in Egypt, but willow has a wider geographical distribution, from China to Europe (Mabberley 2008: 760-761, Van der

Veen et al. 2011: 211). But also, this willow peg can belong to any species of the genus *Salix* sp., since its identification remained at genus level (*Salix* sp.). The willow pegs could have therefore been non-local; perhaps the result of repair that took place outside Egypt. Thus, the origin of these pegs is quite hypothetical.

The eight wood shavings samples from the Islamic period point to an exploitation of three local species to Egypt: acacia, fig and tamarisk, and one possibly imported species: pine (Van der Veen et al. 2011: 207 Table 3.1, 212). While the analysis of 33 Roman shavings revealed a larger percentage of foreign woods, Van der Veen et al. (2011: 207 Table 3.1, 212) infer that "there is a marked contrast between the Roman and Islamic maritime artefacts". A larger number of Islamic wood shavings need to be analysed to discern this contrast, especially since the Roman assemblage also include eight shavings made of local woods (acacia, tamarisk and possibly fig).

In conclusion, the scarcity of identified timbers in both the Roman and the medieval Islamic periods do not allow us to draw clear patterns of exploitation of wood for boatbuilding, and track its development with time.

7.3.3.2.2 The 9th century Belitung shipwreck

After investigating the archaeological evidence for nautical wood in the Red Sea, I now turn my attention to Belitung where a so-called "Arab" shipwreck was discovered. I will question the validity of its timber sampling results and their implication in asserting such an identity to this vessel, and determine whether it could have been built on the Red Sea.

The sewn Belitung ship was first thought to be either Indian or Arabian/Persian according to Flecker (2000, 2001, 2008), due its construction technique typical of the western Indian Ocean. When Flecker could not establish the boat's origin from the construction details and hull shape alone, wood samples were taken off structural elements of the boat for species identification (Flecker 2000). However, two different sets of results for wood identification have been arrived at respectively by CSIRO and Liphschitz. The preliminary results put forward by CSIRO contain some tentatively identified species, and some others that were positively identified: Rosewood (either

Dalbergia sp. or *Pterocarpus* Jacq.[156]) for the stem-post, teak for the through-beams; and Cupressus sp.[157] for the ceiling timbers. The frames and the anchor shank are either *Afzelia* sp. or *Amoora* sp.[158] The hull planks might be *Amoora* sp., and the keelson chock is probably *Ficus* sp. (Flecker 2000: 215; 2001: 347). All of these timbers are found in India and South-East Asia (see Section 7.2). This led Flecker to consider an Indian origin for the boat (Flecker 2000: 216, 2001: 348). To him, the only timber that does not originate in India is *Afzelia* sp.. This pushed him to consider rather an "Arab" origin, instead of an Indian one (Flecker 2000: 215-216; 2001: 347-348). He says: "Of these timbers, only one, *Afzelia* sp., is native to Africa and nowhere else […] If this identification were conclusive, it would provide strong evidence for Arab construction." (Flecker 2000: 215; 2001: 347). It is not clear why Flecker considers a boat being made with an African timber as "Arab". Moreover, several authors (Burkill 1966: 61; Gamble 1902: 280; Mabberley 2008: 18; Titmuss 1965: 245; Usher 1974: 24) report the presence of *Afzelia* in India and tropical Asia, with some species being commercial timbers known as Malacca Teak. This contradicts Flecker's interpretation and supports an Indian origin. A South-East Asian origin, considering the wreckage place, in Indonesian waters, is worth considering as well.

Flecker considers that the Belitung ship might have been "made by Arabs/[Persians]" with some of the woods being local to Africa such as species of *Afzelia*, *Dalbergia* or *Pterocarpus* (Figure 12.59), and with Indian timbers such as teak and *Amoora* sp. that were exported to the Middle East. He fails however, to explain which import areas of the Middle East he means, where in the Middle East the boat might have been built, and how African species actually got there. It is surprising also that the boat could not have been built on the East African coast considering the species local to Africa. It is also puzzling what Flecker means by the term "Arab" boatbuilders. If he (2008: 386) means Oman or Yemen as a potential location for the construction of the Belitung ships, then the boat was built by Omani/Yemeni shipbuilders. In that case, these are "Arabian"

[156] From the Leguminosae family, it is a genus of 35 tropical species mainly distributed in Africa and South-East Asia (Mabberley 1998: 715; Usher 1974: 488). These authors also report some species used for boatbuilding.

[157] From the Cupressaceae family, it is a genus of 14 species growing in the Mediterranean areas to the Middle East, from the Himalayas to China, south, west, and north America to Honduras (Mabberley 1998: 239) Usher (1974:189) reports one Chinese species (*C. funebris* Endl.) used in boatbuilding.

[158] From the Meliaceae family, it is a genus of 120 species of trees growing in Indomalaysia and the West Pacific (Mabberley 1998: 21,38; Usher 1974: 41).

shipwrights. Also, three major ethnic communities, Arabian, Persian and Indian, were involved in similar boatbuilding techniques in the western Indian Ocean at the time (Agius 2013: 92). Thus, ascribing one particular identity to the Belitung wreck is conjectural.

The other set of wood sampling results from the Belitung wreck were provided by Liphschitz (Flecker 2008). These constituted the preferred choice of Flecker as he explains: "Liphschitz has been far more successful in making definitive identifications. In her opinion, the wood samples, taken from the same parent specimens as the CSIRO samples, were in quite good condition despite being in untreated wet storage for seven years. She attributes this to the sectioning method, using a razor-blade instead of a coarser sliding microtome which may have been used by the CSIRO. [...] Liphschitz specialises in identifying waterlogged shipwreck timbers, whereas the CSIRO's work is far more general. Drawing on cross, tangential and radial reference sections Liphschitz has no doubt about the genus identifications and is 'pretty confident' about the species. While the CSIRO identifications cannot be discarded, the author believes that Liphschitz's results should be given considerably more weight" (Flecker 2008: 385). Liphschitz 's set of results is the following: *Afzelia africana* was used in the stempost, frames, hull planks, anchor shank and as dunnage; *Afzelia bipindensis* was used for the keelson, *Tectona grandis* was used for the through-beams; and the ceiling planks were probably made of *Juniperus procera*. These timbers, apart from teak are local to Africa, and in the case of Juniper to Yemen, and this persuaded Flecker (2008: 386) to refute an Indian place of construction for the Belitung ship that "was most probably constructed in the Middle East, perhaps in the region of Oman or Yemen". It is also surprising here that an Eastern African place of construction is not taken into account as the author does not explain how the African woods might have arrived to the South-Arabian peninsula.

In conclusion, Flecker (2000, 2001) argues that the CSIRO results implies an Indian origin for the boats place of construction since most of the genera occur in India. However, he defends an "Arab" construction due to "the historically-documented timber export trade", and the fact that *Afzelia* sp. does not grow in India. It should be stressed that the genus *Afzelia* sp. is indeed present in India (Gamble 1902: 280). Therefore, if the CSIRO results were given more weight in addition to all the species identified being from Indian/South East Asian origin, the Belitung wreck could have very well been made in India or South East Asia. Flecker's preference to consider Liphschitz's data set as more valid seems to emanate more from his personal preference to attribute an Arabian/Persian origin to the wreck. This might be more appealing to the field of maritime archaeology, as such a shipwreck from early medieval times seems a unique case so far. As Trigger (1989: 381) says: "how far can we [archaeologists] go on in acquiring an objective understanding of the past and how certain we can be of the accuracy of what we believe we know about it, given the propensity of value judgements to colour our interpretations".

7.3.3.2.3 Al-Balid timbers

The case of the identification of the wood species of al- Balid timbers is probably the most enigmatic when it comes to determining the potential origin of timbers, which were found recycled in buildings. Five planks were sampled for identification and the species identified were: *Terminalia* sp. (one plank numbered BA 0604172.69), Leguminosae Caesalpinaceae (one plank numbered BA 0604159.263), *Tectona grandis* (two planks), and cf. *Estribeiro* sp.(one plank) (Belfioretti & Vosmer 2010: 111-112).

Concerning the first two planks, the genus *Terminalia* sp. belongs to the Leguminosae Caesalpinaceae family and subfamily. Moreover, both planks BA 0604172.69 and BA 0604159.263 physically fit together (Belfioretti & Vosmer 2010: 113). Therefore, the latter plank might also be from *Terminalia* sp.. This genus grows in Tropical areas of the world, so these parts of hull planking might have originated from areas as far as Latin America to India and South-East Asia, Yemen and Sudan.
Both teak plank hulls might also have come from India, Burma or Laos, where the major teak forests are. Indonesia is to be ruled out since teak was introduced there some 400-600 years ago (Mabberley 2008: 845) and one of the teak planks was dated to 930±50 BP (Belfioretti & Vosmer 2010: 114, Table 7), roughly around 300 years earlier.

Plank BA 0604128.73 was tentatively identified as *Estribeiro* sp.. Belfioretti & Vosmer (2010: 111) speculated that since this species is endemic to Brazil, it might have been brought by Portuguese ships during their visits to al-Balid. However, the authors describe this plank as presenting evidence for stitching over wadding reinforced with dowels, following a typical pattern of western Indian Ocean sewn boats (Belfioretti &

Vosmer 2010: 114). Therefore, if indeed this timber was brought by the Portuguese, it is not clear whether Belfioretti & Vosmer suggest that a boat comprising this particular plank was built at al-Balid with imported Brazilian timber; or whether the boatbuilding might have happened elsewhere in the western Indian Ocean– perhaps India where the Portuguese had established colonies by the 16th century and might have been involved in timber trading. However, in the latter case, with India having plentiful timber resources, it is hard to imply a Brazilian timber import. The last possible scenario would be that the timber was recycled from a boat built in Brazil by the Portuguese, which wrecked/was abandoned near/at al-Balid.

The supposed Estribeiro plank is associated with another plank fragment (BA 0604128.74) which was not sampled for identification, but only for radiocarbon dating. It is dated from 490±40 BP, that is around from the 15th-16th centuries (Belfioretti & Vosmer 2010: 114). Since both planks belong to the same vessel, this date gives weight to a potential Portuguese involvement in the origin of the plank. Overall, given the fact that these two latter planks present evidence for stitching and lashing, widely considered Indian Ocean boatbuilding characteristics, we might delimit the provenance of the wood to India and South-East Asia. Belfioretti & Vosmer (2010) do not speculate on the origin of the timbers, and thus no further comments can be made here.

In conclusion of this analysis section, wood identification provides substantial information about the origin of a boat, its building, repair, and area of operation. However, the analysis is not sufficient by itself to determine the origin of a ship, and greater knowledge is acquired through the study of building techniques and methods, the hull shape, the artefacts, if cargo is present, and the routes or destination it was sailing. Another way of looking at this issue would be not to limit the interpretation to 'origin stories' (Lundberg 2003), that is a focus on determining the origin of a boat, which has shaped research pertaining to nautical wood identification. The presence of different types of timbers in a boat is part of its narrative: where it has been, the people who sailed and repaired it, the things they picked on the way. It is part of the interconnectedness between materials, people and places. Boats plying the western Indian Ocean are entangled with its diverse ethnic seafaring communities, Europeans, Persians, Arabs, Indians, and Chinese. They are fluid things (de Laet & Mol 2000), and cannot be ascribed to one identity. Rather, through the mixing and intermingling of timbers, cargoes and crew, boats become multi-cultural.

The archaeological evidence investigated here is not only a technological snap-shot of boatbuilding trends in the wider Indian Ocean in Roman and medieval Islamic times. It pertains to vessels involved in the active global trading systems of the Indian Ocean, and as these vessels travelled, so did the goods, people and ideas they carried. Also, these watercraft, through their timbers, embody the intermingling of places, environments, people and the things they create. The mixture of several species of timbers reflects this diversity in a boat's history and constitution which is constantly undergoing change, refurbishment and repair. Boat timbers, independently of their source, have histories that stretch before the boat. "Timbers are themselves things fashioned from a felled tree or salvaged from a dismantled boat, and after the boat's biography has ended they are re-used in new boats or in repair, and in other things, in paddles, jetties, and footbridges, as benches, doors and boatbuilding stands. They continue to interact with persons, things and other materials after the boat's biographical narrative is finished" (Ransley 2009: 169). I will now explore the significance of archaeological timbers at the end of a boat's life.

7.3.4 Recycling planks: maximizing use or new significance?

The recycling of planks would seem practical so as not to waste any discarded piece of wood, since the adjacent Red Sea hinterlands are denuded of timber-producing forests. Moreover, the process of timber recycling offers insights into life histories and narratives of re-used timber planks. Planks uncovered in situ in buildings and funerary contexts possess narratives preceding their present state. Such timbers were once part of trees connected to certain landscapes. They became parts of boats connected to the sea, a maritime environment, with all that entails of different people and practices. These timbers then moved on beyond the life of the boat they once belonged to, and acquired new meanings. They became part of living spaces at Berenike and al-Balid, and part of a funerary context when in Quseir al-Qadim. Thus the recycling of planks confers nautical timber a new function, a new meaning in the material culture of the peoples of the Red Sea and Arabian Sea, thus engaging in new cultural and social practices.

The recycling of ship timbers in buildings is not attested in the archaeological record only. Some Islamic medieval authors also provide insights into such practices. Ibn al-

Athīr (1987: I.572)[159] tells us that in the 5th century AD planks, from a shipwreck on the coast of Jeddah were recycled in the new roof of a sanctuary in Mecca after its destruction by flood. More recently, Prins reports the re-use of a portion of sewn hull planking in the construction of the ceiling of a guard room at Fort Jesus in Mombasa, Kenya (Prins 1959: 211; Adams 1985: 16)

Nautical timbers were not only recycled in on-land construction but also served in the construction of new boats. Indeed, Margariti (2007: 162) argues that in 546/1151 boat parts salvaged from a shipwreck near Aden were retrieved by local people, and recycled either into new vessels or incorporated into old ones in need of repair. Such practice is also evident from the ethnographic experience of the present thesis. The Saudi master-boatbuilder Ibrahim Bilgaith claims to have recycled a teak plank several times in different boats (See Section 8.47).

7.3.5 Shavings

As seen above there were substantial amounts of wood shavings from both the Roman and medieval Islamic periods, and those from Myos Hormos/Quseir al-Qadim and Berenike were sampled for wood identification (Vermeeren 2000a; Blue et al. 2011; Gale & Van der Veen 2011; Van der Veen et al. 2011). The significance of these shavings is not that they are only an indicator of potential boatbuilding activities. They also form part of the narrative of the boats, as described beautifully in the following paragraph from Lundberg's (2003: 330) article on narratives of whaling boats of Lamalera in Eastern Indonesia called téna; here wood shavings were reused as firewood for cooking:

"*These off cuts, now collected for use as firewood to cook the ceremonial meal for the boat builders, are, in fact, part of the planks (and keel and lugs and ribs). They are part of the story of the design and construction of the téna: the not-planks that allow the planks to be. But stories of boat construction are never about these no-things. These piles of shavings are the excess to the law of structured texts. Shavings are like biographical notes, the private asides that have inspired researchers to write, but must disappear in order to allow stories to appear objective and linear. These traces are thus never entirely discarded; they are incorporated into the story, swallowed up by the story even as it becomes the manifestation of these asides – just as in Lamalera the*

[159] Subsequently quoted by Ibn Khaldūn (1956: I.624) and al-Qalqashandī (1963-1970: IV.250-251).

shavings disappear in order to become the fire that cooks the ceremonial food to sustain the boat builders while simultaneously sustaining the traditions that build a téna."

Such an interpretation transcends space and time and offers an alternative understanding the wood shavings of our Red Sea sites. Perhaps some of these shavings were used for domestic fire along with larger discarded wood pieces, since a substantial amount of charcoal remains from both endemic and foreign species were found (Vermeeren 2000a: 6; Van der Veen et al. 2011: 220-223). Still these shavings are an integral part of a boat's narrative independently across time and space.

Another interesting parallel with ethnographic evidence comes from Sudan Madani (1986: 141), who has observed that shavings have a ritual significance to them: On a daily basis, Sudanese boatbuilders gather wood shavings and discarded wood pieces in front of the boat under the fore end its the prow and set them on fire. Such a ritual takes place at exactly the same time at dusk until the boat is completed. Sudanese boatbuilders believe that this practice casts out the devil, keeps the evil eye away, and eases the work process. The significance of such a practice, i.e. the purifying and protective power of fire, is culturally rooted in a symbolic understanding which precedes the advent of Christianity and Islam, and is probably linked with the Greek myth of Prometheus (Madani 1986: 152-154). The question arises as to whether Sudanese and other boatbuilders of the past adopted the same purifying ritual using wood shavings of their boats.

In conclusion, the archaeological record from the Red Sea, Arabian Sea and Belitung has informed this research on the ancient practice of wood exploitation for boatbuilding. Local timber species, particularly acacia, sycomore, and tamarisk, were most probably used in boatbuilding in the Red Sea at a greater scale than has been suggested amid a prevailing scholarly focus on the importance and superiority of non-local woods. It also assessed import of timbers to the Red Sea from the Mediterranean, East Africa, and India. It showed how boats plying the wider Indian Ocean reflect the multi-cultural diversity of ethnicities involved in building and operating these boats, as well as timber agents and funders. Such a multi-cultural identity is part of a boat's narratives through its materiality, its timbers, which originate from a multitude of places; through the landing places; the cargo and personal things it carried; and the people who intermingled with it from timber agents, to boatbuilders, to the owners, crew and passengers. This discussion also offered a phenomenological perspective on the significance of plank recycling and wood shavings and their implication in the narrative of a boat.

8 Selection of tree species in the Red Sea ethnographic record

This chapter presents the ethnographic record of timber-producing trees used in boatbuilding in the Red Sea areas where Agius, the MARES Project and this author conducted fieldwork (See 12.3.5 Table 5 and 12.3.6 Table 6). It compiles main ethnographic data entries by alphabetical order of tree name and for each type of wood — whenever the information is available — provides a physical description, its geographical origin, its nautical applications, and the boatbuilders' reasons for its use in boatbuilding. Hence, this chapter voices the knowledge and experience of our informants.[160] This chapter reads more like a presentation of the ethnographic data collected, while the subsequent chapters 8 and 9 look at the significance of the ethnographic information as a research tool in its own right and how this reflects back in time.

Agius, the MARES Project and this author recorded more than 70 colloquial Arabic names of timber types. These are transcribed in this chapter according to the dialectal variants of our informants. This is why some wood types possess more than one spelling. For example, acacia has different Arabic transcriptions such as *ṣant*, ṣ*anṭ*, *sunt*, and *sunṭ* according to an informant's dialectal variance. I will use the one that is stated the most when discussing the related wood type. I have attempted whenever possible to provide the English and scientific names of these wood species. However, I employ the colloquial name in the text to faithfully render my informants' voice and terminology.

My informants, along with Agius's and Cooper's, have provided invaluable information about the types of woods they know and use in boatbuilding. Insights from boatbuilders and wood merchants often proved to be highly accurate, emerging from numerous years of experience they gathered from their personal observations and, for most of them, from their hereditary craftsmanship. Their empirical knowledge encompassed detailed information on, and description of, trees and their timber, an awareness of the requirements for selecting, felling, cutting, converting and seasoning logs, and an understanding of the structural use of wood species as boat components and the reasons behind that use. When asked about the provenance of timber, most of our informants

[160] When referring to a same statement that was provided by people interviewed separately or collectively by Agius, Cooper and myself, I will henceforth refer to these interviewees as ‘our’ informants; unless stated otherwise.

stated the obvious: they buy wood from wood merchants. These are large wood-importing companies, small-scale providers, or middle-men acting as a liaison between the boat-builder and the land owner. Nonetheless, there were still a number of other interviewees that knew where imported woods originated from and the trade routes followed. The interviews I conducted with wood providers in Egypt proved to be particularly helpful, since I had more time to thoroughly explore several aspects of the wood use in boatbuilding, than during the Saudi Arabia fieldwork (see Section 5.3.2).

As explained in Section 5.3, the information here has gone through a critical process of validating what might be plausible and acceptable. This is necessary when ethnographic research attempts to provide a reflexive account of what has been done and collected from the field. As a result, many statements from informants that seemed irrelevant or misleading were discarded. In the cases of fieldwork in Egypt and Saudi Arabia, I took wood samples from designated timbers and sent them to Berlin for scientific identification by Dr. Rainer Gerisch.[161] This allowed the association of a scientific name with its correspondent colloquial appellation. Additional help for identifying colloquial names from ethnographic interviews is provided by four main sources on colloquial names of wood: Gamble (1902), Hepper & Friis (1994), Provençal (2010) and the Wood Explorer software.[162] An account of the main ethnographic data entries, related to the use of wood in boatbuilding, follows.

8.1 Al-Abyaḍ/Abyaḍ

Abyaḍ in Arabic means white. It is a generic term that boatbuilders use to designate any wood that is whitish in colour, rather than representing a particular species. While walking me among piles of wood al-Hafa boatyard in Jizan, Saudi Arabia in May 2010, master boatbuilder Ibrahim Bilgaith pointed to a stack of pre-cut planks of light whitish-

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[161] In December 2010, Chiara Zazzaro had sent samples that the MARES team took in Yemen in 2009; and in February 2012 I sent the samples taken in Egypt, Suakin, Djibouti, Eritrea, and Saudi Arabia by myself and/or other team members.

[162] The Wood explorer software is available at http://www.thewoodexplorer.com/desktop.html. Most of the data for the database was assembled in the early 1990s, in an effort to create a comprehensive encyclopaedia on commercial wood species. "This was a non-profit project involving some 30 data-entry people collecting, organizing information from more than 1,200 wood books, periodicals, research papers, and expert woodworkers around the world [...]. The Wood Explorer covers 1,650 species in great depth. Many of our wood images originated from an exclusive contract we had with the U.S. Forest Products Laboratory, and are not available anywhere else." The data base is regularly updated.

brown and said that these were *khashab abyaḍ* literally meaning 'white wood' (Figure 8.1). He also called these planks *sweydi* (meaning from Sweden) and *romāni* (meaning from Romania) (See sections 8.56 and 8.46 respectively). Gerisch[163] identified a sample from these planks as *Pinus* sp. with "window-like cross-field pits".[164] Gerisch also identified another sample from a plank of *abyaḍ* at Port de Pêche, Djibouti and identified it with *Pinus* sp. This sample had "pinoid cross-field pits".[165] It is therefore safe to infer that *abyaḍ* designates a type of pine.

Figure 8.1: A pile of pre-cut planks of *khashab abyaḍ* or *sweydi* at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: author).

[163] Personal communication by email on 8th January 2012 and 17th July 2012.

[164] The identification remains at genus level with Gerisch describing this sample as *Pinus* sp. with 'window-like cross-field pits'. Gerisch explains: "There are many pine species worldwide; using the species level based on wood anatomical characters is not possible. The two categories that I am using for charcoal are the one that have pinoid tracheid to ray pitting in the radial section or window-like. In the Near East, pinoid crossfield pits have *Pinus brutia*, *P. halepensis*, *P. pinea*. Window-like crossfield pits in Europe and the Near East have *P. nigra* and *P. sylvestris*. For America, it is difficult to find literature about a complete documentation. There are worldwide about 120 pine species, in the USA for example *P. radiate*, *P. clausa* (Florida), *P. contorta*, (N-America), *P. monophylla* (California), *P. jeffreyi* (California), etc. For shipbuilding, *P. strobus* is of importance (the wood has window-like pits), also the Southern yellow pine *P. palustris* (which has no window-like pits)". (Personal communication by email on 26th March 2012).

[165] Personal communication by email on 17th July 2012.

Abyaḍ is a wood imported to the Red Sea in the form of pre-cut planks that are used mainly for the upper part of the hull and deck planking, as well as for yards. Agius also observed a dug-out *hūrī* in Aden, Yemen, that was extended with planks of *abyaḍ*.[166] Our informants explain their use of this wood by the fact that this is a light affordable wood that is easily bent and worked into shape. ᶜUmar Saᶜid Bahaydar, a 60-year-old boatbuilder from Khokha, mentioned Russia, Italy, and Sweden as sources of import.[167] This might be true, as pine is widely distributed and commercialised in Europe (Haden-Guest *et al.* 1956: 231, 240-241, 242-246).

8.2 Al-aḥmar/Khashab aḥmar

Aḥmar in Arabic means red; *khashab aḥmar* is thus red wood. This use is similar to the case of *abyaḍ*, where a wood is designated by a generic name related to its colour rather than a specific species. Two *aḥmar* samples from logs in Port de Pêche proved to be one *Khaya* sp. from the African mahogany group, and one *Shorea* sp.[168] Our informants in Sudan, Yemen and Saudi Arabia who spoke about this wood were aware that it is imported, but did not know exactly from where. *Khaya* sp., from the Meliaceae family, consists of five species growing in Sudan, tropical Africa and Madagascar (Bégué 1958: 10; El Amin 1990: 313-317; Mabberley 2008: 452) (Figure 12.56). *Shorea* sp., from the Dipterocarpaceae family, is a large genus of around 196 species distributed in Tropical and South East Asia (Mabberley 2008: 794) (Figure 12.62). Ziyad Ahmed Khizari, a 48- year-old navigator erroneously informed Cooper that the *Khaya* sp. sample was imported from Europe.[169] This stresses the importance of verifying related ethnographic statements with scientific wood identification. *Aḥmar* is sometimes synonymous with *jāwī*[170] a tropical reddish wood that I describe below (See Section 8.30). Comparative ethnographic use of *Khaya* sp. is for garboard strakes and hull planks in wooden boatbuilding in Tanzania (Falck 2014: 167).

The boatbuilders Agius interviewed in Sudan in 2004, and Agius and Cooper in Yemen in 2009 use *aḥmar* for hull planks, especially lower ones, and the keel. Hussein Ibrahim

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[166] Agius's Yemen fieldwork notes on 9th February 2009.

[167] Interviewed by Cooper in February 2009.

[168] Gerisch personal communication on 17th July 2012.

169 Interviewed by Cooper on 12th October 2009 in Djibouti city.

[170] As stated by Ibrahim Bilgaith interviewed on 11th May 2010, and Hussein Ibrahim Muhammad. interviewed by Agius on 29th November 2004 in Suakin.

Muhammad (aka Hussein Baloum), a 72-year-old master boatbuilder from Port Sudan, says that *aḥmar* is very strong and resistant to shipworms.[171] When mixed with other plank woods in the hull, there are two different practices for employing *aḥmar*. Ibrahim Bilgaith of Jizan, Saudi Arabia prefers to use it for the lower planks, the upper planks being of imported pine. He explains this practice on the basis that *aḥmar* is stronger than pine and thus can better sustain the pressure from the waves and hauling the boat.[172] However, Salim Hadi Shangi, a 55-year-old boat-owner and fisherman from Bir Fuqum village, Yemen, said teak is used preferably for the lower hull planks and *aḥmar* for the upper planks, implying that the latter is not as strong and resistant as teak.[173] Nevertheless, these choices are also dictated by the purchasing power of the boatbuilders, since teak has become rarer on the market and at high prices.

8.3 ᶜAlāya

ᶜAlāya is an example of shifting trends dictating the choice of timber in boatbuilding. Hamdi Hasan Lahma, a 48-year-old master boatbuilder from Rasheed, Egypt,[174] informed me that *ᶜalāya* is a type of wood that was used for hull and deck planking some 30 to 40 years ago. He described it as a durable, long-lasting, excellent wood that can no longer be found in Egypt. Lahma was aware that *ᶜalāya* was imported but he did not know from where. As this wood was unavailable at the time of my fieldwork, I could not take a sample of it to ascertain its species.

8.4 Alob

This wood was mentioned only once by Muhammad Nour Saleh Othman, a 42-year-old dhow builder of Nigerian origin, who was interviewed by Agius in Suakin.[175] He says it is used for frames. The word *alob* is in the Rutana dialect, the Kushitic language of the Beja community. Perhaps this Kushitic name is an equivalent to the Arabic *ᶜilb* or *ᶜelb*, in other words *Ziziphus spina-christi*. Nothing further could be added about this type of wood as there are almost no reference to it in the related literature, or from other ethnographic interviews.

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[171] Interviewed by Agius on 29th November 2004.

[172] Interviewed on 12th May 2010.

[173] Interviewed by Cooper on 10th February 2009.

[174] Interviewed on 14th January 2012.

[175] On 23rd November 2004.

8.5 ᶜAnba

The word *ᶜanba* can be considered as a dialectal variety of *ᶜanb* or *ᶜamb*, Arabic names for *Mangifera indica* L., or (Eng.) mango (Al-Hubaishi & Müller-Hohenstein 1984: 199; Wood 1997: 200; Provençal 2010: 22) (Figure 12.33). Indeed, a sample from a log *hūrī* in Saddayn (Figure 8.2). Farasan in Saudi Arabia, said to be carved from *ᶜanba* proved to be *Mangifera indica*.[176] Named *Mangifera amba* by Forsskål, he transcribes it as *amb*, a colloquial Yemeni name (Forsskål 1775: 205; Hepper & Friis 1994: 75; Provençal 2010: 22).

Figure 8.2: Abandoned log *hūrī* made of *ᶜanba* at Saddayn, Farasan archipelago, Saudi Arabia (Photograph: John P. Cooper).

[176] Analyzed and identified by Dr. Rainer Gerisch (personal communication on 8th January 2012).

Our informants in Yemen, Saudi Arabia and Djibouti said that dug-out *hūrī*s were made from *ʿanba* and imported from the Malabar coast of India.[177] This was confirmed by the scientific analysis of wood samples from log *hūrī*s in Suakin, Eritrea, Djibouti, Yemen and Saudi Arabia[178] (See 12.3.6 Table 6). These are concrete proof of the import of log *hūrī*s from India to the Red Sea, as Hornell (1942: 30) had said earlier. Villiers (1969: 307) also describes how *hūrī*s were shipped on the decks of dhows from India to Arabia. The use of mango in building log boats in India is widely attested. Greeshmalatha & Rajamanickam (1993: 41) say that mango is the preferred wood of Keralan carpenters for carving *hūrī*s because the tree has a long and wide trunk. Swamy (1999: 133 Table 4, 138) records the use of mango in log-boats in Karnataka, on the Malabar coast. Rajamanickam (2004: 130,132-134) explains that mango wood is used for dug-outs and extended dugouts in India because it is light, strong, easily hollowed out, with wide and long trunks. *Hūrī*s made of mango on the Malabar coast are widely distributed across the Indian Ocean (Boxhall 1989: 295). Indeed, Tom Vosmer took wood samples from three *hūrīs* in Oman, two from beached *hūrī*s on the mainland just opposite Mahawt Island and one from As-Suwaih.[179] Gerisch identified these as *Mangifera indica*.[180]

Other nautical applications of mango include planks, knees, paddles, pegs, rudders and chine strakes: this has been observed ethnographically in Bangladesh, India, Sri Lanka, Oman, and Tanzania (Hornell 1946: 244; Vosmer 1997: 218; Kentley 1987: 35, 38; 1999: 188; 2003: 137, 145, 153; 2003a: 171; Swamy 1999: 133, Table 4, 138; McGrail & Blue 2003: 48; Palmer 2003: 110; Rajamanickam 2004:133-134; Agius 2005: 31; Falck 2014: 167). It is interesting to note the presence of mango trees in the contemporary landscape of Arab countries such as Yemen and Egypt. The Botanist Wood (1997: 200) says that these were introduced to Yemen, but he does not provide a

[177] Master boatbuilder Ibrahim Ahmed Bilghaith, 55 years old, interviewed on 11th May 2010 in Jizan, Saudi Arabia; boatbuilder Ala Allah Abdo Hasan Mujawir, 45 years old, from Muharriq, interviewed by Agius on 15th May 2010 in Farasan, Saudi Arabia; Fishermen Hafiz Umar Awad, 35 years old, and Ahmed Qahtan, in his 60s, interviewed in Aden, Yemen by Agius on 9th February 2009; and navigator Ziyad Ahmed Khizari (aka Tarzan), 48 years old interviewed by Agius and Cooper on 12th October 2009 in Djibouti city.

[178] Gerisch personal communication on 29th May, 1st July 2011, and 8th January, 25th May, 17th July 2012.

[179] Tom Vosmer personal communication by email on 30th August 2014.

[180] Gerisch personal communication on 29th May 2011.

timeframe for this. Watson (1983: 72-73, 181 note 11), referencing early botanists such as Forsskål, argues that mango must have been a relatively recent introduction to Egypt, Sudan and Eritrea from South Asia, probably during the past two centuries. Indeed, in the 18th century, Forsskål (1775: 205) noted the presence of mango trees in Egypt. Even if the introduction was relatively recent, it would be interesting to further investigate why traditional boatbuilders relied, since then, on imported mango log boats and did not fashion them themselves locally. This was perhaps due to the trees not yet attaining dimensions suitable to carve out a logboat. Indeed, Burkill (1966: 1426-1427) says that the propagation of mango trees in non-native areas is possible but can be challenging due to variations in climate.

8.6 ᶜArj

ᶜArj is mentioned by fishermen and boatbuilders interviewed in Eritrea, Yemen, and Saudi Arabia by Agius, Cooper and this author[181] Found locally in these areas, it is mainly used for the structural components of a boat, such as the frames, stern and stem posts. Perrier (1992: 56) reports the use of *arg* for the lower stempost in boatbuilding yards in Mocha and Dhubab, Yemen. Also in Yemen, Prados (1996: 94) reports the use of *ᶜarj*, which he rightfully identifies with *Ziziphus spina-christi*, as natural crooks for frames in the extended log *hūrīs* he observed.

Ibrahim Bilghaith, a 55-year-old master boatbuilder and owner of al-Hafa boatyard in Jizan, Saudi Arabia informed me that *ᶜarj* is also used for cross beams and knees, since it is very hard and durable.[182] It is probably these characteristics that justify why Ahmed Mohammed Shahhar, a 56-year-old fisherman, informed Agius that *ᶜarj* is used for the mast. This is questionable since the naturally crooked *ᶜarj* corresponds more to curved components of a ship, rather than a mast which usually necessitates a straight log (Figure 8.3). This would be possible though if a mature *ᶜarj* tree with a tall trunk is exploited. Otherwise, it could also be used for the mast of a small fishing boat.

[181] Fisherman Basim Ali Bin Ali, 19 years old, interviewed on 12th February 2009 by Agius; Master boatbuilder Ibrahim Abduh Mahdi, 70 years old, interviewed by Cooper 22nd February 2009; fisherman Isa Muhammed, 31 years old, interviewed on 24th Febrarury 2011 by Agius; fisherman Bilal Muhammad Ge'der, 45 years old, interviewed by Agius on 1st March 2011; boatbuilder Ibrahim Ahmed Bilghaith, 55 years old, interviewed by myself on 11th May 2010; and fisherman Ahmed Mohammed Shahhar, 56 year old, interviewed by Agius on 11th, 12th May 2010.

[182] Interviewed on 11th May 2010.

Figure 8.3: A stack of *ʿarj* at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: author).

ʿArj is reported by Hepper and Friis (1994: 218-219) and Provençal (2010: 87) as the "standard transliteration (sic.)" of the Yemeni name *ardj*.[183] It is a synonym of *sidr*, the Classical Arabic name for *Ziziphus spina-christi* (L.) Desf. (Al-Hubaishi & Müller-Hohenstein 1984: 204; Hepper & Friis 1994: 218-219; Wood 1997: 191; Provençal 2010: 87).[184] However, two samples I took from logs designated as *ʿarj* by my informants in al-Hafa boatyard in Jizan were scientifically identified as *Conocarpus lancifolius* Engl. by Gerisch[185] (Figure 12.21). More typically, *Conocarpus lancifolius* corresponds to the colloquial name *damas*, as identified from two *damas* tree samples one from Yemen and one from Djibouti (See Section 8.17).[186] This has several implications: either the identifications of al-Hubaishi and Müller-Hohenstein, Hepper and Friis, Provençal, and Wood are erroneous; or my informants in al-Hafa boatyard in Saudi wrongly called *ʿarj* what should have been *damas*. Alternatively, the Saudi

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[183] Another Yemeni colloquial name for this species is *ʿalb* or *ʿilb*, which will be detailed below.

[184] Forsskål (1775: 204) reports the names *Ardj* and *Örredj*, which he identified with *Rhamnus nabeca*. It is accepted now that *Rhamnus nabeca* Forssk. is the same species as *Ziziphus spina-christi* and should not be mistaken with *Rhamnus napeca* L., which is a plant from Ceylon with the current name *Ziziphus napeca* (L.) Willd. [Provencal personal communication by email on 28 August 2012].

[185] Personal communication by email on 8th January 2012 and 26th March 2012.

[186] Gerisch personal communication by email on 1st July 2011 and 17th July 2012.

name *ᶜarj* is synonymous with the Djibouti and Yemeni name *damas* i.e. *Conocarpus lancifolius*. The latter statement seems the most probable since, interestingly, Wahhab, an owner of a fishing boat in his 30s at Khokha on the Yemeni Red Sea coast, told Cooper that the name *damas* used in Aden, is synonymous with *ᶜurj*, a variant *ᶜarj* used in his region.[187]

Only taking more samples of *ᶜarj* in different parts of the Red Sea will enlighten us on its scientific identification. Also, interviewing more people would help in determining whether there is a dialectal pattern related to *ᶜarj*.

8.7 ᶜAyn/ Zengili ᶜayn

This type of wood was mentioned once in our fieldwork by Muhammed al-Ghaili, a 65-year-old dhow builder who was interviewed by Agius in Aden.[188] He says that this wood was used for keels, and imported to Yemen from the Malabar coast. I have no further ethnographic information on this wood type. Perhaps the closest appellation might be the Indian wood known as *aini* (*Artocarpus hirsuta* Lam.), which is also spelt *ayini*/*annili* (Greeshmalatha & Rajamanickam 1993: 40, 41, 43) (Figure 12.12). A sample of a *hūrī* beached on the mainland just opposite Mahawt Island, , 6km south of Filim in East Oman which Tom Vosmer took, was identified as *Artocarpus* sp. by Gerisch.[189] However, I have no information as to the name of this wood in Oman. *Aini* is widely reported in the literature as being used in keels and planks in India (Gamble 1902: 652; Sharma *et al.* 1974: 18; Greeshmalatha & Rajamanickam 1993: 40-41, 43; Kentley 1996: 250; 2003: 152; Arunachalam 1997: 15; Rajamanickam 2004: 132). Severin (1985: 280) says that *aini* began to be exported from the hill forests behind Cochin in Kerala following India's 1979 restrictions on teak exports. *Aini* was also observed in boatbuilding in Badar-e Kong on the southern Iranian coast a few decades ago, in the 1970s, according to Ball (2012: 22-24).

There is a need for more samples of *ᶜayn* that would help confirming its identification with *Artocarpus hirsuta*. Muhammed al-Ghaili, a 65-year-old boatbuilder from Hadramaut and residing in Aden,[190] used *zengili ᶜayn* as an alternative name for *ᶜayn*, or

[187] Interviewed by Cooper in Khokha, Yemen in February 2009.

[188] Interviewed on 7th February 2009.

[189] Personal communication by email on 29th May 2011.

[190] Inteviewed by Agius in Aden on 7th February 2009.

maybe to designate a different type of wood. A discussion on *zengili ʿayn* is provided in Section 8.59).

8.8 Aru

Aru was mentioned only by a number of boatbuilders I interviewed in Egypt (Figure 8.4). The literature has not revealed any linguistic information, but a sample of this wood was identified as *Quercus* sp. (deciduous), a deciduous oak (Figure 12.43).[191] It is mainly employed in large leisure boats for the cabin, stairs and inside furniture,[192] but also for the frames,[193] keel,[194] rudder.[195] *Aru* is only used in leisure boats because it is expensive and local fishermen say they cannot afford it.[196] I was told that it this light-brown wood is imported from various locations: the USA,[197] France, Russia, former Yugoslavia, Turkey and Greece. This list suggests a European export of deciduous oak. An African origin also figures in our ethnographic record from countries such as: South Africa, Kenya, Cameroon.[198] Meanwhile, certain oak species such as *Quercus infectoria* subsp. *boissieri*, *Q. ithaburensis*, *Q. libani*, *Q. cerris*, *Q. robur*, *Q. infectoria*, *Q. trojana*, *Q. petraea*, *Q. pubescens* are distributed in the Near East.[199]

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[191] Gerisch personal communication by email on 20th March 2012.

[192] Boatbuilders Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, interviewed in Buhayrat al-Burullus on 16th January 2012; and al-Arabi Mohamad al-Shuwwa, 29 years old, interviewed in Quseir on 24th January 2012.

[193] Master boatbuilder Hamdi Hasan Lahma, 48 years old, interviewed in Rasheed, Egypt on 14th -15th January 2012; boatbuilder Ibrahim al Sayyid, in his 30s, interviewed in Suez on 19th January 2012.

[194] Boat-builder Yusif Ahmad Maarouf, 57 years old, interviewed in Anfushi, Alexandria on 12th January 2012.

[195] Boatbuilder Mohammad Abu el Sayyid Shata, 53 years old, interviewed in Suez on 19th January 2012.

[196] Master boatbuilder Hamdi Hasan Lahma, 48 years old, interviewed in Rasheed, Egypt on 14th -15th January 2012.

[197] Master boatbuilder Hamdi Hasan Lahma, 48 years old, interviewed in Rasheed, Egypt on 14th -15th January 2012; and Samer Khairi, in his 40s, sales manager at Safwat Moawad company for wood import, interviewed on 17th January 2012 in 21Km, Alexandria.

[198] Mark Moawad, timber agent, interviewed on 17th January 2012.

[199] Gerisch personal communication by email on 18th October 2012.

Figure 8.4: ***Aru*** **logs at the Lahma shipyard in Rasheed, Alexandria (Photograph: author).**

8.9 Atl

The name *atl* has several dialectal variants including *atal*, *atel*, and *athal*. *Atl*[200] is the Egyptian colloquial name for the species *Tamarix aphylla* L. (Eng. Tamarisk) (Forsskål 1775: 206; Hepper & Friis 1994: 235; Provençal 2010: 96) (Figure 12.48). A sample of an *atl* log I took from the Qassas shipyard in Quseir, Egypt, was scientifically identified as *Tamarix aphylla* (L.) Karst. by Gerisch.[201] The word for it in standard Arabic is *athl*, which is close to the dialectal rendering of the name as *athal* according to Agius's informants in Saudi Arabia.[202] Wood (1997: 112-113) reports three species of *Tamarix* in Yemen designated by *athl* and *ithl*. *Athl* is also a colloquial name for *Tamarix arabica* Bunge. (Alkhulaidi & Kessler 2001: 92) and *Tamarix nilotica* (Ehrenb.) Bunge. (Al-Hubaishi & Müller-Hohenstein 1984: 203).

Atl is used in the structural parts of a boat: the frames, the stem and sternposts (Figure 8.5). Only informants from the Red Sea coast of Egypt and Saudi Arabia mention it. They say it is a local light-brown wood that is easily available and worked; and its natural crooks correspond to curved boat components. Places of origin in Egypt range

[200] Refer to Provençal (2010: 96) for more on the linguistic origin of the word *Atl*.

[201] Gerisch personal communication by email on 20th March 2012.

[202] Ali Hamid al-Zimi, dhowbuilder, 48 years old, interviewed by Agius in Yanbu al-Bahr on 12th May 2007; and Abdo Mohammed Isa Aqili, 46 years old, pearl diver interviewed by Agius in Jizan on 10th January 2010.

from Upper Egypt to the Nile Valley.[203] It is also present in Saudi Arabia, especially in the south-west (Vesey-Fitzgerald 1955: 483; Migahid & Hammouda 1974: 74; Al-Nafie 2008: 169), in the Tihama and other areas of Yemen (Wood 1997: 113), as well as in Sudan (El Amin 1990: 61-62).

However, nine out of the thirteen boatbuilders I spoke to in Egypt said they avoid using *atl*, except in small fishing boats. They say it is a soft, weak wood that cannot handle stress on the hull; it is not very water resistant and so can absorb water and become heavy and friable. Although it is less expensive than other woods used for frames, it does not last long, and needs to be replaced every year.[204] Tamarisk was identified in Pharaonic planks at Lisht and Abydos (Ward 2000: 19, 107, 110, 139; 2006: 125). Present-day Egyptian boatbuilders perhaps have the option of avoiding it, which Lisht and Abydos builders did not.

Figure 8.5: Frames of *atl* (light brown) and *tūt* (Morus sp., reddish brown) in a fishing boat at Abdo Shata workshop, Quseir, Egypt (Photograph: author).

8.10 Baharzāf

The word *Baharzāf* is a variant of *Bahar zaf*, which is a colloquial Ethiopian name for eucalyptus (*Eucalyptus* sp.) (Uhlig 2003: 445) (Figure 12.26). Ahmed Jaber Ali, a 45-year-old boatbuilder and fisherman from Djibouti[205] uses *Baharzāf* for masts and says

[203] Boatbuilders Ibrahim Ali Musa, 72 years old, interviewed by Agius at Quseir, Egypt on 31st March 2002; Khalil Mohammad Khalil, 60 years old interviewed at Hurghada, Egypt on 22nd January 2012; and Mohammad Abu el Sayyid Shata, 53 years old, interviewed at Suez on 19th January 2012.

[204] Al-Arabi Mohamad al-Shuwwa, 29 years old, interviewed in Quseir on 24th January 2012.

[205] Interviewed by Agius in Obock, Djibouti on 22nd October 2009

that it is imported from Ethiopia. The timber was introduced in Ethiopia from Australia by a Frenchman called Mondon-Vidaillet at the end of the 19th century (Vernède 1957: 10; Uhlig idem: 81, 90). The trees have long straight trunks which are suitable for masts.

8.11 Ballūt

Ballūt is a Classical Arabic name for oak (*Quercus* sp.) (Nehmé 2000: 216). Yusif Ahmad Maaruf, a 57-year-old boat-builder from Alexandria[206] told me this is an imported wood that is used in the keel, stempost, and the superstructures in leisure boats. This is the only mention of *Ballūt* in my ethnographic data.

8.12 Bashkīl

Bashkīl is a colloquial name for bamboo (*Bambusa* sp.[207]) in Djibouti, Yemen and Saudi Arabia. Al-Arabi Mohamad al-Shuwwa, a 29-year-old boatbuilder I interviewed in Quseir, Egypt used the name *bambū*.[208] To confirm the above, a *bashkīl* sample from a racing *hūrī* fleet in al-Hafa, Jizan, Saudi Arabia was identified as bamboo by Gerisch.[209] Another variation of the name is *bomba*, uttered by Mohammad Metwalli, a 40-year-old boatbuilder from Suez working in Hurghada at the time I spoke to him.[210]

Although *bashkīl* is not a wood resource (Figure 12.16), it is worth mentioning here because of its popular use for masts and yards for fishing and racing *hūrī*s, and also as extensions on either end of a yard on bigger boats, in the regions mentioned above (Figure 8.6). This is due to its light weight and cheap cost. *Bashkīl* has widespread sources of import: in Djibouti, Agius was told it comes from India;[211] in Saudi Arabia, Agius and I were informed that bamboo is imported from Kenya, Egypt, Bangladesh

[206] Interviewed on 12th January 2012, in a boatyard in Anfushi, Alexandria.

[207] Mabberley (2008: 89-90).

[208] Interviewed on 24th- 25th January 2012.

[209] Gerisch personal communication by email on 8th January 2012.

[210] Interviewed on 22nd January 2012.

[211] Boatbuilder and fisherman Ahmed Jaber Ali, 45 years old, interviewed by Agius in Obock, Djibouti on 22nd October 2009.

and wider Asia.[212] Indeed, bamboos occur in Sub-Saharan Africa, India, East and South-East Asia (Mabberley 2008: 89-90).

Figure 8.6: Bamboo yards for racing *hūrī*s at al-Hafa boatyard in Jizan, Saudi Arabia (Photograph: Chiara Zazzaro).

8.13 Bantek

Bantek is used for hull planks, and is imported from India, according to Mohammed Ali Abdallah al-Najjar, a 90-year-old, dhow builder from Fuqum, Yemen.[213] The word is a Yemeni colloquial name for (Eng.) Benteak (*Lagerstroemia lanceolata*/*L. microcarpa* Wight) (Titmuss 1971:68). Indeed, Perrier (1992: 54), in his ethnographic record of traditional boats in Djibouti, mentions that "beanteck" is a name used both locally and in Yemen.[214] He also says that it is imported from India, and used for keels in Djibouti. Moreover, it can also be used for stringers; two stringer samples from wrecked boats in

[212] Master boatbuilder Ibrahim Ahmed Bilghaith, 55 years old, interviewed in Jizan, Saudi Arabia on 11th May 2010; and fisherman Ahmed Mohammed Shahhar, 56 years old, interviewed by Agius in Jizan, Saudi Arabia on 11th -12th May 2010.

[213] Interviewed by Agius in Aden, Yemen on 10th February 2009.

[214] Perrier (1992: 54, ft.1) says however that he could not verify the exact names of woods, probably meaning the scientific names.

Godoria, Djibouti were identified as *Lagerstroemia* sp. by Gerisch.[215] *Lagerstroemia* is also used for planks in Yemen, as indicated by a sample which Lucy Blue and John P. Cooper took from the sewn plank of a derelict boat in Aden.[216]

The import of *bantek* to the Red Sea does not seem to extend beyond Yemen, since only one boatbuilder from Yemen mentions it. The fact that the boatbuilder is of old age and that *bantek* is found in abandoned boats, is perhaps an indication that its use has been discontinued in that country in the last few decades. Hawkins (1977: 58) reports the presence of Indian *venteak* planks in the boatbuilding yard at Ma'alla, Yemen. Venteak is the Tamil name for *Lagerstroemia lanceolata* (Gamble 1902: 372-373). Agius's fieldwork in Oman in the 1990s refers to the use of planks of benteak in local boatbuilding (Agius 2005: 31). All this suggests that benteak's exploitation area was limited to the southern Red Sea and the Arabian littoral of the Gulf. The last record of such exploitation dates from at least the past decade.

Benteak is a reddish timber that is endemic to India and is commonly used in traditional boatbuilding there (Gamble 1902: 372-373; Titmuss 1971: 68; Sharma *et al.* 1974: 17; Hawkins 1977: 116; Kunhali 1993: 58; Arunachalam 1997: 16; Mabberley 1998: 464; Rajamanickam 2004: 132) (Figure 12.55). It was already noted in the 1960s by Hawkins (1965) who reports that frames of *venteak* were built into Tuticorin thoni, a type of Indian commercial sailing vessel operating between the south-east coast of India and the north coasts of Sri Lanka.

8.14 Barzūma

During MARES fieldwork in Jizan, Saudi Arabia in January 2010, Abdo Mohammed Isa Aqili, a 46-year-old pearl diver, informed Agius that the frames of a boat are fashioned from a local wood he called *barzūma*.[217] In order to reach a taxonomic identification of this timber, three samples were taken by Cooper at al-Hafa boatyard and sent to Gerisch. The results are slightly confusing as two of these samples were identified as one of *Conocarpus lancifolius* and one as *Melia* sp.[218] In the case of an

[215] Personal communication by email on 17th July 2012.

[216] Identified by Gerisch, personal communication by email on 29th May 2011.

[217] Interview at al-Hafa, Jizan, Saudi Arabia on 10th January 2010.

[218] Gerisch personal communication by email on 8th January 2012.

identification with *C. lancifolius*, it is safe to infer that *barzūma* and *ʿarj* (see Section 8.6) are two Saudi colloquial names for the same species.

8.15 Bichbine

Bichpine, also sometimes pronounced as *bachbay* or *bachbayn*, is an Arabic pronunciation of (Eng.) Pitch pine (*Pinus rigida* Mill.). A *bichpine* wood sample I took from a plank at Qassas' boatyard in Burullus, Egypt was scientifically identified as *Pinus* sp. by Gerisch.[219]

I only encountered this type of wood through my informants in Egypt. All thirteen of them agree that *bichpine* is an excellent wood for boatbuilding. Hamdi Lahma[220] showed me a large squared log of the wood lying in his boatyard in Rasheed, Egypt. He told me that nowadays *bichpine* is very rare, can only be found as roof beams in big old abandoned houses, and is recycled as hull planks[221] (Figure 8.7). When he adzed a small surface of it, a sweet delightful smell emanated from the wood, revealing a beautiful reddish-brown grain (Figure 8.8). These qualities are highly appreciated by Egyptian boatbuilders, who tell me that working with *bichpine* is a pleasure to the senses. They also say that a type of incense is produced from the sawdust of the wood.

[219] Gerisch personal communication by email on 20th March 2012.

[220] Interviewed on 15th January 2012.

[221] This was also passed on to me by Mohammad Abu el Sayyid Shata, a 53-year-old boatbuilder, from Damietta that I interviewed in Suez on 19th January 2012; and Abdo Shata, a 58-year-old boatbuilder from Suez who I interviewed in Quseir on 24th January 2012.

Figure 8.7: ***Bichpine*** **roof beam (Length 8.20 x Width 0.37 x Depth 0.19 metres) at Lahma shipyard, Rasheed, Egypt (Photograph : author).**

Figure 8.8: Grain of the ***bichpine*** **beam at the Lahma shipyard in Rasheed, Egypt (Photograph: author).**

Boatbuilders in Egypt agree that *bichpine* is reminiscent of large wooden craft built at the times of their fathers and grandfathers. Nowadays, it is seldom used since, they say, it is very costly. Otherwise it would be their preferred choice over any other timber for hull planking and the mast because, they say, it is a strong, durable, long-lasting, worm-resistant wood. They add that it contains oil which improves its waterproofing quality.

This indicates a highly resinous wood. Indeed, pitch pine – as indicated by its name – has a high amount of pitch or resin, weighing about 513 kg/m³ (USDA 2010: 2-14). Thus, the wood also resists decay, a highly sought quality in boatbuilding. Hamdi Lahma stressed its durability, saying that the wood could last between two hundred to four hundred years.

Mohammad Abu el Sayyid Shata, a 53-year-old Egyptian boatbuilder,[222] told me that *bichpine* is imported to Egypt from the USA. This was confirmed by Mohammad Morsi, accountant at the wood import company Sharikat al-Masura in Hurghada,[223] and Mark Safwat Moawad, owner of a wood import company in the town of 21 Kilometres, Alexandria.[224] Indeed, pitch pine is endemic to the USA and stands of it stretch over eastern United States habitats from central Maine south to northern Georgia (Gucker 2007). However, Mark noted that pitch pine is imported in small quantities. Thus, the use of *bichpine* in boatbuilding is expected to decrease due to the rarity of its exploitation and import. It might only survive through the oral histories of the Egyptian boatbuilders.

8.16 Blāw

Blāw is an enigmatic wood type. It was mentioned only once to Agius during an interview in Tadjoura, Djibouti with Ibrahim Abu Bakar, owner of a *zārūq.*[225] Abu Bakar describes it as a yellowish wood used for the keel in a *zaʿīma*. No wood samples could be obtained for identification and the related literature revealed nothing. It is however important to mention this wood for future reference.

8.17 Damas

Damas is an Arabic name for *Conocarpus lancifolius* Engl. one of the two species of the genus *Conocarpus* (Bilaidi 1978: 31) (Figure 12.21). This is confirmed by two samples Cooper took from *damas* trees in Port de Pêche, Djibouti and Maᶜalla, Yemen, that were identified as *Conocarpus lancifolius* by Gerisch.[226] *Damas* is also called

[222] Interviewed in Suez on 19th January 2012.

[223] Interviewed on 22nd January 2012.

[224] Interviewed on 17th January 2012.

[225] Interviewed on 19th October 2009.

[226] Gerisch personal communication by email on 17th July 2012.

"Yemeni Laurel"[227] since it is found in Yemen, and is also found in Somalia. Wood (1997: 175) says it was introduced from Somalia to Yemen, and is widely distributed in Mocha and Hodeida. Damas also grows in East and North Africa, and Saudi Arabia (Saboureau 1975: 3; El Amin 1990: 89; World Conservation Monitoring Centre 1998). El Amin (1990: 89) says that it was introduced to Sudan in 1950 as a "shelter belt species in Khartoum, Kassala, Blue Nile, Kordofan and Upper Nile".

Boatbuilders in Yemen carve frames, knees and keels from their local *damas* wood which grows into nice crooks.[228] They say it is a strong timber thus can sustain structural strength. Bilaidi (1978: 31) says that *damas* produces a tall straight trunk (Figure 8.9). This explains its use as a keel. Also, two samples taken from structural parts of boats in Djibouti – a floor timber and a futtock – proved to be made from *Conocarpus lancifolius*. From our ethnographic data, *damas* and *ʿarj* (See Section 8.6), both identified as *Conocarpus lancifolius*, are exploited in the southern Red Sea in Yemen, Djibouti and south-west Saudi Arabia. This is not surprising as boatbuilders in these regions would naturally exploit the locally available timber species.

[227] Navigator Ziyad Ahmed Khizari, 48 years old, interviewed by Agius in Djibouti city on 12th October 2010.

[228] Boatbuilders Muhammed al-Ghaili, 65 year olds, and Ibrahim Muhammad Abduh al-Anbari, in his 60s interviewed by Agius in Aden, respectively on 7th – 9th February 2009 and 10th February 2009.

Figure 8.9: *Damas* trunks in Yemen (Photograph: John P. Cooper).

8.18 Dangala

Dangala is a colloquial name in Eritrea for a type of mangrove that is tall and reddish in colour, used for frames of boats. Siraj Muhammed Siraj, a 41-year-old researcher in eco-culture and marine biology said this to Agius and Cooper in Massawa, Eritrea.[229] Siraj provided the scientific name for this type of mangrove as "*Avicennia rasofora*". However, my research in the botanical literature has not revealed any species bearing this name; but rather that *Avicennia* sp. and *Rhizophora* sp. are two different species of mangrove. *Rizophora* sp. belongs to the 'red' mangrove group, and *Avicennia* sp. to the 'white' mangrove group (Soonabai Pirojsha Godrej Marine Ecology Centre n.d.).[230] Siraj has rightfully described the colour, but not the scientific identification. Gerisch identified a sample as *Avicennia marina* (Forssk.) Vierh. from a natural crook used as a framing timber on a *saddāfa* in Massawa, Eritrea.

[229] Interviewed by Agius and Cooper on 28th February 2011.

[230] For *Rhizophora mucronata* growing in Sudan see El Amin (1990: 98).

8.19 Daymān/Duyman

Daymān (in Djibouti) and *duyman* (in Yemen) are two names for a type of wood used in both countries for the frames of boats. Wood (1997: 171) identified as *daymān* is identified also as a Yemeni colloquial name related to the species *Pithecellobium dulce* (Roxb.) Benth. It is a small tree that can reach a height of 15 metres (Figure 12.40), and is planted in the Tihama in Yemen (Wood: ibid), in Djibouti (Robleh 2007: 54), and in Sudan (El Amin 1990: 187-188).[231] Mabberley (2008: 673) explains that it was introduced from Central America to Asia as a shade tree with edible fruit, at an unknown date. It is also used in soap making, as firewood and in tanning (Usher 1974: 467; Mabberley: 2008: 673; Le Houérou n.d.).

8.20 Duglas/Doblesfir

Duglas is the name uttered by Egyptian boatbuilder Hamdi Lahma from Rasheed,[232] and *doblesfir* by Egyptian 53-year-old boatbuilder Mohammad Abu el Sayyid Shata, from Damietta.[233] It is evidently Douglas fir (*Pseudotsuga taxifolia*/*P. menziesii* Mirb.) from the Pinaceae family (Figure 12.42). It is a commercial timber of the USA that grows on the northwest coast of the country and in the Rocky Mountains (Haden-Guest *et al.* 1956: 149, 154-155; Titmuss 1971: 125; Usher 1974: 485; Mabberley 2008: 711). Haden-Guest *et al.* (1956: 154-155) say that Pacific coast Douglas fir forests grow in dense stands which "are among the economically most important forests in the United States." They add that Douglas fir is the most abundant saw-timber species in the United States (Haden-Guest *et al.* 1956: 159) and is among the country's main lumber exports (Haden-Guest *et al.* 1956: 170). My Egyptian informants told me that it is an imported wood like *bichpine* (see Section 8.15) that were used some thirty to forty years ago for hull and deck planking as well as masts. To Hamdi Lahma, it is not a wood of good quality suitable for boatbuilding, although it was used in the reconstruction of the *Min of the Desert*, in which Lahma participated (See Sections 4.5 and 5.3.2). Other nautical applications of this timber are also attested (USDA 2010: 2-11).[234]

[231] For a more detailed botanical description refer to El Amin (1990: 187-188) and Wood (1997: 171).

[232] Interviewed in Rasheed on 14th January 2012.

[233] Interviewed in Suez on 19th January 2012.

[234] http://www.thewoodexplorer.com/onlinedbf/maindata/we985.html [Accessed 27th August 2012].

8.21 Ferrer

This name was mentioned to me once, in Egypt, and I have not found a scientific identification for it. Hasan Hussein Hammuda, a 60-year-old boatbuilder in Safaga, told me that this was an imported wood that he uses for paddles but he did not have a sample of it.[235] He said it is a light wood, suitable for paddles, as they should not be too heavy for the paddler, and could be replaced by *suwweid*, a light softwood that I describe in Section 8.56.

8.22 Finnī

During Agius's fieldwork in Quseir, Ibrahim Ali Musa, a 72-year-old boatbuilder,[236] told him that *finnī* is an imported wood from Sudan, with which he made a 15-metre-high mast and a 25-metre-long yard. I could not find a scientific identification for this wood. If indeed it comes from Sudan it can be any of more than 30 tree species recorded (Bégué 1958). Bégué studied the phytogeography of Sudan and exploitation of forests, but does not provide insights into the local terminology for trees. No other ethnographic information is available thus far, but perhaps *finnī* is a variant of *funn* which is most probable identified with *Calophyllum inophyllum* L. (See Section 8.23) (Figure 12.17).

8.23 Funn

Funn is employed for masts and is imported from the Malabar coast, as Agius was told by Muhammed al-Ghaili from Hadramaut.[237] In the absence of a scientifically identified sample, I speculate that *funn* might be an idiolect for *fann* a Gulf Arabic name recorded by Agius (2005: 31) for *punnai* or *poon* (*Calophyllum inophyllum* L.). As stated above, it is also most probably a variant of *finnī* which is also used for masts (See Section 8.22)

Meanwhile, Gamble (1902: 57) identifies *punnai* as the Tamil name for *Calophyllum inophyllum*, a reddish-brown wood which, he says, is used in shipbuilding, especially for masts (Figure 12.17). Both punnai/poon and fann are used for masts since they produce firm, tall and straight timbers suitable for masts (Agius 2005: 31). Samples from five masts collected by Cooper and Zazzaro at Dakkat al Ghaz in Aden, Yemen

[235] Interviewed in Safaga on 21st January 2012.

[236] Interviewed by Agius in Quseir on 31th March 2002.

[237] A 65-year-old boatbuilder interviewed in Aden by Agius on 7th February 2009.

were identified as *Calophyllum* sp. by Gerisch.[238] There is significant literature on punnai wood used for masts in India because of its strength and resilience, so it does not break or gets brittle easily (Gamble 1902: 57; Wilson 1909: 14; Hawkins 1965: 152; 1977: 58, 117). Gerisch also identified a *Calophyllum* wood sample taken by Tom Vosmer from the keel of an abandoned cargo *badan* beached on Mahawt Island, Oman.[239] It is also used in India for keels, cross beams, rudder posts (Arunachalam 1997: 15-17) and dug-out canoes (Bhargava 1983: 117). *Calophyllum inophyllum* is used in other regions of the western Indian Ocean, such as for hull planking and the interior of traditional watercraft in the south of the Maldives Islands (Maniku 1998: 16) and for log boats in Tanzania (Falck 2014: 163).

8.24 Gandal

Frames of some plank-built *hūrī*s in the Farasan archipelago, Saudi Arabia, were made of *gandal* from the islands of Zafzaf and Kira by the uncle of Muhammad Uthman Mahmud Hanas. Hanas, a 70-year-old pearl diver from Sayer village in Farasan[240] recounted the days when his uncle had a boatbuilding workshop just outside the house where I interviewed him. I have not found a scientific identification for this type of wood nor was it mentioned by any other informant. It might perhaps be a variant of the Eritrean *dangala* (See Section 8.18), and thus identified with a type of mangrove tree which grows on Farasan Islands. It supports the idea of employing local timber types in structural boat components in areas of the Red Sea.

8.25 Gazwarīn

Mentions of *gazwarīn* or *gazwarina* for nautical wood were provided by Agius's and my informants in Egypt and Suakin, Sudan. These names are variants of (Ar.) *kasuarina* (Orwa et al. 2009a), and (Eng.) *casuarina* belonging to the genus *Casuarina* sp. L. Mabberley (1998: 159). What might be considered its Yemeni linguistic equivalent, *kāzwārīnā*, is identified as *Casuarina cunnighamiana* Miq. (Al-Hubaishi & Müller-Hohenstein 1984: 192). Hashim Mohammad Nour Manninay, a 30-year-old boatbuilder from Suakin told Agius that *gazwarīn* is "the Egyptian eucalyptus tree". However, I could not obtain relevant samples of *gazwarīn* from Egypt or from Suakin to verify this; nor has the literature on Egyptian botany revealed any information on it.

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[238] Personal communication by email on 1st July 2012.

[239] Personal communication by email on 29th May 2011.

[240] Interviewed on 24th May 2010.

Boatbuilders are divided in their opinions regarding the exploitation of *gazwarīn*. Those who do use it say it has become rare, but employ it for frames, keels, masts, and tillers. Those who do not, say that the wood is brittle and splits, and does not endure maritime conditions.[241] Its grain is weak and is not water resistant.[242] Some say the tree is curved and small, the others that it is tall, straight and strong, thus its use as a keel or mast. All the Egyptian informants say it is a local wood, and Agius's informant from Suakin also says it is imported from Egypt.[243] However, a species of casuarina (*Casuarina equisetifolia* L.) is cultivated in central and southern Sudan as a garden and shade tree (El Amin 1990: 249). It is surprising then that the local resource is not employed, instead of importing it from Egypt. *Casuarina equisetifolia* might then be a variant of *gazwarīn* mentioned as *gazwarina sudāni* – Arabic for 'casuarina from Sudan'– by Hajj Ali Abd el-Rahman el-Qassas.[244] The latter told me that he had used this wood in the past for the keels of cargo ships. He describes it as a tall straight sturdy tree that can reach 20 to 25 metres in height. He said, however, that it is a local wood that used to grow in Upper Egypt. Atef Matar agrees that a keel can be carved from *gazwarina sudāni* and adds that this species can be found in the (Ar.) *Muntazahāt* of Alexandria i.e. large forest areas established by the King Faruq (r. 1936-1952). Therefore the name *gazwarina sudāni* might just indicate *Casuarina equisetifolia* as it is the only *Casuarina* species cultivated in Sudan, without necessarily suggesting a Sudanese provenance for it.

Casuarina sp. distribution is mainly across India, South East Asia and Australia (Gamble 1902: 665; Usher 1974: 131; Mabberley 1998: 159) (Figure 12.18). Mabberley (1998: 159) mentions one species *Casuarina equisetifolia* L. as cultivated being in East Africa, but I have not found a reference to its cultivation in Egypt. It has been attested in Sudan by El Amin (1990: 249). Bilaidi (1978: 31) describes the cultivation of *Casuarina equisetifolia* in Yemen, having been introduced from South Africa. He says the trees are mainly used as windbreaks on farmland (Bilaidi 1978: 31). Wood (1997:

241 Boatbuilder Mohammad Metwalli, 40 years old, from Suez, interviewed in Hurghada on 22nd January 2012. Master boatbuilder Ibrahim Ali Musa al Najjar, 72 years old, from Quseir, interviewed in Quseir on 24th January 2012.

242 Atef Matar, a local wood merchant in his 50s, from Birkat al sabaᶜ, Egypt, interviewed on 28th January 2012.

243 Boatbuilder Hashim Mohammad Nour Manninay, 30 years old, interviewed by Agius in Suakin, Sudan on 29th November 2004.

244 A 66-year-old boatbuilder from Buhayrat al-Burullus, interviewed on 16th January 2012.

75) says that three species of *Casuarina* were introduced in recent years to Yemen, but does not specify from where. *Casuarina* is commonly employed in boatbuilding in crossbeams, top strakes, and outriggers (Kentley 1999: 188; 2003: 137, 153; Swamy 1999: 133, Table 4) in several areas in India such as Karnataka on the west coast, and from Madras to Cuddalore, and also Andhra Pradesh on the east coast.

8.26 Ḥajlīj

The names *Ḥajlīj*, *Ḥajlīt*, *Halīj*, and *Ḥagrīt* are colloquial terms for a local wood in Suakin, Sudan employed for frames.[245] Agius[246] says that these terms are in Rutana and he could not find an Arabic equivalent. From a speculative point of view, *Hajlij*[247] is a city in Sudan on the Blue Nile and close to national reserves, so could it be that Agius's informants indicated a wood that came from this area.

Halīj is a local wood from Eritrea employed for stem posts and frames.[248] It might be the Eritrean equivalent of *ḥajlīj*, *ḥajlīt* or *ḥagrīt*. In his study on Yemeni extended *hūrī*s in the Tihama, Prados (1996: 94) mentions a wood called *hulaj* that he identifies with *Balanites aegyptiaca* (L.) Del., used for frames. Wood (1997: 202) mentions *ḥalaj* as a Yemeni colloquial name for *Balanites aegyptiaca*; a tree he describes as 6 metres tall and growing abundantly in the Tihama (Figure 12.15). Also, El Amin (1990: 299-301) says that *Balanites aegyptiaca* in Sudan are indigenous, widespread, and grow between 8 to 10 metres high. *Hulaj* and *ḥalaj* might be variants of *ḥajlīj*, *ḥajlīt*, *halīj*, *ḥagrīt*, and thus follow the same scientific identification. In the absence of any linguistic reference and scientific identification, there is not much that could be said about this wood. It is simply another example of the exploitation of local species by the peoples of the Red Sea for the structural components of their boats.

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245 Hussein Ibrahim Muhammad aka Hussein Baloum, a 72-year-old master boatbuilder interviewed by Agius in Suakin on 29th November 2004. Mudassir Mousa Othman Mohammed aka Takroumi Fallati, a 44-year-old boatbuilder of Nigerian origin interviewed by Agius in Suakin on 6th December 2004.

246 Sudan fieldwork notes on 6th December 2004.

247 https://maps.google.co.uk/ Hajlij, Al Roseires, Blue Nile, Sudan [Accessed 29th August 2012].

248 Fisherman Idris Daud Ali, 50 years old, interviewed in Zula, Eritrea by Agius on 22nd February 2012.

8.27 Hātel/ Hātil

Hātel or *hātil* timber is used for frames and grows locally in Eritrea, according to Idris Daud Ali, a fisherman interviewed by Agius.[249] Not much can be added in the absence of scientific identification. It belongs to the list of local woods exploited in the structure of a boat.

8.28 Hardī/Hardo

Ahmed Jaber Ali, a 45-year-old boatbuilder and fisherman from Obock, Djibouti informed Agius that *hardī* or *hardo* is employed for frames.[250] According to Agius, these names are equivalent to *kusra* in Afari. *Kusra* is described as a type of 'jujube' by Perrier (1992: 56). The jujube is identified scientifically as *Ziziphus ziziphus* (L.) H. Karst./ *Z. jujube* Mill. (Mabberley 1998: 924; Provençal 2010: 88, ft. 154) (Figure 12.52). Therefore, *Hardī/Hardo* might be a colloquial name for this species in Djibouti (See Section 8.31).

8.29 ᶜIlb/ᶜElb

ᶜIlb, also pronounced *ᶜelb* or *ᶜalb* which is the Yemeni colloquial name for *Ziziphus spina-christi* (L.) *Desf.*[251] (Forsskål 1775: 204; Alkhulaidi & Kessler 2001: 98; Provençal 2010: 87-88) (Figure 12.53). *ᶜUlb* is another Yemeni variant (Al-Hubaishi & Müller-Hohenstein 1984: 204; Wood 1997: 191). But only *ᶜilb* and *ᶜelb* were provided by our informants. *ᶜAlb*, *ᶜelb*, *ᶜilb*, and *ᶜulb* are synonymous with the classical Arabic names *nabq* and *sidr* (Forsskål 1775: 204; Al-Hubaishi & Müller-Hohenstein 1984: 204; Wood 1997: 191; Alkhulaidi & Kessler 2001: 98; Provençal 2010: 87). *ᶜIlb* is a strong wood, renowned for its durability, and that constitutes structural parts of a boat such as: frames, stern and stem posts. It is locally exploited in Yemen and Djibouti,[252]

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[249] Interviewed in Zula, Eritrea by Agius on 22nd February 2012.

[250] Interviewed by Agius on 24th October 2009.

[251] *Ziziphus spina-christi* is named *Rhamnus nabeca* according to Forsskål. *Ziziphus spina-christi* has the author designation (L.) *Desf.* which means that botanist Carl Linné first described it under a different genus name, and the current genus name *Ziziphus* was given by the botanist R.L. Desfontaines. (Provençal personal communication by email on 28th August 2012).

[252] According to Agius and Cooper boatbuilding informants in Yemen (Aden, Khor el Ghoreira, Khokha) and Djibouti (Tadjoura), interviewed respectively in February 2009 and October 2009.

and is found on local farms, plantations and in gardens.[253] Indeed *Ziziphus spina-christi* is widely distributed in these countries (Hepper & Wood 1979: 67; Hepper n.d. 312, 316; Al-Hubaishi & Müller-Hohenstein 1984: 204; Wood 1997: 191-192; Moqbil 2005: 9). Agius noted the use of local *ʿilb*/*nabq*/*sidr* in boatbuilding in Oman, especially for frames and stem and sternposts (Agius 2005a: 33; Agius 2008: 148) (See 8.44 Nabq and 8.53 Sidir).

8.30 Jāwī/Jāwa

Jāwī means in Arabic Javan. A sample I took from a hull plank in al-Hafa — that Ibrahim Bilgaith, a 55-year-old local boatbuilder from al-Hafa, Saudi Arabia, had identified as *jāwī* — was identified as *Shorea* sp. by Gerisch.[254] From the Dipterocarpaceae family, *Shorea* sp. is a large genus of around 196 species distributed in Tropical and South East Asia (Mabberley 2008: 794) (Figure 12.62).

Ibrahim Bilghaith, from Saudi, describes *jāwī* as a red wood used for the lower strakes for hull planking.[255] He says it is second best to teak but less expensive. It seems that *jāwī* has replaced teak due to its price and availability. To Bilghaith, *jāwī* can be called *khashab aḥmar* (See Section 8.2) due to its red colour; and corresponds also to the Yemeni *zangali* (See Section 8.59). Muhammad Uthman Mahmud Hanas, a 70-year-old pearl diver from Sayer village in Farasan[256] also mentioned the use of *jāwī* in hull planking, but said the wood came from India via Aden. He did not indicate a timeframe for this trade. Import from India is quite possible, as there are 12 species of *Shorea* sp. growing there (Gamble 1902: 77-83) and they could transit through Yemen from India as part of western Indian Ocean trade networks. Contrary to my Saudi informants, Ibrahim Ali Musa al Najjar from Quseir, Egypt[257] told me that a type of wood he called *jāwa* was imported from India for the production of "a type of incense", and was not used for boatbuilding. One species, *Shorea robusta*, is known for the production of a whitish aromatic resin in central India, which used as incense but also for caulking (Gamble 1902: 80) (Figure 12.62). These two conflicting statements by my informants

[253] Mohammed Ali Abdallah al-Najjar, a 90-year-old boatbuilder from Fuqum, interviewed in Aden, Yemen by Agius on 10th February 2009.

[254] Gerisch personal communication by email on 8th January 2012.

[255] Interviewed at al-Hafa boatyard, Jizan, Saudi Arabia on 11th May 2010.

[256] Interviewed on 24th May 2010.

[257] A 72-year-old master boatbuilder, interviewed on 24th January 2012.

might then indicate the wide range of species that *jāwi* encompasses, and their different uses; which some of my informants might not have been aware of. In addition, *jāwi* was used in the Emirates and Oman as noted by Agius during his fieldwork there in 1996 and 1998 respectively.[258]

8.31 Jujube

Jujube is the English common name for *Ziziphus ziziphus* (L.) H. Karst./ *Z. jujube* Mill. (Mabberley 1998: 924; Provençal 2010: 88, ft. 154). It was mentioned to Agius and Cooper in Djibouti. It is used for frames, and comes from Zabid near Khokha and Hodeida in Yemen.[259] Subsequent to his visit to boatbuilding yards between Mocha and Dhubab in Yemen, Perrier (1992: 56, 59, 60, 70) mentioned a type of jujube tree he calls *kusra*. He says that it is a Yemeni wood used for the lower stempost, the sternpost, and the frames in the boats he saw. He adds that *kusra* grows around wadis; the trunks of mature trees reach 20 to 30 metres in height and 2 metres in diameter at the base (ibid: 56) (Figure 12.52). Agius notes that *kusra* is the Afari name for *hardī/hardo*; which indicates that *jujube* (See Section 8.31), *kusra*, and *hardī/hardo* (See Section 8.28) might therefore be colloquial names for the species *Ziziphus ziziphus*.[260]

8.32 Kafūr

Kāfūr corresponds to the Arabic name for the camphor tree (*Cinnamomum camphora* (L.) J.Presl.) endemic to East Asia.[261] However, the trees my Egyptian informants called *kafūr* looked like eucalyptus (Figure 8.10, Figure 8.11, and Figure 8.12). Two wood samples I took from planks — that boatbuilders Hamdi Lahma in Rasheed and Hajj Ali Abd el-Rahman el-Qassas in Lake Burullus boatyards identified as *kafūr* — were scientifically identified as *Eucalyptus* sp. by Gerisch;[262] thus confirming my informants

[258] Agius personal communication by email on 18th September 2014.

[259] Kamil Hassan, director at the Ministry of Higher Education in Djibouti city, interviewed by Agius on 10th October 2009; and Ali Marani an old fisherman from Djibouti on 28th October 2009.

[260] Refer to section on *hardī*/*hardo* above.

[261] Dietrich, A.. " Kāfūr." Encyclopaedia of Islam, Second Edition. Brill Online, 2012. Reference. University of Exeter. 31th August 2012 http://referenceworks.brillonline.com/entries/encyclopaedia-of-islam-2/kafur-SIM_3780

[262] Gerisch personal communication on 20th March 2012.

statements. *Kāfūr* is another Arabic variant for *Eucalyptus* sp. used in Yemen (Alkhulaidi & Kessler 2001: 52; Wood 1997: 173).[263]

During my fieldwork in Egypt, almost all boatbuilders I interviewed used *kafūr*, that is eucalyptus, in boatbuilding. It is also exploited, albeit less so, at the al-Hafa boatyard in Jizan, Saudi Arabia. My Egyptian informants had a large breadth of information about *kafūr* and were aware of its properties, characteristics as a tree and the timber it produces. They described it as a tall, straight, reddish wood, that is durable, strong, and resistant in water against shipworms and stress. Used in a boat, it has a long life-span, lasting from 10 to 50 years.[264] It has a straight grain that suits straight components of a boat such as planks and the keel, and thus cannot be made into curved shapes such as frames, because it will break.[265] When it dries it becomes harder to work with and it splits or cracks when left under the sun for a long period of time.[266]

Egyptian boatbuilders use *kafūr* for keels because it is tall and straight and can grow up to 20 to 30 metres in height. Therefore, it can be made into a keel, the wood of which needs to be in one piece for strength and shock resistance.[267] Egyptian wood merchant Atef Matar explains that *kafūr* is ideal for keels of 15 metres or more in length, since they cannot be carved out from curved trunks of other local trees such as *tūt* (mulberry, section 8.57), *sanṭ* (acacia, section 8.49), *labakh* (lebbeck, 8.37) or *sarsū ͨ* (Indian Rosewood, section 8.50).. *Kafūr* is resistant against water and shipworm, and thus appropriate for a keel (Figure 8.13). It is also used for keelsons because they need to be long and sturdy to offer support to the frames. The keelson should be from a piece of *kafūr* that is dry, strong, old, and felled at the right time, so it lasts for a long time.[268]

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[263] For more on Eucalyptus species planted in Yemen see Wood (1997: 173-174). There are also six species planted in Sudan that were introduced from Australia (El Amin 1990:71-75).

[264] Atef Matar interviewed on 28th January 2012.

[265] Mohammad Abu el Sayyid Shata interviewed in Suez on 19th January 2012, Ibrahim al-Sayyid interviewed on the 19th January 2012, Mohammad Metwalli interviewed on 22nd January 2012, Abdo Shata interviewed on 24th January 2012.

[266] Mohammad Abu el Sayyid Shata interviewed in Suez on 19th January 2012, Khalil Mohammad Khalil interviewed on 22nd January 2012, Atef Matar interviewed on 28th January 2012, and Ali Ahmad Sherdi, a 40-year-old boatbuilder interviewed in Safaga on 21st January 2012.

[267] Master boatbuilder Hamdi Hasan Lahma, 48 years old, interviewed in Rasheed, Egypt on 14th -15th January 2012; boatbuilder Ibrahim al Sayyid, in his 30s, interviewed in Suez on 19th January 2012.

[268] Hamdi Hassan Lahma interviewed on 14th January 2012.

Egyptian boatbuilder Hamdi Lahma explained to me that the sheer strake, cap rail[269] and rubbing strakes should be from *kafūr*, because when these are nailed together, they maintain a strong bond providing resistance to stress. He says that this is due to the fact that the wood is not "porous". Hamdi Lahma explains that the upper section of a hull should be made with *kafūr* wood that is well dried, so as not to be influenced by weather conditions. If the wood has a humidity of more than 20%, it will warp and put the hull's water-tightness at risk, he says.

[269] Also mentioned by Khalil Mohammad Khalil interviewed on 22nd January 2012.

Figure 8.10 (Top left): ***Kafūr*** **tree, Egypt (Photograph: author).**
Figure 8.11 (Top right): Detail of ***kafūr*** **leaves (Photograph: author).**
Figure 8.12 (Below left): Detail of ***kafūr*** **bark, Egypt (Photograph: author).**

Kafūr can be used for the hull and deck planking better than *suwweid*, a type of pine widely used in Egypt.[270] However, Atef Matar seems to disagree with boatbuilders and says that even if *kafūr* is stronger than *suwweid*, the former will weigh the boat down if the hull was made entirely of it, due to its higher density. Therefore, he says that the

[270] Ali Ahmad Sherdi interviewed on 21st January 2012.

best approach would be to use *kafūr* for the lower planking in a boat so it handles shocks, and *suwweid/sweydi* (a type of pine see section 8.56) for the upper planking.

Stringers are cut from *kafūr* because it can provide long lengths (5 to 8 metres) which enhance the hull's strength, rather than using short stringers. Setting a lesser number of links between the frames, and opting for a single long stringer increases the stability of the hull.[271]

Kafūr is recommended for rudders because of its strength, so these would not easily break.[272] In large Nile boats, a *kafūr* rudder of 3 or 4 metres long offers the possibility for the skipper to turn the boat around fast and have greater control over it[273] (Figure 8.14). Other general uses for *kafūr* mentioned to me in Egypt were for transverse and longitudinal deck beams, cross-beams, paddles, oars, masts, and yards.

Some of my informants were very knowledgeable about the optimum conditions for obtaining *kafūr* timber. Hamdi Lahma recommends that the tree should be planted in a dry place, without much water around, and it should be more than 50 years old when felled. As a result, when converting it into a keel, for example, it would not warp or split. The more mature the tree, the better the timber quality for boatbuilding, as the wood becomes stronger and more solid. Egyptian boatbuilder Mahmoud Abdel Maguid al-Qassas agrees with Lahma, and adds that a *kafūr* tree could reach 30 metres in height by 25-30 years of age. Accordingly, Ibrahim al-Sayyid told me that if the *kafūr* tree has "drunk" a lot of water where it was planted, then the wood will fissure when used in boatbuilding. *Kafūr* is sourced locally in Egypt and many sources were cited by my and Agius's informants: from Upper Egypt, Cairo, Kafr el Sheikh, Sharqiyyah, Wadi Nil, Rashid, and Qailubiyya. Meanwhile, Ibrahim Bilghaith at al-Hafa said that *Kafūr* is imported from Egypt to Saudi Arabia.

[271] Hamdi Hassan Lahma interviewed on 14th January 2012, and Hasan Hussein Hammuda interviewed on 21st January 2012.

[272] Ali Ahmad Sherdi interviewed on 21st January 2012.

[273] Hamdi Hassan Lahma interviewed on 14th January 2012.

Figure 8.13: Squaring a keel made of *kafūr* at Lake Burullus, Egypt (Photograph: author).

Figure 8.14: Abandoned *kafūr* rudder at Lake Burullus, Egypt (Photograph: author).

Atef Matar told me that there are several types of local *kafūr* (Ar. *Kafūr baladī*), but that these types do not have names. He said they look alike, but the trunks are slightly different in their grain (Ar. *samara*), their quality and durability. One of these variants is called *kafūr lamūni* (Eng. Lemon Eucalyptus) or *kafūr rukhāmi* (Eng. Marble Eucalyptus) or *kafūr al-afranji* (Eng. French Eucalyptus), which is employed mainly for masts and keels (Figure 8.15). *Kafūr lamūni* is considered stronger and more resistant than *kafūr* because it is grafted with a *lamūn* tree (Eng. Lemon tree).[274] It is whiter than *kafūr*, scented with the smell of lemon. It is resistant to the sun and does not crack or split like *kafūr*. It is thus more expensive.[275] To attempt a taxonomic identification for *kafūr lamūni*, I took a sample of it from Lahma boatyard in Rasheed which Gerisch identified as *Eucalyptus* sp. L'Hér./*Corymbia* sp. He suggests that it is most probably the species *Eucalyptus*/*Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson.

Figure 8.15: *Kafūr lamūni* squared log (14.92 x 0.20 x 0.18 metres) (Photograph: author).

8.33 Kamar

During his fieldwork in Suakin, Sudan, Agius met Hussein Abd al-Hamid Abd Allah, an old sea captain and fisherman born in 1884 who told him that a wood called *kamar*, imported from Java, is used generically in boatbuilding.[276] I am tempted to associate *kamar* wood with *kamarere*, a common Indonesian name for *Eucalyptus deglupta* Blume. This species is native to Indonesia and used there in boatbuilding (Orwa et al.

[274] Yusif Ahmad Maaruf, Atef Matar interviewed on 28th January 2012; Hamdi Hassan Lahma interviewed on 14th January 2012.

[275] Khalil Mohammad Khalil interviewed on 22nd January 2012.

[276] Interviewed in Suakin by Agius on 24th November 2004.

2009b). The tree grows up to 60 metres in height and reaches a girth of 2.40 metres (Mabberley 1998: 321). It is thus suitable for producing long strakes for hull planking. Also, *kamar* might be identified with *jāwī* (section 8.30) since they are both imported from Java. It might either be that these are two names of a same wood species, or that *kamar* is a species of the wider *jāwī* species group; if *jāwī* indicates a generic name. However, these identifications remains speculative in the absence of a scientific identification. It is a wood type that has not been mentioned to Agius, Cooper or me since Agius's fieldwork in Sudan in 2004, and that would be interesting to investigate in future fieldwork.

8.34 Kandala

Kandala is an Afari word mentioned by Ahmed Jaber Ali, a 45-year-old boatbuilder and fisherman interviewed by Agius in Obock, Djibouti.[277] He described it as a red wood used for frames, that was locally available from the Seven Brothers Islands in the Gulf of Aden. Since no sample was obtained, the identification of this wood remains speculative. The name *Kandala* is a variant of the Saudi name *Gandal* (See Section 8.24) and indicates most probably a type of mangrove.

8.35 Khashab turkī

(Ar.) *Khashab turkī* literally means "Turkish wood". Ibrahim Ali Musa al-Najjar, a 72-year-old master boatbuilder from Quseir[278] told me that he built the hull's structure from a yellow-coloured wood imported from Turkey; thus calling it *khashab turkī*. In the absence of further information, it could allude to any yellowish wood species, such as pine or birch, imported from Turkey, rather than a specific one.

8.36 Kūshī

Ahmed Qahtan, a Yemeni fisherman in his 60s, in Aden[279] told Agius that log *hūrī*s are carved out from *kūshī* wood imported from the Malabar coast. Perhaps *kūshī* could be the same wood type designated by the colloquial Indian name *kashi*, identified as *Bridelia restusa* Spreng. (Gamble 1902: 595). Gamble describes this as a large deciduous tree of good quality wood that is durable in wet conditions (Gamble 1902:

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[277] Interviewed on 24th -26th October 2009.

[278] Interviewed on 24th January 2012 in Quseir, Egypt.

[279] Interviewed by Agius on 9th February 2009.

595); thus it might be suitable for dug-outs. Usually, our informants have said that log *hūrī*s were carved on the Malabar coast, especially from mango trees and were imported to the Red Sea. Since is no other information about *kūshī*, it remains another enigmatic wood for future reference.

8.37 Labakh

Labakh is reported by Provençal (2010: 65) as a Classical Arabic name used for several trees species, but in Egypt it designates *Albizia lebbeck* (L.) Benth. (Forsskål 1775: 177; Hepper & Friis 1994: 176; Provençal 2010: 65) (Figure 12.10). It came to my knowledge only though my Egyptian informants. Unfortunately, they did not provide me with a related wood sample to allow me to scientifically confirm this. Egyptian boatbuilder Mohammad Abu el Sayyid Shata[280] and wood merchant Atef Matar said *labakh* has become very rare due to extensive exploitation, and low rates of cultivation. The tree grows in Egypt and is felled from Sharqiyyah, Alexandria, Kafr el-Sheikh, Damietta, Damanhur, and el-Mahalla.[281] It is endemic to tropical Asia, but is distributed around Africa, Central America, North America and Oceania (Usher 1974: 30; El Amin 1990: 175; Mabberley 1998: 25). It was introduced in Yemen in the 18th century, if not earlier (Wood 1997: 171). Thirteen species of *Albizia* (Figure 12.9) are recorded by El Amin (1990: 169-177) in Sudan, some of them endemic and others exotic.

My informants describe *labakh* as a beautiful wood that is brown in the centre and white and yellow on the periphery (See also Yadav *et al.* 2011: 1434). Egyptian boatbuilders use *labakh* for the structural components of a boat, mainly frames, stem and stern posts in their lower and upper parts. This practice was also found in wooden boatbuilding in Jeddah, Saudi Arabia where three samples from the frame and the knee of an abandoned fishing boat were identified as *Albizia* sp.[282] (Figure 12.9). These wood samples were kindly collected and donated to the MARES Project by Edward Cordell.

My Egyptian informants explain that the *labakh* tree presents natural curves suited for these components. The say also that it is a good-quality, durable wood that is water resistant, so it does not warp; and robust so that it resists shocks to the stempost from waves and knocks, and those faced by the lower sternpost from the strains of the

[280] Mohammad Abu el Sayyid Shata interviewed in Suez on 19th January 2012.

[281] Ali Ahmad Sherdi interviewed on 21st January 2012.

[282] Gerisch personal communication by email on 8th January 2012.

propeller. It is supple and absorbs shocks without bending or breaking easily.[283] However, Egyptian boatbuilder Ibrahim al-Sayyid said that it is prone to insect attack.[284] The consequences of insect attack were particularly mentioned by my Egyptian informants, that is not to say that perhaps other boatbuilders must have been aware of such problems but it went unrecorded.

Albizia lebbeck (Figure 12.10) is used widely in ship construction in South Asia. For example, it is one of the main woods used by traditional boatbuilders in Tamil Nadu (Rajamanickam 2004: 132).[285] Indeed, McGrail *et al.* (2003: 213) report on its use in the stem and stern posts of traditional *Vattai* fishing boats there. Bhattacharyya (2006: 245) also mention *Albizia lebbeck*[286] among several types of local wood used for the construction of the Balagarhi dingi, a small country boat of Balagarhi, in west Bengal.

8.38 Malabarī

Malabarī in Arabic literally means "from Malabar", i.e. the Malabar coast. This implies that *malabarī* might allude to a wood imported from there rather than a specific timber type. The term was mentioned only once to Agius by Mohammed Ali Abdallah al-Najjar, a 90-year-old boatbuilder from Fuqum, Yemen.[287] Al-Najjar said that it is a wood employed for keels and stemposts and is imported from Malabar. It must have been a tall strong wood, among other timbers exported from India to the Red Sea. It either can mean any wood from the Malabar coast, or a specific type which I could not scientifically verify due to the lack of available samples.

8.39 Mantīk

This wood was only mentioned to me by Saudi boatbuilder Ibrahim Bilgaith. He said he uses it for keels and masts, as it is a wood of good quality which he compares to *kafūr* (Section 8.32). Bilgaith says *mantīk* is imported from India via Dubai.[288] The two *mantīk* samples I took from some used planks (Figure 8.16) from al-Hafa boatyard

[283] Atef Matar interviewed on 28th January 2012.

[284] Ibrahim al-Sayyid interviewed on the 19th January 2012.

[285] He writes is as *Albizzia cebbeca* which is erroneous.

[286] He also provides the colloquial name *sirish*. This name is noted by other authors such as Gamble (1902: 303) and Hepper & Friis (1994: 176).

[287] Interviewed by Agius in Aden, Yemen on 10th February 2012.

[288] Interviewed by Agius and the author of this thesis on 11th May 2010.

turned out to be *Hopea* sp. Roxb.[289] It is a genus which is distributed over 104 species from India to New Guinea (Mabberley 1998: 412), and is closely related to, and sometimes included in, the genus *Shorea* sp. (See Section 8.2 *khashab aḥmar* and Section 8.30 *jāwī*). Meanwhile, Agius (2005: 31) reports a type of wood called (GA.) *mantī* or *manṭīj* identified as benteak, *Lagerstroemia lanceolata* Wall., and recorded as one of the best hull planking woods used in the Gulf. Thus, the correlation between these three names is quite problematic. Either Bilgaith wrongly identified this wood as *mantīk*; or the Gulfi words *mantī* or *manṭīj* are not equivalent to the Saudi *mantīk*, since each designated a different species.

Figure 8.16: Recycled planks of *mantīk* at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: author).

8.40 Marantī

Marantī was mentioned to us by Ibrahim Bilgaith, and most probably corresponds to the English word meranti, identified as *Shorea* sp. (Gottwald 1968: 36; Durand 1986; Mabberley 1998: 539). Meanwhile Gerisch[290] also identified a *marantī* sample, I took from dismantled planks at al-Hafa boatyard, as *Shorea* sp. *Marantī* was mentioned to me only once by Ibrahim Bilgaith[291] at al-Hafa boatyard in Jizan (Figure 8.17). He uses it as beams in the awning of the top cabin of fishing boats. He said that it is as valuable

[289] Gerisch personal communication by email on 8th January 2012.

[290] Gerisch personal communication by email on 8th January 2012

[291] Interviewed on 11th May 2010.

as teak. However, one wonders as to the reasons why a wood compared to the durability and strength of teak, would be just used for the top cabin, and not in the keel or lower planking, where the greatest stress of weight and wave action is. The reason is most probably because meranti wood is not resistant to marine borers (Durand 1986: 52). Therefore it cannot be compared to teak. To Bilgaith, *marantī* is imported from Kenya which is doubtful since its distribution is concentrated in East and South-East Asia (Gottwald 1968: 36; Durand 1986; Mabberley 1998: 539).

Figure 8.17: Used marantī planks at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: author).

8.41 Mītī

Yemeni boatbuilders[292] use *mītī* for masts and frames for small boats, and say it is imported from Somalia. Also, Ahmed Muhammad Gumaani, a 59-year-old, Yemeni master builder, working in Tadjoura, Djibouti told Agius that he uses a wood called *meyti* which is imported from Somalia (Figure 8.18). Thus, *mītī* and *meyti* can be the same timber species. I could not however find a potential scientific identification of this wood in the literature on vernacular names; and Agius did not take a sample of it. Also, Vosmer informed me that 'miti' is the Swahili word for tree, but he had not heard of it used as a type of wood.[293]

[292] Boatbuilders Ibrahim Muhammad Abduh al-Anbari, 60s from Khokha and Mohammed Ali Abdallah al-Najjar, 90 years old, from Fuqum, both interviewed by Agius in Aden on 10th February 2009.

[293] Tom Vosmer personal communication through Agius by email on 27th February 2012.

Figure 8.18: Meyti logs in Tadjoura, Djibouti (Photograph: Dionisius A. Agius).

8.42 Muraymira

The names *Muraymira*, *Mraymara*, *Maraymirah*, and *Miraymira* are colloquial variants for *Melia azedarach* L. A wood sample from a tree identified ethnographically to the MARES team as a *miraymira* in Ma'alla, Yemen, was identified as *Melia azedarach* L. by Gerisch[294] (Figure 12.34). Indeed, this identification figures in botanical references related with Yemen (See Wood 1997: 200). Other known Yemeni name variants for this species are *marar* (Al-Hubaishi & Müller-Hohenstein 1984: 199), and *murimara* (Ali *et al.* 2001: 175). Originally from tropical Asia and Australia, Mabberley (1998: 534) says *Melia azedarach* was "known to Arabs [sic] by 1080 AD".

Muraymira is used in Yemen, Djibouti and Saudi Arabia mainly for frames as it is a strong wood that grows locally. In fact, wood samples identified as *Melia* sp., from Yemen, Djibouti and Saudi Arabia show that the sphere of the species' utilization is limited to structural components such as knees, futtocks, and floor timbers, as well as mast steps. Ibrahim Muhammad Abduh al-Anbari, a boatbuilder in his 60s from Khokha also told Agius that *mraymara*, as he called it, is used for keels and masts.[295] Two samples from the keel of a *ʿobri* at Dakkat al-Ghaz in Aden, Yemen were one of *Shorea* sp. and one of *Melia* sp. This indicates that originally the keel was essentially made with *Shorea* sp., a tall exotic wood (Figure 12.62), and most probably only had a section repaired with *Melia* sp. Muraymira is a small tree growing to about 6 metres in height

[294] Gerisch personal communication by email on 1st July 2011.

[295] Interviewed in Aden by Agius on 10th February 2009.

(Wood 1997: 200), so it fits masts and keels for small boats or keels made with several wood pieces for larger boats.

8.43 Muskī

Muskī, sometimes called *moski* or *mosku*, is an imported wood that is used on the western coast of the Red Sea, according to my informants in Hurghada, Safaga and Quseir in Egypt, and those of Agius in Suakin, Sudan. It has widespread uses: boatbuilders employ it for hull and deck planks; masts and yards; cap rails; cross beams; and rudders. Ibrahim Ali Musa al Najjar, a 72-year-old master boatbuilder from Quseir told me that *moski* has been used since at least the times of his grandfather. To him, nothing can compare to it because it is supple and easy to work with.[296] Mohammad Morsi, an accountant at a wood import company called 'Sharikat al-Mansura' in Hurghada,[297] explains that *moski* is the same wood species as *suwweid* (See Section 8.56), but of different quality.[298] Two *suwweid* samples from Lahma boatyard in Rasheed and from al-Qassas boatyard in Lake Burullus were both identified as *Pinus* sp. by Gerisch. It is then safe to assume that *moski* is a type of pine. *Muskī* is imported in pre-cut planks from various places. In Sudan, Agius was also informed that *Muskī* comes from Sweden or Canada and even India. The sources of import in Egypt according to Egyptian accountant Samer Khairi are from Sweden, Finland, and Russia.[299]

8.44 Nabq

Nabq and other variants such as *nabg*, *nabag*, and *nabaq* indicate the edible fruit of the *sidr* tree (See Section 8.53), a tree species identified with *Ziziphus spina-christi* (L.) Desf. (Forsskål 1775: 204; Salmon 1901: 26; Al-Hubaishi & Müller-Hohenstein 1984: 204; Hepper & Friis 1994: 218; Provençal 2010: 87) (Figure 12.53). It is also synonymous to *ʿilb*/*ʿelb* (Section 8.29). A few of our informants used the name *nabq* interchangeably with *sidr*. Only two people in Sudan and two in Egypt said that *nabq*

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[296] Interviewed in Quseir on 24th January 2012.

[297] Interviewed on 22nd January 2012.

[298] This was also said by Mohammad Metwalli, a 40-year-old boatbuilder interviewed in Hurghada on 22nd January 2012.

[299] Samer Khairi, in his 40s, sales manager at Safwat Moawad company for wood import, interviewed on 17th January 2012 in the town called '21Km' near Alexandria.

grows locally and is used for frames. The local wood merchant Atef Matar[300] told me that *nabq* was used in the past in boatbuilding, but it was abandoned due to the weakness of the wood. This is doubtful as *nabq* has a history of being prized for its strength and its use as timber in construction work, being durable, hard, and termite-resistant (Mikhail 2011: 162).

8.45 Nīm

Nīm is the Arab word for English neem (*Azadirachta indica* A. Juss.) (CTFT 1963: 23; Ciesla 1993; Mabberley 1998: 84). This association is confirmed by a wood sample I collected from a *nīm* log at al-Hafa boatyard in Saudi Arabia, identified as *Azadirachta indica*.[301] Ali Hamid al-Zimi, a 48-year-old boatbuilder at Yanbu al-Bahr, Saudi Arabia informed Agius that *nīm* is also called *ṭarafa*. This might be wrong because *ṭarafa* is the same as *ṭarfah* which is identified as *Tamarix tetragyna* Ehrenb. (Hepper & Friis 1994: 235; Provençal 2010: 96).

Nīm is used in Sudan, Djibouti, Eritrea, and Saudi Arabia for the structural parts of a boat such as frames, and stem and stern posts as well as rudders. Its natural curves are ideal for such components (Figure 8.19, Figure 12.14). Mudassir Mousa Othman Mohammed, a 44-year-old, boatbuilder in Suakin told Agius he prefers *nīm* to *nabaq* (*Ziziphus spina-christi*) because, he says, it is lighter but stronger and easy to work.[302] However, *nīm* is quite heavy with a density of 660kg/m3 (CTFT 1963: 25). Also, it is highly resistant to woodworm (Radwanski & Wickens 1981: 405). Originally endemic to India, it is widely distributed in tropical Asia and Africa (CTFT 1963: 25; El Amin 1990: 311; Mabberley 1998: 84) and is commonly cultivated in the Tihama in Yemen (Wood 1997: 201) and Saudi Arabia (Ahmed *et al.* 1989: 35). It is widely used in traditional boatbuilding in South Asia, especially in Tamil Nadu, India (Gamble 1902:144; Rajamanickam 2004: 132). Also, neem is used for the floor and futtock timbers of the *Vattai* fishing boats there (McGrail *et al.* 2003: 211). It is also used for frames in the Maldives Islands (Maniku 1998: 16).

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[300] Atef Matar interviewed on 28th January 2012.

[301] Gerisch personal communication by email on 8th January 2012.

[302] Interviewed by Agius on 6th December 2012.

Figure 8.19: *Nīm* logs at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: John P. Cooper).

8.46 Rūmāni/ Romāni

Rūmānī or *Romāni* literally means Romanian in Arabic. Ibrahim Bilgaith told me that it is imported from Romania in pre-sawn planks (Figure 8.20). Gerisch[303] identified a wood sample of *rūmāni* from al-Hafa boatyard as *Pinus* sp. (with window-like cross-field pits). It is used for hull and deck planking. Hamdi Lahma from Rasheed, Egypt, tells me it is of lesser quality than *suwweid*, another type of pine (See Section 8.56). However, Ibrahim Bilgaith from Jizan, Saudi Arabia says it is rarer and more expensive than *suwweid*.

[303] Gerisch personal communication by email on 8th January 2012.

Figure 8.20: Imported pre-cut planks of *romāni* at al-Hafa boatyard, Saudi Arabia (Photograph: author)

8.47 Sāg

The names *Sāg*, *Saj*, *Sāj*, *Sag*, *Say*, and *Tek* are colloquial appellations and dialectal variants for teak, or *Tectona grandis* L.f. (Gamble 1902: 526; Dietrich 2012). This was confirmed by two samples I took from a hull plank and a keel that Ibrahim Bilgaith identified as *sāg*, at al-Hafa boatyard; and one sample from a plank that Hamdi Lahma identified as *tek* at his boatyard in Rasheed. These three samples were identified by Gerisch as *Tectona grandis*.[304]

Teak is a large deciduous tree with a trunk of more than 25 metres in height with a dark golden-yellow heartwood turning progressively brown to black with time (Gamble 1902: 526; Pandey & Brown 2000) (Figure 12.49). Indigenous to India, Burma, Myanmar, Laos, and Thailand, teak was introduced to Java some 400-600 years ago;

[304] Gerisch personal communication by email on 8th January 2012, 20th March 2012.

and has been planted throughout tropical Asia and Africa, Latin America and the Caribbean, as well as some Pacific islands and northern Australia (El Amin 1990: 442; Kaosa-ard 1989: 55-57, 58 Figure 1; Mabberley 1998: 845; Pandey & Brown 2000).

Rajamanickam (2004: 130-134) describes teak as "the best wood for boatbuilding… known for its quality, strength and buoyancy" and that it is generally used in India for the keel, stem and stern posts, and frames. Our informants in Egypt, Saudi Arabia and Yemen agree as they used to employ teak either wholly or in a wide range of nautical features such as masts, planks, cap rails, keels, and stem and stern posts. They say teak long trunks are ideal for carving out keels and masts, as well as hull planking of ships of about 13 metres to 14 metres a plank. These uses were confirmed by wood identification. Analysis of wood samples from the keel and the stempost of a *sanbūq* in Mocha, and hull plank from a *zārūq* in Khor al-Ghurayrah, Yemen showed that these were made of teak.[305] Also, samples of two hull planks, two keels and a deck plank from boats in Obock, Ras Ali and Godoriya in Djibouti were all identified as teak.[306] During his fieldwork in 2005 on the island of Socotra in the Arabian Sea, Jansen Van Rensburg (2010) collected around eight wood samples from log *hūrī*s that were identified as teak by both Caroline Cartwright from the British Museum and Michael Allen from Allen Environmental Archaeology (AEA) (Jansen van Rensburg 2010: 101).[307] These were log *hūrī*s carved in India and imported to the island.

Some Egyptian boatbuilders told me they do not use *sāg* because it is very hard to cut, nail and work with. This is not true because teak is only moderately hard (Gamble 1902: 526). Ibrahim Ali Musa al Najjar told me it cannot be used as keel because it is too heavy and it will weigh the boat down. This is true of teak logs that have not been girdled and left standing for two years before felling and extraction (Figure 8.21) (Mabberley 1998: 845). Girdling is the stripping of the bark around the entire circumference of the trunk, and thus it allows teak to dry completely and season evenly so that it readily floats in water (Gamble 1902: 528).

[305] Gerisch personal communication by email on 1st July 2011.

[306] Gerisch personal communication by email on 17th July 2012.

[307] Also Jansen van Rensburg personal communication by email on 18th July 2012.

Figure 8.21: Teak tree in Burma that has been girdled at its base prior to felling (©Jefferies 1945: 49).

These Egyptian boatbuilders are perhaps the exception to the rule in not choosing teak over all other timbers. Still, their opinions show the importance of the personal choice of a boatbuilder when it comes to using a nautical wood.

Ibrahim Bilgaith is a boatbuilder who does value teak above all other timbers. He showed me a keel made of *sāg* at al-Hafa which he had used from boat to boat (Figure 8.22). Made of a single log (13.7m x 0.28m x 0.22m), it is prized by him since *sāg* is very expensive, reaching 12 000 or 14 000 Saudi Riyals/m^3. He adds that *sāg* has the value of gold to him. In Fuqum, Yemen, Salim Hadi Shangi informed Cooper that the lower planks in a *sanbūq* they were observing were made of *sāg* because it is a durable wood that was not affected by the corrosion of iron nails.[308] Indeed, the French admiral Pâris (1841: 17) noted that teak contains less acid than European woods, is a bit oily, and does not corrode metals used for fastening. Also, Phillips-Birt (1979: 122 in Devendra 2002: 155) describing tenth century Arabian ships, says that "teak often used for planking […] is ideal for iron fastening, containing as it does an oil that preserves the metal, unlike oak, with its acid content, which attacks it".

[308] Interviewed on [?] February 2009.

Figure 8.22: Recycled *sāg* keel at al-Hafa boatyard, Jizan, Saudi Arabia (Photograph: author).

The strength and durability of teak are qualities that are sought after in boatbuilding in India (Greeshmalatha & Rajamanickam 1993: 40). Rao (1970: 97) suggests this goes back to the third millennium BC. Meanwhile, Indian teak export dates from antiquity when teak was imported to Mesopotamia for boatbuilding in the mid-first millennium BC. Modern researchers on boatbuilding traditions also emphasize the importance of teak as a construction material. The French admiral Pâris (1841: 17) boasts about the superior quality of Bombay ships made with teak. He says: "the best teak is found on the Malabar coast. It is suppler but as hard and less heavy than oak and could serve in all parts of a boat. It is easily worked, having a fine grain and few knots; and its roots are hard and used for pulleys […] Ships that are built with teak last a long time, and there are coasters that are a century old. There are some vessels made with teak that are fifty-year-old and have not undergone major repair". In the 20th and 21st centuries, teak was and still is employed in boatbuilding in the western Indian Ocean. Hornell (1946a: 199) says that teak was used for the planking of the *dhangi*, a carvel-built cargo boat from the north-west Indian coast, and of the *batel*, an open vessel from the same area (ibid: 201). Kunhali (1993: 57) notes the use of teak for planks at a boatyard in Beypore in the late 1980s. These were provided from the nearby forest around the upper basins of the River Chaliyar (ibid: 56). Swamy (1999: 133, Table 4) says that teak is used at Karnataka on the western coast of India, in extended log-boats, nailed plank-built river boats, and sea cargoes. More specifically, he says, teak is used for keels, planks, masts, and rudder blades while Malayan teak is used for keels and planks (ibid: 133). In fact, teak is used in all parts of India from Karnataka to Kerala, Tamil Nadu, Andhra Pradesh and Orissa (Rajamanickam 2004: 130-134). Its popularity extends to West Bengal where teak, brought from Rajabhatkhawa (North Bengal), goes into the construction of the Balagarhi dingi, a small country boat of Balagarh, a renowned boatbuilding centre in West Bengal (Bhattacharyya 2006: 245). Greenhill (1957: 113) observed that the boats of East Pakistan were also made with teak.

In the last century, Arabian boats were also built with teak of several types. "Burma teak is used, either wholly or for the essentials — keel, stern post and prow. More generally Mysore teak was employed for the beams and spars with Malabar teak for the shell" says Hornell (1942: 13). He also describes how Arabian vessels from the Gulf reached the ports on the Malabar coast, especially Calicut, Beypore and Ponnani where their return cargo consisted of "building materials for the boatbuilding yards" at Bahrain, Kuwait, and southern Arabia, "teak for the skin and main timbers, jungle wood crooks for the ribs" (Hornell 1942: 13; 1946a: 213). LeBaron Bowen (1949) also observed that the dhows of Eastern Arabia were made with teak. Besides the hull, teak was also used for rigging blocks, the mast and yard, and the bowsprit (ibid: 109, 110, 118). More recently, during his fieldwork in the Gulf, Agius (2005: 30) reported seven "types" of teak that are used in boatyards there, and that they are designated by the names where they come from: Burma, India, Indonesia, Pakistan, Sri Lanka, Tanzania, and Thailand. Teak is also used for keels in traditional wooden boats of Tanzania (Falck 2014: 167).

Information about *sāg* exploitation in boatbuilding in the Red Sea in the recent past seems to be limited to Egypt, Saudi Arabia, and Yemen. Over the last century, there have been substantial changes in its import and exploitation. In Egypt, my informants tell me *sāg* was used some thirty ago, but that none of them uses it nowadays for fishing boats. *Tek* is another name Egyptian boatbuilders used for teak, according to the identification of a *tek* wood sample from a log I took from Lahma boatyard in Rasheed, Egypt, with *Tectona grandis*.[309] *Tek* is not associated with traditional boatbuilding anymore but, from what I observed along with feedback from my Egyptian informants, it is employed in luxury yachts for ceilings, floors and decks. They told me that it is an expensive, precious wood which is highly resistant to water and weather conditions; and is imported to Egypt from various places such as Burma, India, and Africa. In Saudi Arabia, Ibrahim Bilgaith told me that the *sāg* planks, and the keel he had lying around his boatyard, were recycled boat parts as teak is no longer imported. He added that *sāg* was imported from India via Jeddah and import stopped some twenty to thirty years ago. In Aden, out of four boatbuilders, only two used *sāg* in the past for planks and frames[310]. The others who have mentioned *sāg* are Mohammed Ali Abdallah al-Najjar, a 90-year-old retired boatbuilder and Ali Ibn Ali Salim, 36-year-old, who builds fibreglass boats. In Fuqum, Salim Hadi Shang told Cooper that the *jalbah* he was showing him was built by his grandfather entirely of *sāg*.[311] Earlier research in Yemen in the nineties by Prados (1996: 104) explains the decline of teak exploitation in boatbuilding. "According to Mahmud Mu'allim, a Tihamese boatbuilder from Khokha, Yemeni boatbuilders stopped using teak (*saj*) within the past twenty years because of the wood's high cost. Fishermen from al-Shihr, however, claimed that the builders used teak planking in crafting sewn *sanbūqs,* which accounts for the vessels' durability and the attractiveness of those that continue in active service" (Prados 1996: 104).

This decline in teak use is not just the situation in the Red Sea. From his ethnographic fieldwork in boatyards of the Gulf, Agius (2005: 30) notes that: "Today, finding teak

[309] Gerisch personal communication by email on 20th March 2012.

[310] Ibrahim Muhammad Abduh al-Anbari, a boatbuilder in his 60s, interviewed by Agius in Aden on 10th Febraury 2009; Muhammed al-Ghaili, a 65-year-old boatbuilder, interviewed by Agius in Aden on 7th Febraury 2009.

[311] Interviewed by Cooper in Fuqum, Yemen on 10th February 2009.

logs of a large size is becoming difficult and very expensive". The scarcity of suitable teak logs does not seem a recent problem but was already observed in the 19th century. Pâris (1841: 17) argued that because teak was preferred to any other wood species, it was becoming rarer every day and difficult to exploit. Thus, this resulted in its high cost which in turn pushed for its decline. He had predicted that in the future teak would be only used for middle-sized vessels. More than one hundred years later, Sharma *et al.* (1974) and Rajamanickam (2004: 130-134) indicated that teak was still considered the favoured Indian indigenous timber for boatbuilding, but it had gradually been replaced by other hardwoods, due to its high price.

The high cost of teak logs in India and abroad is a consequence of teak forest exploitation and production. Subsequent to India's independence in 1947, and following tree plantation schemes in the 1950s, laws against felling teak trees from public and private lands were introduced to limit the loss of tree cover. This pushed farmers to plant fewer trees out of fear that they would not be able to sell them (Balooni 2000). In 1982, India's government banned the felling of teak trees grown on private land without its permission. This also discouraged Indian cultivators from planting them, which further caused a decline in teak availability. In 1988, the National Forest Policy banned the felling of teak trees, aiming at increasing national forest cover. This also negatively influenced the teak plantation businesses. Such policies pushed India, especially Kerala, to transform from an exporter to an importer of teak logs and sawn timber from around fifty-one countries in South East Asia, Africa and Latin America (Pandey & Brown 2000). Teak supply not being able to meet the growing demand increased its price (Mahapatra et al. 2011). Agius's, Cooper's and my informants in the Red Sea said that the teak they had used was imported from India. If indeed they did, it most probably was teak re-exported from India to the global market (Mahapatra et al. 2011). Recently, the main global exporters of teak logs and sawn timber are Myanmar, Indonesia, Thailand and Côte d'Ivoire (Pandey & Brown 2000). However, wooden boatbuilding is an almost extinct practice in present-times, as it is being replaced with fibreglass.

8.48 Samur

Our informants in Saudi Arabia and Yemen mentioned the names *samur*, *smūr,* and *sumur* as colloquial variants for acacia. *Samur* is an Arabic name for acacia, and an Omani name for the species *Acacia tortilis* (Forssk.) Hayne (Provençal 2010: 64). It was mentioned by Ali Hamid al-Zimi, a 48-year-old boatbuilder, at Yanbu al-Bahr, Saudi

Arabia.[312] It might therefore be a Saudi name for *Acacia tortilis*, or a generic name for acacia. *Samur* is also a Yemeni colloquial name for *Acacia tortilis* and *Acacia mellifera* (Vahl) Benth. (Al-Hubaishi & Müller-Hohenstein 1984: 188). Meanwhile, *smūr* is the same as *smurr*, a colloquial Yemeni name noted by Forsskål (1775: 176), transcribed as *sumur* by Provençal (2010: 64), and indicates *Acacia mellifera* (Vahl) Benth. (Provençal 2010: 64).[313] Indeed, *smūr*[314] and *sumur* were mentioned to Agius and Cooper by Yemeni boatbuilders in Aden and Khokha.[315] Also, *sumur* is a colloquial Yemeni name for two acacia species: *Acacia tortilis* and *Acacia campoptila* Schweinf. (Wood 1997: 168, 171). Additionally, Prados (1996: 94) reports the Yemeni colloquial name of *sumar* he identifies as a "species of *Acacia*", which is used for frames in the extended log *hūrī*s he observed in Yemen. Thus, *sumar* is another variant of *samur*/*sumur*.

Samur is used for structural boat parts such as frames, and stern and stem posts. It is obtained locally in Saudi Arabia and Yemen. Indeed, this species (*Acacia mellifera*) is widely distributed in Tropical Africa but also grows in Yemen and Saudi Arabia (Dharani 2006: 110; Wood 1997: 170). Usually a shrub of 3 metres tall and occasionally a tree of 7 metres, it produces hard, tough wood (Dharani 2006: 113) which is suitable for structural components in boatbuilding (Figure 12.4). *Acacia tortilis* is a tree reaching 15 metres high that is widespread in North Africa, and the Arabian Peninsula (Usher 1974: 14; Wood 1997: 171) (Figure 12.6). It is thus suitable for structural boat parts. Meanwhile, *Acacia campoptila* is a shrub (Wood 1997: 168), and so its limited dimensions make it unlikely to produce wood for boat components. Just as the variants *samur*, *smūr*, and *sumur* indicate certain acacia species, there are other colloquial names that also indicate various species of acacia and include *sanṭ, ṣant, sunt*, and *sunṭ* (Section 8.49).

[312] Interviewed by Agius on 12th May 2008.

[313] Although, *Acacia mellifera* is designated by other colloquial Yemeni names *ḍayʾan* and *ẓubah* according to Wood (1997: 170).

[314] *Smūr* was reported by Ibrahim Muhammad Abduh al-Anbari, a boatbuilder in his 60s as a name for *damas* used in Hodeida. This most probably is erroneous as *damas* indicated *Conocarpus lancifolius* and is not an acacia species. He was interviewed by Agius in Aden on 10th February 2009.

[315] Mohammed Ali Abdallah al-Najjar, 90 years old, and Ibrahim Muhammad Abduh al-Anbari, 60s, both interviewed by Agius in Aden on 10th February 2009; Umar Said Bahaydar, 60 years old, interviewed by Cooper in Khokha in February 2009.

8.49 Sanṭ

The names of *Sanṭ*, *Ṣant*, *Sunt*, and *Sunṭ* are dialectal variants provided by Agius's and my informants in Egypt and Sudan. They all indicate a type of acacia tree, *Acacia nilotica* (L.) Willd. Ex Delile (Forsskål 1775: LXXVII No.554; Hepper & Friis 1994: 175; Provençal 2010). *Sanṭ* is also a Yemeni colloquial name for *Acacia gerrardii* Benth. (Alkhulaidi & Kessler 2001: 20), and *A. cyanophylla* Lindl. (Al-Hubaishi & Muller-Hohenstein 1984: 188). However, the two *sanṭ* samples I collected from Rasheed and Lake Burullus boatyards in Egypt, were identified with *A. nilotica*.[316] Linguistically, the modern Egyptian colloquial name *sanṭ* echoes *sndt*, the Ancient Egyptian word for the wood. *Sunt* was used for river dug-outs and for the bows and sterns of planked canoes in southern Sudan (Madani 1986: 90).

Sanṭ is a medium size tree, typically 5 to 6 metres in height that may reach 12 to 15 metres in favourable conditions, usually "branching from low down on the trunk" (El Amin 1990: 160; Dharani 2006: 118) (Figure 8.23, Figure 12.5). Egyptian boatbuilders buy *sanṭ* locally especially from Upper Egypt, Cairo, Kafr el-Sheikh, Sharqiyyah, Alexandria, Damietta, Damanur, el Mahallah, and the Nile valley. *Acacia nilotica* is in fact native to Africa, the Middle East and India (Rico n.d.; Usher 1974: 11).

Figure 8.23: *Sanṭ* trees at Birket al-Sabeᶜ, note the curved trunks and branches (Photograph: author)

[316] Personal communication by email on 20th March 2012.

A large number of Agius's and my Egyptian informants spoke about *sanṭ* as ideal for structural nautical components such as frames, stem and stern posts (lower and upper, inner and outer parts), and cross beams; and less so for stringers, planks, keels and transom and curved stern planking. Indeed, they take advantage of the natural crooks, which are ideal for the curves of a boat (Figure 8.24, Figure 8.25). However, because *sanṭ* produces large curves, it is preferably used in large ships of 20-25 metres long and not in small boats, where it is replaced with tūt (mulberry, Section 8.57).[317] In Sudan, Hussein Ibrahim Muhammad, a 72-year-old boatbuilder, told Agius he uses *sanṭ* for keels and stem posts.[318] In Oman, Agius (2005: 33) also says that the keel of two boats he observed in al-Batinah and in Musandam were made of a type of acacia locally called "*qaraṭ* (*Acacia nilotica* and *A. indica*[319] [sic.])". Such identification is valid since *qaraṭ* is synonymous with *qaraḍ*[320] or *Acacia nilotica* (Provençal 2010: 64). However, carving a keel out of *sanṭ* is not ideal. Describing Nile cargo boats at Omdurman in Sudan, Hornell (1946: 216) explains that since "*sunt*" rarely grows straight and with no sufficient suitable length, the keel is patched up from two or three pieces of wood and scarfed together, rendering it weak. Al-Arabi Mohamad al-Shuwwa, a boatbuilder I spoke to in Quseir agrees: he says that *sanṭ* cannot be used in a keel because it is not very long.

[317] Boatbuilders Khalil Mohammad Khalil, 60 years old, interviewed in Hurghada on 22nd January 2012, Abdo Shata, 58 years old, interviewed in Quseir on 24th January 2012, and Ibrahim Ali Musa al Najjar, 72 years old, interviewed in Quseir on 24th January 2012.

[318] Interviewed on 29th November and 1st December 2004.

[319] *Acacia indica* is a subspecies of *Acacia nilotica* (Bargali & Bargali 2009: 13).

[320] *Qaraḍ* is also a Yemeni colloquial name for the subspecies *Acacia nilotica kraussiana* (Benth.) Brenan. (Wood 1997: 170) and *Acacia etbaica* Schweinf. (Wood 1997: 170; Alkhulaidi & Kessler 2001: 22).

Figure 8.24: A semi-converted *sanṭ* curved log destined for a stempost at Lahma boatyard at Rasheed, Egypt (Photograph: author).

Despite the constraints of length, *sanṭ* is considered by Egyptian boatbuilders to be one of the best local woods, and the strongest among them. My informants boasted of its qualities by saying it is solid, water- and shock- resistant, and durable at sea. Indeed, *sanṭ* produces tough, durable and termite-resistant wood (Dharani 2006: 120). My Egyptian informants work this reddish wood when freshly cut, because when it dries, it is difficult to nail and convert. Agius (2005: 33) also observed this in Oman. Al-Arabi Mohamad al-Shuwwa told me that, in the long run, *sanṭ* becomes difficult to repair and replace, after a period of 6 months for example, because the timber dries. This is why it is becoming rare and is substituted with *tūt* (*Morus* sp., Section 8.57), which is less strong but more supple to work with). Also, the fact that *sanṭ* has a slow growth rate, slower than *tūt*,[321] might explain its shortcomings for meeting the local demand.

[321] Mohammad Metwalli, a 40-year-old boatbuilder interviewed in Hurghada on 22nd January 2012.

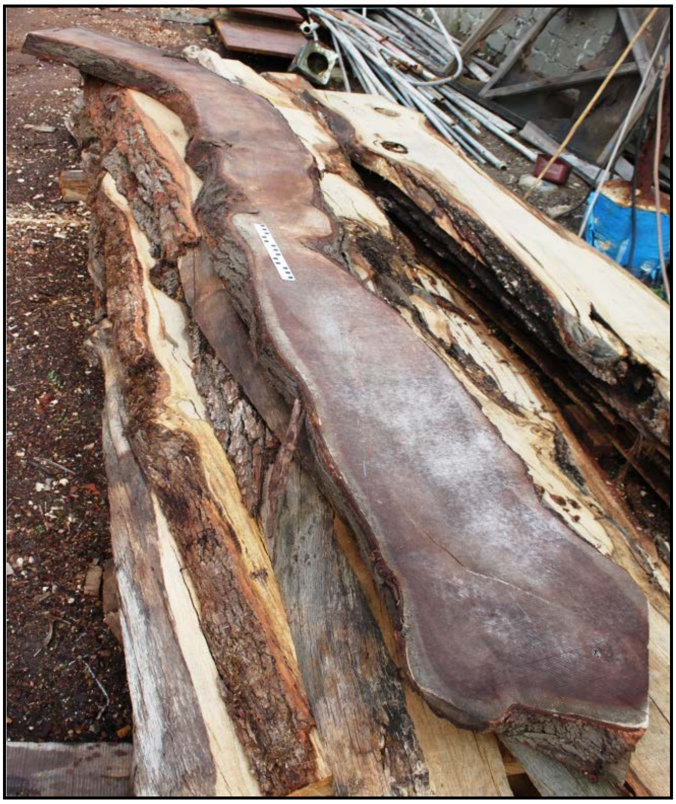

Figure 8.25: Semi-converted *sanṭ* sawn plank at Lahma boatyard, Rasheed (Photograph: author).

Sanṭ can be used in a boat without other types of wood: during his fieldwork in Sudan in 2004, Agius observed two Nile cargo boats that were entirely made of acacia at a boatyard in Omdurman. More than fifty years earlier, Hornell (1946: 215) had noted that "*sunt* (*Acacia nilotica*)" was usually the wood used in the building of Nile cargo boats at Omdurman. He describes it as a hard, brittle wood that was not easily worked; and adds that no long strakes can be obtained from it but only "short lengths of thick planking halved together in the strakes" (Hornell 1946: 215). Another Nile boat that Hornell studied at Wadi Halfa, Sudan in 1937 was also made exclusively of *sunt* except, he says, for the mast — the wood type of which he fails to mention (Hornell 1946: 221). The same applies for the hulls of Nile cargo boats plying between Aswan and Luxor (Hornell 1946: 222).

Sanṭ use in boatbuilding spreads beyond the Red Sea. It is widely used for frames, stem and stern posts in India (Arunachalam 1997: 16), where one of its colloquial names is *babul* (Gamble 1902: 292; Porcher Michel 1995). Hawkins (1965: 151) says that the "natural bends and crooks" of *babul* are fit for frames. He observed their use in a *thoni*, a south Indian cargo vessels. The acacia trunks and branches are adzed into shape. A three hundred-ton hull necessitates around four hundred trees. *Acacia nilotica* is also used for frames in boats of Tamil Nadu (Rajamanickam 2004: 133). In West Bengal, Bhattacharyya (2006: 245) describes local *babul* as used for the Balagarhi dingi, a small country boat of Balagarh, as the most popular and cheaper substitute wood for the more expensive teak or *sal* (*Shorea robusta*, Figure 12.62), because it is easily available, and relatively hard. Also in West Bengal, but in Orissa, "*babla*" serves as a substitute for *sal* in the frames of the Patia, a reverse-clinker traditional fishing boat (Kentley *et al.* 1999:155; McGrail *et al.* 2003: 78). McGrail *et al.* (2003: 78) have not provided identification for this *babla*, but it is a common name for *Acacia arabica* (Lam.) Willd. which is synonymous with *Acacia nilotica* (L.) Willd. Ex Delile (Gamble 1902: 292; Porcher Michel 1995).[322] It is probably also a variant of *babala*, the Bengali name for *Acacia arabica* (Valke 2005). Gamble (1902: 292-293) says that *babola* is an Indian colloquial names for *Acacia arabica* and attests its use in boatbuilding. It is a naturally curved tree that would suit the shapes of frames, he says. In the Gulf, Agius (2005: 30-31) recorded the use of *babul* in curved shapes of boats and in *shūʿīs* of Oman (Agius 2005: 33).

8.50 Sarsū^c/ Sirsa^c

The name *sarsū^c* is used on the Mediterranean coast of Egypt at Alexandria and Rasheed, and further inland at Birket al-Sabe^c; while the name *sirsa^c* is employed on the Red Sea coast of Egypt at Suez, Hurghada, Safaga and Quseir. *Sarsū^c* and *sirsa^c* are two name variants of the same tree genus, identified as *Dalbergia* sp. by Gerisch.[323] Shaltout & Keshta (2011: 132) say that the colloquial name *sarsoo*, which echoes *sarsū^c*, indicate the species *Dalbergia sissoo* Roxb. Ex DC (Figure 12.23). This species was introduced to Egypt, in the early 19th century by Ibrahim Pasha, as an ornamental tree, as well as for timber purposes (Shaltout & Keshta 2011: 132). My Egyptian informants told me that they acquire it locally. It has also been introduced from India to Sudan where it grows nowadays in the central part of the country (El Amin 1990: 231). It is safe to assume from all the above that *sarsu^c* and *sirsa^c* are colloquial Egyptian names for *Dalbergia sissoo*.

In Egypt, *Sarsu^c* is used for the structural elements of a boat such as frames, keels, stem and stern posts (lower and upper), because of the strength of the wood. In Djibouti, the

[322] http://www.thewoodexplorer.com/maindata/we10.html [Accessed 27th June 2012].

[323] Gerisch personal communication by email on 20th March 2012. I took a wood sample of *sarsu^c* from a log at a boatyard in Suez.

MARES team members took samples from a sternpost, a rudder and floor timbers from an abandoned boat at Ras Ali, though they could not obtain an ethnographic identification. Gerisch identified these as *Dalbergia* sp. thus stressing the use of this wood in structural elements as well as for propulsion. *Dalbergia sissoo* is described as a tall tree reaching 25 to 30 metres high (El Amin 1990: 231; Shaltout & Keshta 2011: 133), which explains its use for keels. Indeed, a keel made with *Dalbergia* sp. was sampled by Tom Vosmer from a cargo *badan* beached and abandoned on Mahawt Island, Oman; and the sample was identified by Gerisch.[324] *Dalbergia* has an open spreading crown (Shaltout & Keshta 2011: 133), the crooks of which are suitable for curved features of a boat. My informants described the wood as beautiful with a mix of brown and yellow colours (Figure 8.26). They also said that *sarsu* ᶜ is becoming scarce, almost extinct.[325] This explains why it is nowadays more used for decoration elements of leisure boats, and less for fishing vessels.[326]

Figure 8.26: Ibrahim al-Sayyid cutting a *sirsa* ᶜ sample. Note the yellow and brown colour of the log (Photograph: author).

[324] Gerisch personal communication on 29th May 2011.

[325] Mohammad Abu el-Sayyid Shata interviewed in Suez on 19th January 2012, and Mohammad Metwalli interviewed on 22nd January 2012.

[326] Ali Ahmad Sherdi interviewed on 21st January 2012.

8.51 Shām

This wood was mentioned to me only once, by former pearl diver Muhammad Uthman Mahmud Hanas[327] in Farasan, Saudi Arabia who said that *shām* planks of one inch in thickness were used in the construction of the *hūrī* hulls built by his late uncle. A sample of *shām* wood piece Hanas gave me proved to be a type of pine (*Pinus* sp. (pinoid cross-field pits)).[328] I have not found any linguistic reference explaining the term *shām*. However, it might rather designate the geographical area where the wood comes from rather than a specific species. Indeed, *al-shām* or *Bilād al-Shām* in Arabic respectively mean present day Damascus or Syria. Species of *Pinus* sp. with pinoid cross-field pits in the Near East include *Pinus brutia*, *P. halepensis* and *P. pinea.*[329] Therefore, *shām* might be a type of pine imported from the Amanus mountain in Syria or from Mount-Lebanon, but this is a tentative suggestion.

8.52 Shūra

Shūra is a colloquial name for *Avicennia marina* (Forssk.) *Vierh.*; a name used in Yemen (Forsskål 1775: 37; Hepper & Friis 1994: 84; Wood 1997: 244; Provençal 2010: 26), and Saudi Arabia[330] (Migahid & Hammouda 1974: 486), and Oman (Agius 2005: 35). *Avicennia marina* is a type of mangrove growing in Old World tropics and Australia. It is reputed for being termite-resistant and is used in boatbuilding (El Amin 1990: 435-437; Anon 1990: 31; Usher 1974: 71; Mabberley 1998: 83) (Figure 12.13). On the Farasan Islands, Muhammad Uthman Mahmud Hanas told me it was used for frames and grows in the islands of Zafzaf and Kira in the archipelago. Mangrove crooks are also employed for frames in Omani boat since they are the "perfect shape and strong" (Agius 2005: 35). Agius (2005: 35) describes some of the mangroves he saw in Khor Fakkan, Khor Kalba, and Umm al Quwain as reaching 30 feet (9.14 metres) in height. Mangrove is used elsewhere in the western Indian Ocean. Quoting a German biologist who travelled to the Lamu islands in 1903, Prins (1986: 70) says that mangrove constituted the bowsprit of one vessel type known in Swahili as *dau la mtepe*; and the hull planking of a double-ended boat he calls *mtepe* (Prins 1986: 84). Spars in traditional boatbuilding in Tanzania are usually made with mangrove (Falck 2014: 164).

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[327] Interviewed on 24th May 2010.

[328] Gerisch personal communication by email on 8th January 2012.

[329] Gerisch personal communication by email on 26th March 2012.

[330] By my informant Muhammad Uthman Mahmud Hanas interviewed on 24th May 2010.

8.53 Sidir

Sidir and *sidra* are two Arabic variants for sidr identified as *Ziziphus spina-christi* (L.) Desf. (Forsskål 1775: 204; Salmon 1901: 26; Al-Hubaishi & Müller-Hohenstein 1984: 204; Hepper & Friis 1994: 218; Wood 1997: 191; Alkhulaidi & Kessler 2001: 98; Provençal 2010: 87) (Figure 12.53). It is also referred to as *ʿilb* (Section 8.29) and *nabq* (Section 8.44).

Agius's informants in Egypt and Saudi Arabia told him they use local *sidr* for frames, the stem and stern posts as well as masts. *Sidr* is widely distributed in both these countries (Salmon 1901: 26; Vesey-Fitzgerald 1955: 481, 483; Migahid & Hammouda 1974: 483; Usher 1974: 619; Anon 1990: 51; Al-Nafie 2008: 169). *Sidr* trees can grow up to 15 metres in height (Vesey-Fitzgerald 1955: 481) which is suitable for the trunk use as masts. Indeed, a wood sample I took from an abandoned mast at Khabs-Khotob in the Farasan archipelago was identified as *Ziziphus spina-christi* by Gerisch.[331] Generally, however the *sidr* tree trunk is twisted and branched (Orwa et al. 2009c), and so suits curved parts of a boat. *Sidr* wood is also reputed for its durability (Wood 1997: 191). The structural exploitation of *sidr* in boatbuilding is stressed by the wood samples Cooper and I collected in Djibouti, Saudi Arabia, and Yemen. These were identified as *Ziziphus spina-christi* by Gerisch: Four samples from the frames, the lower and the upper sternposts of a *zaʿīma* at Ras Ali, Djibouti;[332] a *ʿobrī* futtock sample at Khutub, Farasan archipelago; and a knee sample from a *zārūq* at Khor al-Ghurayrah, Yemen.[333]

Ethnographic research in the Gulf has highlighted the popular exploitation of *sidr* in traditional boatbuilding in Oman. During his fieldwork there, Vosmer (1997) recorded that the shell-built boats he studied were made with local *sidr* for the frames, floors, and beams. Later, Agius (2005: 33-35) recorded the use of *sidr* for frames, stem and stern posts, and gunwales in boats in al-Batinah region, a district of Oman in the Musandam Peninsula, and Tiwi in the Sharqiyyah.

[331] Gerisch personal communication by email on 8th January 2012.

[332] Gerisch personal communication by email on 17th July 2012.

[333] Gerisch personal communication by email on 1st July 2012.

8.54 Singafura aḥmar

The ethnographic name *Singafura aḥmar* literally means 'Singapore red' in English. It might therefore indicate a wood called following its origin (Singapore) and its colour (Red). No wood samples were available for scientific identification.

Singafura aḥmar is used in keels and stem posts imported as sawn wood from Singapore, according to Mohammed Ali Abdallah al-Najjar, a 90-year-old, dhow builder from Fuqum.[334] These sawn planks are 5 cm thick, and vary in length of 6, 18, or 24 metres. Depending on a boat's size these planks could serve in keels according to their length. *Singafura aḥmar* must also be a strong, durable wood suitable for the stress faced by a stem post and keel.

8.55 Snawbar

The names *Snawbar*, *Suneybar*, *Soneybar*, *Sinibar*, *Snobar*, *Sanebār* can be considered as dialectal variants for *ṣanawbar* the Classical Arabic name for the pine tree. A wood sample I took from a mast said to be made with *suneybar* at al-Hafa boatyard in Jizan was identified as *Pinus* sp. with window-like cross-field pits.[335]

From our ethnographic research, it seems that *snawbar* is almost exclusively used for hull planking, and less so for masts and yards, and oar blades, in Djibouti, Yemen and Saudi Arabia. Comparatively, Yusuf bin Naser Al-Zaabi, interviewed by Agius in the al-Butteen shipyard, in Abu Dhabi, said *snawbar* is the preferred wood for yards (Agius 2005: 35).

It is hard to determine the exact provenance of *snawbar* since it is a widely distribute genus. Our informants indicate some of the points of import: Boatbuilder Ahmed Jaber Ali informed Agius that *sanebār* is imported to Djibouti from Sweden, via Khokha in

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[334] Interviewed by Agius in Aden on 10th February 2012.

[335]The identification remains at genus level with Gerisch describing this sample as *Pinus* sp. with 'window-like cross-field pits': Window-like crossfield pits in Europe and the Near East have *P. nigra* and *P. sylvestris*. For America, it is difficult to find literature about a complete documentation. There are worldwide about 120 pine species, in the USA for example *P. radiate, P. clausa* (Florida), *P. contorta*, (N-America), *P. monophylla* (California), *P. jeffreyi* (California), etc. For ship building, *P. strobus* is of importance (the wood has window-like pits), also the Southern yellow pine *P. palustris* (which has no window-like pits)' (Gerisch Personal communication by email on 26th March 2012).

Yemen.[336] Yemeni boatbuilder Abduh Balgayth told Cooper that *sinibar* comes from Sweden, Austria and Malaysia.[337] *Snawbar* and the other above-mentioned colloquial names are equivalent to *abyaḍ* (see Section 8.1), *rūmānī* (see Section 8.46), and *suwweid* (see Section 8.56) which all indicate species of pine.

8.56 Suwweid

Pronounced as *suwweid* in Egypt, *sweydi* in Saudi Arabia, and *swedi* in Yemen, this is a wood that literally means 'from Sweden'. However, it is a generic term used for pine exported from several countries other than Sweden. Gerisch identified as *Pinus* sp. with "window-like cross-field pits" a sample I took from a sawn plank that Ibrahim Bilgaith indicated as *sweydi* at al-Hafa,[338] and another sample from a plank that Hajj Ali al-Qassas identified as *suwweid* from his boatyard in Lake Burullus.[339] It can also be considered as a synonym of *snawbar* (Section 8.55).

Suwweid is very versatile and is mainly used in hull and deck planking. Other boat parts for which it is used include: cabins, transom stern planking, masts and yards, cross beams, stringers, cap rails, rubbing strakes, and rudders and paddles. I was able to verify some of these nautical uses through wood sampling. Five samples from abandoned hulls in Jeddah,[340] Tibta, and Saddayn in Saudi Arabia, and in al-Qudbah in Yemen were identified with *Pinus* sp. (window-like cross-field pits). The same goes for a sample of a *zārūq* cross-beam and a sample of a *zaʿīma* deck plank from Ras Ali in Djibouti; and an abandoned mast at Abu el-Toog in Farasan, Saudi Arabia.

Due to its straight grain and trunk, boatbuilders do not use *sweydi* for frames as they say it will break; since also it is not as strong and durable as local woods such as *sanṭ* (*Acacia nilotica*) and *tūt* (*Morus* sp.). They say it is a light wood that suits the upper structures of a boat, as well as a rudder or paddle to make them easily manoeuvred. However, Hamdi Lahma says that *suwweid* is prone to become brittle from the friction of ropes or paddles against the hull planks. This is why he prefers to use *kafūr*, which is less prone to friction damage, for the uppermost planks and cap rail. *Suwweid* is

[336] Interviewed by Agius in Obock, Djibouti on 21st October 2009.

[337] Interviewed by Cooper in Hodeidah, Yemen on 22nd February 2009.

[338] Gerisch personal communication by email on 8th January 2012.

[339] Gerisch personal communication by email on 20th March 2012.

[340] These were taken by and sent to the MARES Project courtesy of Edward Cordell.

relatively water-resistant, does not warp or taper, thus making it ideal for the rest of the hull planking, he says. Hamdi Lahma adds that *suwweid* is flexible and thus can be slightly curved for a boat's hull. Al-Arabi Mohamad al-Shuwwa told me that only the keel of fibreglass boats can be made from *suwweid* since it will be protected at sea and against hauling stress by the fibreglass layer, otherwise if exposed it cannot sustain the strain of a keel.[341]

The introduction of *suwweid* in boatbuilding in the Red Sea is recent. Hamdi Lahma said his father started using it in his last working days, at a time when the wood started becoming common in Egypt, some 20-25 years ago. This echoed what Ibrahim Bilgaith told me in Saudi Arabia, that since 25-30 years ago *suwweid* had started replacing Indian woods since it was and is cheaper. Forestry policies of the Indian government and the different bans in the 1950s and 1980s on timber export must have also played a major role in the decline of the nautical use of Indian timbers. *Suwweid* is therefore a witness in the changing pattern of nautical wood exploitation where Indian or South East Asian woods have been replaced by a more European-centred species and market.

Suwweid is imported to Red Sea regions as sawn planks of various thicknesses. Hamdi Lahma tells me boatbuilders choose the thickness they deem is proportionate to the size of the ship they want to build. My Egyptian informants tell me that there are several quality types of *suwweid*. These are, ranging from the best quality to the least, *finlandi* (from Finland), *sweidi* (from Sweden), *rūsī* (from Russia), and *abyaḍ* (white).[342] Thus, to them, the place of export entails a certain quality of wood.

I took a sample of a plank that Hamid Lahma identified as *suwweid finlandi* from his shipyard in Rasheed. Gerisch identified it as *Pinus* sp. with "window-like pits",[343] just as the *suwweid* samples I took from al-Hafa and Lake Burullus. Since the identification stayed at genus level it is hard to say whether *suwweid finlandi* is a different pine species than *suwweid*. Ali Ahmad Sherdi tells me there are ten types of *finlandi* depending on its quality (Ar. *farz awwal*, *thānī*, *thaleth*). *Abyaḍ* is very soft and gets

[341] Interviewed in Quseir on 24th January 2012.

[342] Khalil Mohammad Khalil interviewed on 22nd January 2012, Hamdi Hassan Lahma interviewed on 14th January 2012, Hasan Hussein Hammuda interviewed on 21st January 2012, Ibrahim al-Sayyid interviewed on 19th January 2012, Ali Ahmad Sherdi interviewed on 21st January 2012.

[343] Gerisch personal communication by email on 20th March 2012.

paste-like when it comes into contact with water; this is why it is used under a coating of fibreglass.

Our informants in all three countries (Egypt, Saudi Arabia and Yemen) cite the same sources of import: Russia, Turkey, Sweden, and Finland. I was able to verify this for Egypt, when I visited two wood import companies in the town of 21km near Alexandria, and in Hurghada. They confirmed that, apart from Turkey, Russia and the Scandinavian countries constitute the main *suwweid* exporters.[344]

8.57 Tūt

Tūt is a Classical Arabic as well as an Egyptian colloquial name for the mulberry tree, *Morus* sp. (Salmon 1901: 26). *Tūt* is also a Yemeni colloquial name for black mulberry, *Morus nigra* L. (Wood 1997: 72). Three wood samples I took from *tūt* logs at Lahma and Qassas shipyard in Egypt and at al-Hafa (said to be from Egypt) in Saudi Arabia, were identified as *Morus* sp. by Gerisch, who did not provide a species identification.[345] However, Egyptian boatbuilder Hasan Hussein Hammuda tells me there are two types of *tūt* in Egypt: *tūt baladī* and *tūt shāmī*. This was reported almost a century ago by Salmon (1901: 26) who identifies *tūt baladī* with *Morus alba* L. (Eng. White Mulberry) and *tūt shāmī* with *Morus nigra* L. (Eng. Black Mulberry) (Figure 12.36). These two species are still present in Egypt (El-Hadidi & Boulos 1988: 74-75). Hammuda explains that *baladī* is yellow in colour and quite durable in water. Conversely, *shāmī* is yellowish white, of lesser quality and less durable in water; also it warps and bends if exposed for a long time under the sun.[346] *Morus nigra* originates in Asia Minor, Caucasus and Armenia and was introduced to Egypt during the Hellenistic period (Germer 1985: 23-24). Meanwhile, *Morus alba*, originating in Mongolia, was introduced to Egypt during the Early Islamic Period for silk worm breeding (Germer 1985: 24).

Nautical exploitation of *tūt* seems to be exclusive to Egypt, with the exception of Saudi Arabia, where Bilgaith told me he imports *tūt* from Egypt. My Egyptian informants consider *tūt* to be one of the best local woods, which they fetch mainly from Kafr el-

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[344] Samer Khairi and Mark Moawad both interviewed on 17th January 2012, and Mohammad Morsi interviewed on 22nd January 2012.

[345] Gerisch personal communication by email on 8th January and 20th March 2012.

[346] Interviewed in Safaga on 21st January 2012.

Sheikh, Cairo, Upper Egypt, and the Nile Valley. They describe it as a yellow timber that gets darker with time (Figure 8.27). Wood merchant Atef Matar explains that, depending on the age of the tree, the timber might be light or dark yellow. The dark yellow wood is a sign that the tree has matured, and the light yellow that is still young. They also add that although it is not a very tall tree, reaching an average height of 7 metres, its trunk is wide and has natural crooks, suitable for curved boat-parts such as frames, and stem and stern posts (Figure 8.28,Figure 8.29). Other less common uses include: rudders, masts, paddles, round and transom sterns, bollards, and cap rails. Boatbuilders have a preference for *tūt* because it is easily worked, for its durability in water, its strength, and resistance to shocks and pressure. Egyptian boatbuilder al-Arabi Mohamad al-Shuwwa justifies the use of *tūt* for the cap rail because it resists the rubbing action of fishing nets and lines. He told me that *tūt* can last up to 20 years in a boat, whereas boatbuilder Ibrahim al-Sayyid mentioned 35 to 40 years.

Applications of *tūt* are very similar to *sanṭ*, both being local woods mainly destined for the framing elements of a boat. However, *Tūt* seems to be more exploited than *sanṭ*, from what I could observe about boatbuilding practices in Egypt. Atef Matar and Egyptian boatbuilder Mohammad Metwalli explain that this is due to its ready availability. In fact, *tūt* is planted widely by cultivators who seek the large shade it provides, and because it has a faster growth rate than *sanṭ*.[347] Most of the Egyptian boatbuilders I spoke to prefer it to *sanṭ* because it is easier and smoother to work with.[348] Also, *sanṭ* dries very quickly when working it under the sun, whereas *tūt* takes a longer time.[349] Ibrahim al-Sayyid says it lasts longer than *sanṭ* because the latter is more prone to worm attack.

[347] Mohammad Metwalli interviewed on 22nd January 2012.

[348] Hajj Ali Abd el-Rahman el-Qassas interviewed on 16th January 2012, Mohammad Metwalli interviewed on 22nd January 2012, Khalil Mohammad Khalil interviewed on 22nd January 2012, Ibrahim al-Sayyid interviewed on the 19th January 2012, Abdo Shata interviewed on 24th January 2012.

[349] Hajj Ali Abd el-Rahman el-Qassas interviewed on 16th January 2012.

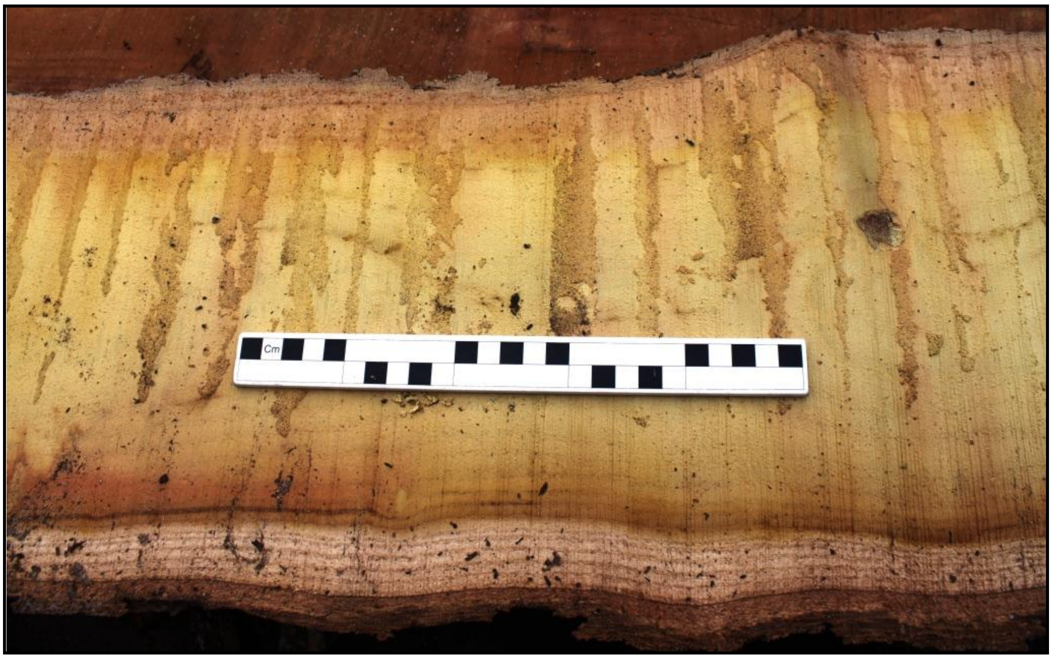

Figure 8.27: The yellow timber of a *tūt* plank at Lahma boatyard at Rasheed (Photograph: author).

Figure 8.28: Frames made with *tūt* at the boatyard in Lake Burullus, owned by Hajj Ali Abd el-Rahman el-Qassas seen here (Photograph: author).

Figure 8.29: A *tūt* tree at Birket al-Sabe[c] (Photograph: author).

8.58 Zān

This wood is indicated by several colloquial names which are *Zān*, *Zenn*, *Zūr* and *Zann.* Ali Ibn Ali Salim, a Yemeni 36-year-old boatbuilder told Agius that *Zann* is "the scientific name for *zūr*".[350] This is obviously erroneous as *zūr* is not a binomial name, nor a type of wood I was able to identify. My informants at Anfushi, Alexandria gave me a sample of what they called *zān*, which Gerisch identified as *Fagus* sp. (Eng. Beech).

[350] Interviewed on 10th February 2009.

Egyptian boatbuilders use *zān* for paddles, masts and straight cut frames in fishing boats, while others employ it for furniture in leisure boats. Al-Arabi Mohamad al-Shuwwa uses *zān* for the keel and the stempost. Ali Ibn Ali Salim, from Yemen, uses *zān* for the *kirda* because it is strong. *Kirda* is the oval-shaped piece on the stern to which the propeller is fixed. Comparatively, beech was used in keels and false keels for small cargo vessels, and frames for larger cargo ships in antiquity (See 12.3.2 Table 2; Wicha & Girard 2006: 113, Table 19.1).

My Egyptian informants did not seem to agree on what kind of wood *zān* indicates. Mark Moawad, owner of a wood import company in the town called 21Km near Alexandria, told me that *zān* is in fact a type of chipboard: a dry wood compiled from wood shavings and pressed together. This explains why Mohammad Abu el Sayyid Shata said he does not use it in boatbuilding because it is absorbs water and becomes spongy. Surely, what Moawad and Shata were identifying as *zān* is not *Fagus* sp.

My informants were also not consistent in their information on colour: some say it is a red wood and some others yellow. Various sources of import are mentioned: From India,[351] Italy, France, Germany[352] and Romania[353] to Egypt and East Asia to Yemen.

Zān gets a one-off mention by Madani (1986: 81) as "a kind of imported wood" used for planks in a river boat plying the Blue Nile, at al-Suki in Sudan. In conclusion, such an enigmatic timber needs further ethnographic investigation coupled with sample identification.

8.59 Zangali

The name *zangali* is the most mentioned among several variants of a type of wood which include *zangali ʿayn*, *zangali aḥmar*, *zangili aḥmar*, *zengili*, *zengali*, and *jangal*.[354] Its identification is quite complex to define. The name *zangali* is used in Eritrea, Djibouti, and Yemen. An alternative name in Eritrea is *jangal*; in Djibouti *zangali aḥmar*; whereas the widest variety of names exist in Yemen with *zangali ʿayn*, *zangili aḥmar*, *zengili*, *zingali* and *zengali*. Cooper adds to this list when he records

[351] Ibrahim Ali Musa al Najjar interviewed in Quseir on 24th January 2012.

[352] Al-Arabi Mohamad al-Shuwwa on 24th January 2012.

[353] Samer Khairi, Mark Moawad both interviewed on 17th January 2012.

[354] I will be using the word *zangali* in this section since it is the most common among our informants.

what seem to be several types of *zangali* used in Yemeni boatyards: *zangali singafora* imported from Singapore, *zangali malasia* imported from Malaysia,[355] *zangali būna* from India, Pakistan, and Malaysia, *zangali hadīdi* and *zangali gāwa* from Malaysia and Java. It is safe to infer so far that the type(s) of wood designated by all these names originate(s) in South and South-East Asia.

Wood identification in this instance does not help in ascertaining a precise identity to *zangali*. A wood sample from a racing *hūrī* in Abu Dhabi, that Abu Hamdan Jumaa Al-Jabi[356] indicated as *jangali* was identified as *Shorea* sp.[357] (Figure 12.62). In this case jangali can be another colloquial name synonymous with *khashab aḥmar* and *jāwī* that were also identified as *Shorea* sp. (See Sections 8.2 and 8.30). Meanwhile, Agius (2005: 30) identifies the Gulfi Arabic name *jangali* as "Jungle wood", which he says is "Indian laurel, *Terminalia alata* Heyne ex Roth. or *coriacea* (Roxb.) Wight & Arn." (Figure 12.50)[358] Another sample from a garboard strake of a *sanbūq* in Tuwalet Massawa indicated ethnographically to Cooper as *zangali* was identified as *Quercus* sp., evergreen or as *Lithocarpus* sp.[359] (Figure 12.44). *Quercus* sp. is a genus of around 530 species, 31 of which can be found in India and several others in South East Asia (Gamble 1902: 671; Mabberley 1998: 722). *Lithocarpus* sp. consists of around 300 species, growing in the Indomalay region that is from India to New Guinea (Mabberley 1998: 495). From his research on traditional boats in Djibouti, Perrier (1992: 58) says that *jingali*, so-called in Yemen and Djibouti, is a red wood imported from India, without offering scientific identification for this wood. Therefore, what is secure from the evidence so far is that *zangali* and its different variances, originate from India and/or South East Asia. But, such evidence also indicates that it is not related to one species or genus. Indeed, ethnobotanical studies pertaining to trees in Pakistan show that the word *zangali* is usually followed by various other names, and each differ according to the

[355] Abduh Balgayth told Cooper that *zangali singafora* and *zangali malasia* are two types of *zangali* on 22nd February 2009 (Cooper Yemen fieldwork notes).

[356] Interviewed by Agius on 8th May 2011.

[357] Gerisch personal communication by email on 8th January 2012.

[358] *T. alata* Roth. is also synonymous with *T. tomentosa* W. (Gamble 1902: 344). Wood (1997: 174) records *Terminalia brownii* Fresen. as a Yemeni local species reaching 15 metres in height and designated by the colloquial names *Qaᶜ*, and *Thūᶜab*. Nine *Terminalia* species were introduced from tropical Asia to Sudan at unknown dates (El Amin 1990: 91-95).

[359] "There are wood anatomical similarity between evergreen oaks and the *Lithocarpus* genus, of which representatives can be found in India" (Gerisch personal communication by email on 19th July 2012).

related species, for example: In Buner District in Pakistan, *zangali sufaida* and *zangali sperdar* are local names for *Populus ciliata* Wall (Khan *et al.* 2003: 368; Hamayun 2005: 12). In Kot Manzaray Baba Valley, Pakistan *zangali inzar* indicates *Ficus palmata* Forssk. (Zabihullah *et al.* 2006: 117). Consequently, *zangali* cannot be identified with one species or genus. Future evidence is needed to understand the dialectal pattern of *zangali*, if such a pattern exists, and establish a more comprehensive list of *zangali* identification.

The uses of *zangali* in boatyards in Eritrea, Djibouti and Yemen are mainly for hull planks especially for the garboard strakes and less so for the keel. In the Gulf, the uses are similar, as Agius (2005: 30) notes that *jangali* is destined for the keel and lower and upper deck. He says the tree reaches a height of 27.43 metres, which is suitable for sawing out a keel. Yemeni boatbuilder Muhammed al-Ghaili, 65 years old, told Agius that he employs *zengili* as he calls it, for the stem and sternposts, and that is imported from East Africa.[360] Earlier, Perrier (1992: 58) said that *jingali* was employed for the upper stempost in the boatbuilding yards of Mocha and Dhubab in Yemen. He adds that *jingali* is strong and imperishable. Our informants merely describe z*angali* as a red wood imported from India, East and South East Asia.

Zangali is most probably just as its English counterpart 'jungle wood', if such an association can be made, more of a generic term for one or several tree species coming from the jungle i.e dense forests of India, East and South East Asia. Indeed, Tom Vosmer informed me that jungle wood "is not one species, but any of a species of timbers that are suitable for framing".[361] Also, jungle wood is widely reported in the literature on traditional boatbuilding of the Indian Ocean. Edye (1834: 14) says that 'all sorts of jungle-wood' are used in the building of the Boatila Manche trading sailing vessels, and for frames in the large Patamár cargo vessels (Edye 1834: 10-11).

Commander Wilson (1909: 6, 20, 31, 42, 50, 62, 71, 75, 81, 88, 93) notes that both hull planks and frames of jungle wood were used for building Arabian and Indian boats at a shipyard in Bombay Harbour. Hornell (1942: 13) also records natural crooks of jungle wood employed as frames in Arabian boats of the Persian Gulf and South Arabia sailing to the Malabar coast. Upon their return, these ships carried among other building

[360] Interviewed by Agius in Aden, Yemen on 7th February 2009.

[361] Personal communication on 23rd July 2012.

material jungle wood crooks for frames (Hornell 1942: 13; 1946a: 213). Hornell (1946a: 199) says that frames of the *dhangi*, a carvel-built cargo boat from the north-west Indian coast, and of the *batel*, an open vessel from the same area, are made with of jungle wood (ibid: 201). Hawkins (1977: 42, 44) reports the use of 'jungle wood' branches imported from Malabar for framing timbers in dhows built in Kuwait and at Ma'alla in Yemen (Hawkins 1977: 58, 117). None of these offer however a species identification.

8.60 Zingīr

Zingīr is cited once by Abduh Balgayth, a boatbuilder in Hudayda, Yemen who informed Cooper he uses it for planks.[362] It might another spelling of the name *zinjil* recorded by Prados (1997: 194) also in the Tihama, in Yemen, and for the same nautical application. He identifies *zinjil* with its trade name *Kapar* of the genus *Dryobalanops* sp. (Figure 12.25), but it is not clear how he reached such an identification. He says it is one of the less expensive substitutes for teak and describes it as a reddish hardwood imported from India and Java. This might indicate that *zinjil* is equivalent to *khashab aḥmar* and *jāwī* and can also be identified with *Shorea* sp. Prados (1997: 194) adds that it is stronger than pine, and used in the lower planking below the waterline but is not as durable as teak against marine borers. In the absence of any further ethnographic and linguistic information, as well as wood sampling, no further comments can be made here.

Ethnographic data from our fieldwork in the Red Sea has revealed substantial information on vernacular names of timbers used in boatbuilding. These timbers encompass both endemic species to Red Sea areas but also imported ones from a wide-range of countries and regions such as the Europe and South Asia. Also, our ethnographic data has highlighted the wide variety of local timbers used for various purposes in boatbuilding, and not only limited to structural components. This counters widely-accepted statements that Red Sea areas were/are short of timber resources and only relied/rely on imported timber. The identification of wood samples from known timbers allowed the association of a vernacular name with its scientific binomial name. This has contributed immensely to our knowledge about the nomenclature and identity of nautical wood types. Still, there are timbers which remain scientifically unidentified,

[362] Interviewed in Hodeidah by Cooper on 22th February 2009.

mainly for logistics reasons. This is why future ethnographic work might enlighten us more on such species.

This ethnographic investigation is a research tool in its own right but can also contribute to our understanding of the past. Mainly, it pertains to the potential existence of linguistic variants that the peoples of the Red Sea regions must have used to indicate and name timbers. The disciplines of history and archaeology by nature might provide written evidence of tree names, but not the way people pronounced them or their vernacular use which might have differed from one region to another.

The present ethnographic enquiry showed how boatbuilders recognised timber from its aspect, colour, and scent. They also explained the reasons behind choosing timber species and their personal preferences. This sensory and cognitive engagement surely must have existed among ancient boatbuilders of the Red Sea (See Section 4.3, and Chapters 9 and 10).

This thorough analyses on wood species used in boatbuilding in the Red Sea is followed by a chapter on modern processes related to the exploitation of these timbers, such as issues of provenance, felling, seasoning, cutting, and conversion; and how these inform our interpretation of pas practices.

9 Timber exploitation processes in the Red Sea ethnographic record

This section explores the processes a tree undergoes from the moment of its selection for felling to its final destination as a boat component. Such processes are an integral part of the ethnographic enquiry of this thesis, and help illuminating past processes of nautical wood exploitation. Understanding these processes, past and present, provides a well-rounded and comprehensive picture of the use of wood in boatbuilding. It contributes to mitigating the gap in our knowledge about nautical timber use; as Meiggs (1982: 325) says "Of all the-major industries the timber industry has been one of the most silent and least recorded".

The timber exploitation processes, I believe, are part of a "human project", which entails social activities necessitating "intention, planning and organization" (Simpson 2006: 60). Exploiting timber for its nautical application starts by the process of selecting suitable trees that would produce good quality timber. The subsequent acquisition process differs between local tree species and imported ones. In the case of local wood, the felling operations are followed by the treatment, seasoning and conversion operations of timber boards. Imported woods are usually treated and seasoned at their country of origin.

This chapter voices the opinions of informants from around the Red Sea, but focuses on those from my fieldwork in Egypt; it being the most informative on the subject. It also correlates the ethnographic data with scientific input from publications on wood characteristics, and with economic literature on timber trade. This is by no means to dismiss my informants' knowledge, as the focus is on their understanding of timber exploitation processes. As Simpson (2006: 79) says: "my approach is to pursue what my informants, themselves, think they are doing and to compare these ideas with their activities in the wider world. This literally seems to me to be a matter of emphasis rather than critique".

Finally, I have, whenever possible, put forward textual and archaeological evidence on the processes of nautical wood exploitation in the past, in order to shed the light on the implications that the ethnography of the Red Sea regions have for the related archaeology of boats. Related archaeological data from these regions in the classical and medieval periods is absent; hence, the reader is presented with evidence from Pharaonic Egypt and the Roman Mediterranean region.

9.1 Selecting wood

Once a boat owner commissions a boatbuilder to construct a wooden vessel, the process starts off by a careful selection of raw materials. Rajamanickam (2004: 129) says: "The navigator and the boatbuilder are very careful in choosing the raw materials, because the quality of raw material is an index of a vessel. A suitable knowledge on the selection of raw materials is very essential to build a vessel with durability". My informants in Egypt showed a deep knowledge of the right characteristics of a tree that would provide timber of good quality. First, the age of a tree has a role to play in the durability index of the timber it produces. The slower the tree grows, the more durable, dense and compact the wood is, says Egyptian boatbuilder Hamdi Lahma.[363] He explains that that is why the strongest wood is *sanṭ* (Eng. Acacia) because it grows very slowly. "You can find a 50-year-old *sanṭ,* tree that is not very tall, whereas you can find a *kafūr* (Eng. Eucalyptus) tree that is 10 years old, which would be younger but taller and less durable", he says. Therefore, a tree's maturity is not relative to its dimensions, but of its growth rate. However, Hoadley (2000: 97-98) argues that the influence of the growth rate on the strength of a wood relates with the tree species. He says that in softwoods, the slower the growth the stronger the wood; whereas in ring-porous hardwoods[364] such as oak, teak and eucalyptus, harder wood is the result of fast growth (Jegels 2006: 6); and in diffuse-porous hardwoods,[365] such as *sanṭ* (InsideWood 2004), there is no predictable relation between growth rate and strength (Hoadley 2000: 97-98; Jegels

[363] Interviewed on 14th January 2012.

[364] In regions of the world where climate is distinctly seasonal, with long cold periods that halt tree growth, a type of vessel arrangement called ring-porous often develops. A few ring-porous hardwoods are also found in the tropics, especially in response to monsoonal conditions that provide a relatively short growing season. The characteristic features of ring-porous hardwoods are clustered large pores (vessels) at the beginning of the growing season followed by more scattered, smaller diameter pores embedded in fibers in the latewood. Some temperate region trees and most tropical species that are classified as ring porous may have only slightly larger and few larger pores at the beginning of the growth ring, or have a more gradual change in pore size transitioning into the latewood. These will be referred to as weakly ring porous (Jegels 2006: 6).

[365] Diffuse-porous hardwoods have similar size vessels arranged in various patterns throughout the growth ring, but typically in a relatively uniform distribution of pores. Diffuse-porous hardwoods dominate in the tropics, but are also common in many temperate zone habitats. They are readily distinguished from ring-porous hardwoods by lacking the distinct concentration of larger pores at the beginning of the growth ring. Tropical hardwoods that lack distinct annual growth rings are classified as diffuse-porous (Jegels 2006: 6).

2006: 6). Thus, these scientific sources contradict my ethnographic source. This mainly relates to the positionality of each of the scientist and the boatbuilder. The former relies on a systematic knowledge that can be rationally explained; while the latter speaks from a long-lived experience, and an inherited and empirical knowledge and craftsmanship.

Boatbuilders prefer to work with trees of old age because they say they are more durable and stronger, and the wood of a 50 to 70 year old tree for example is more resistant to rot when worked than young wood of the same species, according to Egyptian boatbuilders Mahmoud Abd el-Maguid al-Qassas and Ibrahim al-Sayyid.[366] Ibrahim al-Sayyid recognises an old wood from the diameter of a tree and the colour. He says the "less whitish wood there is on the inside of a trunk the more mature the tree is". Indeed, a section of a tree trunk shows both heartwood and sapwood. Generally, the contrast between the two parts is often marked by a difference in colour. As the trunk matures, the heartwood is where "materials like tannins, resins, and colouring matters" are deposited, rendering it darker than the paler and younger peripheral sapwood (Jane 1970: 73).[367] Thus, the older the tree, the greater the proportion of heartwood (Titmuss 1971: 3). Bearing this in mind, it is understandable then why boatbuilders prefer mature trees. The cells of heartwood do not conduct nutrients and sap, rendering it more durable i.e. resistant to fungal and insect attack, and stronger than sapwood (idem: 3; Edlin 1956: 3). To Hoadley (2000: 98), generally the difference in strength between sapwood and heartwood is not substantial; but he does acknowledge that heartwood has a higher rot resistance and stronger than sapwood.

Atef Matar,[368] an Egyptian trader of local wood, recognises a tree's age empirically. He says it is not from a tree's height that he can determine its maturity and age, but experience. He also showed insights into dendrochronology, when he says that that once felled, the tree rings are an indicator of age with every ring corresponding to a year, and by counting the rings he accordingly determines the age of a tree. However, this is more complicated when searching for a scientific justification of this phenomenon. Growth rings are defined as "concentric layers of wood produced during a growing season" (Titmuss 1971: 3). In temperate climates, a tree produces a ring once a year. However, a

[366] Interviewed on 16th and 19th January 2012.

[367] However, some species do not present a difference in colour but the wood displays an even tone throughout the trunk. Also, the extent of hardwood and sapwood may vary depending on a tree species and not only on its age (Jane 1970: 73-77).

[368] Interviewed on 28th January 2012.

sudden halt in growth for any environmental reason can cause the tree to produce false growth rings that might mislead an observer counting these rings (Jane 1970: 69; Titmuss 1971: 3); or a tree can form more than one growth ring during a growing season (Jane 1970: 69). Another confusing element is one seen in mature trees where "one or more growth rings are not continuous but merge into an older ring" (Jane 1970: 69). As for tropical trees, it is unclear whether a growth ring is produced yearly or whether more than one could be produced (Jane 1970: 69).[369] Thus, it remains to be seen whether Matar is aware of such exceptions. The latter designates a young tree or sapwood by the Egyptian vernacular name *baghwa*, whereas hardwood or a mature tree is called *sharbatli*. He confers an anthropomorphic quality to a tree when he explains that a mature tree is better than a young one, because it is stronger, "like a 25 to 30 year old man is stronger than an 8 to10 year old infant". He adds that mature wood is better than young wood because when sawing a young tree the wood splits and fissures because its 'nerves' and grain are weak, but when cutting a mature wood the cutting line stays straight and the wood does not fissures because the grain is strong. However, the strength of a tree is not related to its age but the direction in which its grain has developed. Wood grain is the pattern determined by the direction of wood fibres. If the orientation is parallel to the long axis of a wood log then it is deemed straight-grained, and thus has higher strength (Hoadley 2000: 95-97).

There is a lack of archaeological evidence in the Red Sea regions that reflects the several aspects of choosing an adequate tree for felling in the past. We have no information on how boatbuilders from these regions estimated the age of a tree and how they recognised aspects of mature timbers. We do not know if they perceived any relationship between age and species or had any awareness of dendrochronology. Hence, we can only suggest through our ethnographic enquiry, that ancient and medieval boatbuilders of the Red Sea might have been keen on selecting mature timbers in order to produce durable boats.

9.2 Acquisition mechanisms

There is a general consensus in Red Sea boat studies that the region is one with almost no wood resources for boatbuilding, and that the bulk of timber was and still is imported. This is not entirely true, as I have argued thus far in this thesis. Ethnographic investigation in Red Sea regions has shown the substantial exploitation of local species

[369] For more on growth ring see USDA (2010: 3-5, 6).

— whether endemic or gradually introduced at later periods — such as *Acacia* sp., *Conocarpus lancifolius*, *Morus* sp., *Tamarix* sp. and *Ziziphus spina-christi*, to name but a few. This exploitation is as important in the building process as profiting from imported woods from South Asia or Europe. The acquisition mechanisms I look at in this chapter, consist of how a wood order is placed, and how timber is conveyed to the working space of a boatbuilder.

Past acquisition mechanisms were looked at Chapters 6 and 7 through the study of the related textual and archaeological evidence. Hence, to avoid repetition the reader is referred to these chapters. Meanwhile, the information provided below mainly emanates from ethnographic research I conducted in Egypt and Saudi Arabia. Detailed information is lacking in other areas of the Red Sea where Agius and other MARES team members have undertaken ethnographic research, because nautical wood exploitation was not a central part of their enquiry. This is why most of the informants in Yemen, Djibouti, Suakin and Eritrea were not further questioned about the origin of a wood, apart from the straightforward statements of designating whether the wood is local or imported; and in the latter case what are the export centres. Therefore local wood sources and modalities of acquisition remain largely unexplored in these areas. These would be interesting to investigate in future research to establish a comparative analysis for different regions of the Red Sea.

9.2.1 Local wood sources

Local timber procurement is not a commercial market purchase as it is for imported woods. It is a process of careful selection in agricultural land of specific trees, which requires the expertise of timber agents and boatbuilders. In boatyards and workshops of Egypt and Saudi Arabia, I noted that all local types of wood arrived there in the form of natural crooks, logs, or flat-sawn boards. Boatbuilders first contact local timber agents and suppliers for local wood. These agents act as middle men between the shipwrights and the suppliers who are generally farmers and owners of the land. Saudi boatbuilder Ibrahim Bilgaith told me that the local trunks and crooks he buys come from *mazāriʿ*, that is, plantations. He says that logs of *ʿarj* (see Section 8.6) are found in Sabya, a town of the Jizan Province. He prefers to acquire logs in their natural form rather than pre-sawn timber because he can better control the conversion process.[370] In Rasheed,

[370] Interviewed on 11th May 2010.

boatbuilder Hamdi Lahma[371] considers that the best quality of local trees grow in the Monufia Governorate (Ar. *Muḥāfaẓat al-Minūfiyya*) and its adjacent regions, around 40km north of Cairo. This is quite understandable, as Monufia is a fertile region in the Nile Delta, irrigated by both the Damietta and Rosetta branches. The relationship between the timber agent and the boatbuilder seems to be built on trust and a mutual understanding of each other's work and craftsmanship. Lahma tells me he has a few agents he contacts to place orders, these are people he has become used to dealing with, "who know their work, and what each wood is used for [in a boat]". Lahma adds that he trusts the good judgment of his agents when it comes to knowing what parts of a tree correspond to parts of a boat. "If I inform the agent I need to carve out a lower sternpost, then he would pick a curved part of an acacia or mulberry with a wide curvature perfectly matching my need" Lahma says. Boatbuilders in Suez such as Ibrahim al-Sayyid and Mohammad Abu al-Sayyid Shata,[372] acquire timber from agricultural land in Alexandria, Cairo and the al-Sharqiyyah and Monufia Governorates. Abu al-Sayyid Shata tells me that timber is the product of trees planted to separate agricultural plots and protect the crop from wind and desert sand-storms. Indeed, Egyptian wood merchant Atef Matar[373] explains that planted in close stands, these trees act as a natural protective barrier, due to their tall and straight trunks. Very few other boatbuilders such as Abu al-Sayyid Shata prefer to go in person to wood providers, and choose from among the available logs and tree parts the ones suitable for the boat components he needs.

Boatbuilders working on the Egyptian Red Sea coast also fetch wood from as far away as the Delta, especially regions on the eastern branch of the Nile. Egyptian boatbuilder Ali Ahmad Sherdi[374] working in Safaga deals with local wood providers in Port Said, Damietta and Matariya, a city in the Daqahlia Governorate in the north-east Delta. Egyptian boatbuilder Mohammad Metwalli's contacts are also located in towns in the north-east, such as Mansura, the capital of the Daqahlia Governorate, and al-Sharqiyyah Governorate, except for Kafr al-Sheikh Governorate which lies along the western branch of the Nile Delta.[375] The quantities of wood required are estimated in units of one tonne, which my Egyptian informants call *ṭornaṭa*. Sherdi says he places his order

[371] Interviewed on 14th January 2012.

[372] Interviewed on 19th January 2012

[373] Interviewed on 28th January 2012.

[374] Interviewed on 21st January 2012.

[375] Interviewed on 22nd January 2012.

in *ṭornaṭa* depending on the size of the boat he is building, and sends the agents the templates of related parts (Ar. *forma*) for them to find fitting tree parts. For boatbuilders who work as free agents and do not own a boatyard with a saw mill, such as Sherdi, wood providers not only fetch them wood, but have the logs flat-sawn into planks depending on the requested thickness, and corresponding to the provided templates. In some cases there are saw-mill companies or owners who act as wood providers and middle-men between cultivators and shipwrights. They naturally take a profit from the transaction, as Metwalli tells me: "if the cultivator sold a *ṭornaṭa* for 200LE[376] to the saw-mill, the latter sells it to me for 700 to 1000 LE", which is three to five times the initial price. The advantage of this is to have the boards cut in the required dimensions, when a boatbuilder does not possess a saw-mill at his yard. The practice of acquiring flat sawn boards by boatbuilders to a boatyard with no saw-mill seems a recent development. Egyptian boatbuilder Khalil Mohammad Khalil[377] tells me that in the time of his father, before the advent of the electric saw-mill, timber used to arrive at the boatyard in the form of logs. Boatbuilders would manually remove the bark and carve out the boat components they needed (see Section 9.4.2).

The price of a *ṭornaṭa* seems non-negotiable. Mahmoud Abd el-Maguid al-Qassas,[378] says that wood merchants, whom he calls *gallābeh*, do provide and transport timber to boatbuilders, but at the prices that the *gallābeh* impose. Shipwrights cannot argue much because they are in need of the raw material. Al-Qassas argues that it is the development of the Red Sea leisure boat industry that has led wood merchants to increase prices in search of higher profits. He lamented that "the owner of a leisure boat can afford expensive refurbishments. This is not the case for a fisherman of Lake Burullus, with his restrained income corresponding to half of a salary of a boatbuilder working in leisure boats". In Quseir,[379] Ibrahim Ali Musa al-Najjar fetches sawn timber from workshops or saw-mills in the industrial quarters of the town (Ar. *al-madīna al-ṣināʿiyya*), whence it is brought in logs by cultivators. Meanwhile, Abdo Shata buys his tonnes of wood personally from merchants in Cairo, Suez, and Manzala, a town in the Daqahlia Governorate. He tells me, as other boatbuilders have, that the quantity he buys

[376] LE stands for *livre égyptienne* which is French for Egyptian pound. 200LE correspond to £20 (http://www.oanda.com [Accessed 21th September 2012]).

[377] Interviewed on 22nd January 2012.

[378] Interviewed on 16th January 2012.

[379] All interviews mentioned here were done on 24th -25th January 2012.

is proportionate to the size of the boat he wants to build. As an example, Shata says an 11-metre-long boat needs around five tonnes of wood. Al-Arabi Mohamad al-Shuwwa knows of several saw-mills in Cairo, Port Said, Ismailia Governorate, and Matareya in Daqahlia Governorate but he deals with the latter, as he is originally from there, even though he works in Quseir. Overall, it was not very clear to me how the transactions are made between boatbuilders and wood agents or saw mills. Al-Shuwwa simply said that he does not travel to fetch timber, but sends the money to the saw-mills in Matareya, in exchange for them sending the wood to him.

So far I have discussed the boatbuilders' version of the timber acquisition process. I was able to speak with Atef Matar[380] a major wood merchant in Birket al-Sabeᶜ in Monufia Governorate to get his perspective on the process. Due to logistic limitations, I could not speak with other wood merchants in other parts of Egypt, or in Saudi Arabia. In the case of Saudi Arabia, Bilgaith and other informants told me that the main wood providers are located in Jeddah. It was not possible for me to visit these during the May 2010 fieldwork.

Matar tells me that he is known in his area for his occupation, and so attracts the offers of cultivators or farmers who want to sell trees growing on their lands. Contact between him and tree owners can also happen through people posting advertisements about selling their trees in newspapers, or through a middle-man that knows both him and tree owners. When asked about the origin of the tree owners he says that they are usually from the Monufia Governorate. Usually the trees destined for felling limit plots of plantations (Ar. *mazāriʿ*), and are mainly species of casuarina and eucalyptus.

The motivation behind the sale of a tree is often the fact that old trees need to be cut and replaced with younger ones. So, the choice of selling trees does not depend on the wood merchant but on the tree owner. In any case, the wood merchant is never at a loss because if the quality of a tree is poor, he can convert it into charcoal, instead of selling it for building purposes. Matar showed us the plot of land he owns in Monufia where he stocks timber, and where he has a dedicated space for charcoal production (Figure 9.1). Subsequent to establishing contact with tree owners, Matar personally goes to the related plots or wherever the tree is growing. He sometimes had to fell trees in towns or villages. He evaluates the weight of trees by eye, and negotiates the price per tonne

[380] Interviewed on 28th January 2012.

accordingly. When a large quantity is felled, Matar takes on the felling expenses; he weighs the lumber obtained and settles the payment accordingly.

Figure 9.1: Atef Matar's plot in Monufia. Note the surrounding stacks of timber and the remains of charcoal production. Mohamad Salama and Atef Matar are in the right of the picture (Photograph: author).

Once felled, the trees are transported to Matar's land on carts pulled by a tractor ahead of their distribution to boatyards. When a demand for wood is urgent, Matar delivers logs straight to the boatyard, unless the required timber quantity is substantial. For example: if a boatbuilder requires five tonnes of wood from Matar, and the latter only managed to secure three, he would stock these at his plot until he acquired the remaining two, and then completes the delivery. Matar does not deal with a saw-mill, but sends natural logs or crooks directly to boatyards that have one.

When felling a tree, a wood merchant bears in mind the requirements of the boatbuilder. Matar says that the shipwright provides him with the dimensions of logs and pieces needed, so he fells and cuts a tree accordingly. He argues that a person who is an expert wood merchant like himself and a lumberjack has an eye for conceptualising tree curves that correspond to curvatures needed in boat components such as frames, stern and stem posts. Matar says he fells a tree according to these crooks. His experiential learning has led him to recognise what a boat component requires in terms of a timber's shape and curvature. To him, a religious factor comes at play, as he believes that it is God that created the trees with curves that correspond to the boat parts.

9.2.1.1 Discussion

Acquiring local wood entails the involvement of several agents: the cultivator, the wood merchant, the saw-mill company or owner, the boatbuilder and the boat owner (Figure 9.2). The boatbuilder's role here is representative of the boat owner since the latter commissions him to undertake the work. The process of acquiring local wood for boatbuilding is not necessarily a sequential series of actions but can happen simultaneously or at different times. Only for the sake of this study, are these described in a linear way, which does not really match the multi-linear reality of events. Such social actions are interwoven in complex network relations around a need for nautical timber. Cultivators wanting to sell their trees have two options: they either contact a saw-mill to fell the trees and buy them, or a local wood merchant who usually also acts as a lumberjack. Subsequent to felling trees, the wood merchant either sends the unprocessed logs to a boatyard that has a saw-mill; or he has them processed into boards at a saw-mill first and then sends them to the boatyard. Boatbuilders usually have established relations with wood merchants that they know, trust, and have been trading with for several years. The majority of shipwrights trust the know-how, ability, and expertise of a wood merchant to fell tree parts according to the boat components they require. They say that wood merchants will, for example, send them natural crooks of local timber, adequately felled in order to be used in curved boat components. Some boatbuilders deal directly with saw-mills to buy wood, and some others prefer to visit local-wood merchant yards to personally choose timber. In Sudan, boatbuilder Salih Mohamad Abd al-Rahim interviewed by Madani (1986: 169, 178, 185) on 5th June 1986 said he and his assistants fetch wood from "the forest" and classify timbers there and then by recognising which log is suitable for which boat components.

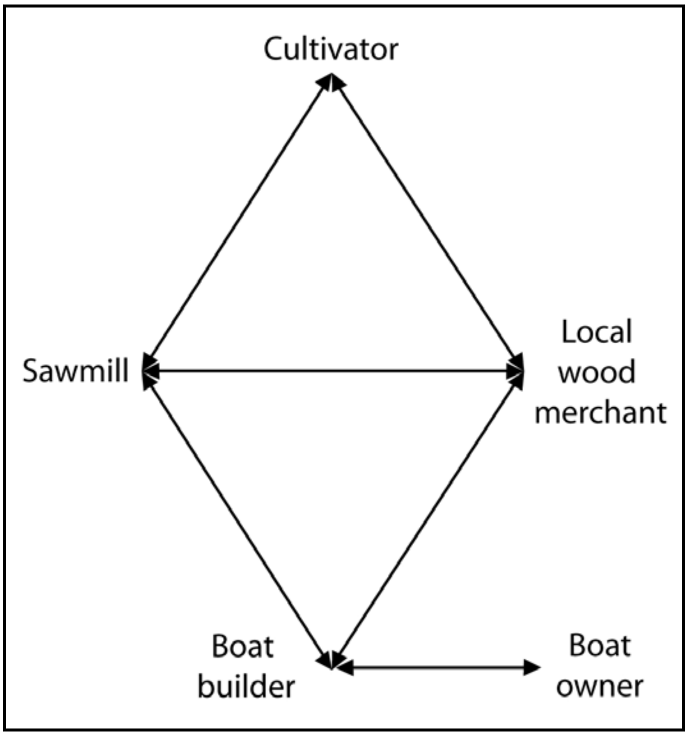

Figure 9.2: Exchange networks for local timber.

In Egypt, locally-sourced timbers grow in agricultural lands in Lower Egypt, and more commonly in governorates along the Damietta Branch. These wood resources supply boatyards on both the Mediterranean and Red Sea coasts of Egypt. In Saudi Arabia, agricultural lands in the province of Jazan provide al-Hafa yard with its local woods. Local timber is ordered by units of one to several tonnes, depending on the size of a boat a shipwright is building. Local wood is usually delivered to a boatyard by trucks or donkey-drawn carts. Its shape varies between logs and natural crooks, or flat-sawn planks, depending on a boatbuilder's request and whether a boatyard possesses a saw-mill or not. The species of local trees exploited for their wood in nautical applications have not changed for at least the last one hundred years, according to the claims of most of the informants I spoke to in Egypt. It is only the price of timber that has increased over the years, they say. Each actor of the local wood exchange network takes his share of the profit. The wood merchant and/or the saw-mill have a central role in this because they negotiate price with both the cultivators and boatbuilders. There are also intrinsic relationships between boat owners, wood traders and boatbuilders whereby the boatbuilders play a central figure in the arrangements between the wood suppliers and the boat owners.

At times certain types of relationships are not without problems as there can exist a sense of competition among boatbuilders. For example, when I was interviewing boatbuilder Amm Hassun on the beach in Safaga, we were suddenly interrupted by another boatbuilder Ali Ahmad Shirdi, who was working not very far from us, and thought I was a potential customer. As soon as Shirdi understood the situation, he exclaimed to Amm Hassun: "I thought you were stealing customers away from me!". Indeed, competition has risen among boatbuilders of 'traditional' fishing crafts in the Red Sea with recent tourism developments, since demand is rather for leisure boats. Failing to get engaged in this new industry, boatbuilders remain reliant on the much less-profitable building and repairing of fishing boats.

The exploitation of local timber for boatbuilding thus entails an extensive network of social networks. Endemic species are used alongside imported species in boatbuilding, the acquisition processes of which I will now investigate.

9.2.2 Imported wood species

Local Red Sea woods were used, and still are in the case of Egypt, in the structural timbers of a boat such as the keel, the stern and stem posts, and the frames. Boatbuilders rely largely on imported woods mainly for the hull planking and upper structure, but also for the keel. The intricate exchange relations between boatbuilders, wood providers, and wood import companies are explored here.

Timber imports are quite modest as wooden boatbuilding is almost dead in present-day Red Sea regions. These regions import wood from both eastern and western sources. To the east, India and countries of South-East Asia act as export centres, and to the west European countries, and less so East African countries and the USA, constitute the main wood providers. I have not attempted here a contemporary economic history of wood import/export fluctuations in the Red Sea. This task is outside the scope of this research. Official records of the designated countries need to be explored in order to verify data from ethnographic interviews. In addition, there is a need for the further investigation of records from wood-import companies and intermediary providers in different regions of the Red Sea, in order to evaluate the volume of the trade in nautical timbers. It is only in Egypt that I was able to speak with wood import agents. More interviews with such agents in other countries of the Red Sea would be indispensable in ascertaining wood import networks there. Emphasis is drawn below on the perceptions of imported wood provenance by the informants that Agius, the MARES team and I spoke with. These perceptions reflect more a residual activity of exchange networks across the Red Sea, reminiscent of an active past hardly applicable nowadays. The main export regions and the types of exported timbers are looked at here; these relate to ethnographic accounts provided by our informants.

9.2.2.1 India and South East Asia

India has a long history of exporting quality woods for building Arabian and Persian vessels plying the western Indian Ocean (Pâris 1841: 9). Cargo dhows engaged in the trade between the south Arabian peninsula and India carried Indian timber, among other goods, on the return journey from India (Edye 1834: 12; Hornell 1942: 14; Hawkins 1977: 42, 44, 58, 117). The ethnographic interviews we conducted revealed that India still figures, however modestly, among the countries exporting species of timber to the Red Sea. Yemen seems the chief importer of woods such as *jāwī* (*Shorea* sp.), *zangali* (*Shorea* sp. or *Terminalia alata* or *Quercus* sp., evergreen/*Lithocarpus* sp.), benteak (*Lagerstroemia lanceolata*), *funn* (*Calophyllum inophyllum* (?)). The once-thriving teak trade is almost non-existent. Villiers (1969: 57) saw imported planks from the Malabar coast destined for hulls of dhows in the early decades of the 20th century during his visit to a dhow-yard in Mukalla, Hadramaut. In Saudi Arabia, Bilgaith told me that the imported Indian timbers such as *sāj*/*sāg* and *jāwī* he used to get for his boatyard in al-Hafa come from wood importers in Jeddah.[381] He added that *jāwī* was imported to Saudi Arabia from India via Aden, in Yemen. Indian woods such as teak, *jāwī* and *zān* (non-identified) were mentioned in conversations with my informants in Egypt as used in boatbuilding there. India's contact with Djibouti seems only through the odd mention of the import of bamboo for yards.[382]

I have outlined earlier in Chapter 8 the decline in wood exports from India, especially in the case of teak (Ar. *sāg*/*sāj*), following the shortage of commercially available teak in India and its subsequent rising price. India over the recent past has become a wood importer, rather than exporter (Mahapatra et al. 2011). Indeed, India have lately been importing a variety of woods from Malaysia, Burma and other South East Asian countries for traditional boatbuilding (Swamy 1999: 133). Moreover, the dilapidated state of mango log *hūrīs* from India that we observed around the areas of our fieldwork in the Red Sea, shows that such practice has long been abandoned. It is not surprising therefore to see that other sources have been sought by wood importers and boatbuilders in the region. This could explain the presence of timber types from Burma, Malaysia,

[381] Interviewed on 11th May 2010.

[382] Ahmed Jaber Ali interviewed by Agius on 1st October 2009.

Singapore, and Indonesia, especially Java. These tropical south-east Asian timbers and woody resources included species such as bamboo and *jāwī* exported to Saudi Arabia, *zangali* and *zān* to Yemen, *jāwī* and *kamar* (*Eucalyptus deglupta* (?)) to Suakin, and teak to most of the Red Sea regions.

9.2.2.2 Africa

Owing to their geographical distribution, some of the countries we conducted ethnographic fieldwork in import African timber. West-East wood trade across the Red Sea is evident through African wood export to the Arabian Peninsula. The bamboo yards I observed at al-Hafa came from Egypt according to Saudi boatbuilder Ibrahim Bilgaith[383]. The latter also told me that Saudi Arabia imports timber from Kenya such as bamboo, pine, and *marantī* (*Shorea* sp.). I have not been able to verify this from official records, but apart from pine, bamboo and *marantī* are rather Asian-growing species (see Chapter 8). Somalia provides *mītī* (not identified) to Yemen according to Yemeni boatbuilders Mohammed Ali Abdallah al-Najjar and Ibrahim Muhammad Abduh al-Anbari.[384] East African regions provide *zangali* to Yemen according to Yemeni boatbuilder Muhammed al-Ghaili.[385] This is doubtful as *zangali* is a south Asian export (see Chapter 8). Meanwhile, Yemen acts as wood provider to Djibouti for *damas* and *jujube* wood that grow in Zabid, near Khokha, and in Hodeida.[386]

Within the African continent, my Egyptian informants mentioned Sudan by as supplying *finnī* (probably *funn*, *Calophyllum inophyllum* L.) and teak to Egypt. The notion of a Sudanese export of teak to Egypt may be problematic. Teak was first introduced to Sudan under British rule in 1920 (Gorashi 2001: 12), and the plantations reached 10,700 ha in 1990 (Kaosa-ard 1998). From 1956, the date of Sudan's independence, to 1972, the date of the formation of Southern Sudan Autonomous Region, teak and other forest plantations and timber production from natural forests were at their most extensive, in spite of the civil war between the north and south. In 1983, Sudan fell into a second civil war until 2005 that has, since then, witnessed illegal logging of teak and mahogany plantations (Anon 2003). In South Sudan, where teak forests are concentrated (El Amin 1990: 442), and some privately owned, teak seems

[383] Interviewed in Jizan on 11th May 2010.

[384] Interviewed by Agius in Aden on 10th February 2009.

[385] Interviewed by Agius in Aden on 7th February 2009.

[386] Ali Mar'ani an old fisherman interviewed by Agius in Djibouti on 28th October 2009.

either locally exploited for construction or subject to illegal logging and trafficking south to neighbouring Uganda (Anon 2003; VOA 2007; Mugisa 2011). I have not found any reference to Sudanese teak exports to Egypt.

Finally, Ethiopia supplies nearby Djibouti with *baharzāf* (*Eucalyptus* sp.), a species introduced to Ethiopia in the 19th century and widely cultivated since.[387] Uhlig (2003: 81, 90) says this wood is locally exploited for construction. I have not found any official record of its export. However, a cross-border export between the two countries of this widely available species can be conceivable at perhaps a small scale. Evidence for this is quite scare since only one informant from Djibouti spoke to Agius about *baharzāf*.

9.2.2.3 Europe and Russia

As one wood export centre wanes, another rises. Ethnographic research related to nautical applications of wood in the Red Sea reveal the decline, in the last few decades, of south-Asian wood imports, and the rise in European imports, mainly of pine. Bilgaith explains that this change is economically driven, as pine is cheaper than Indian and South Asian woods. Such change can also be explained by the different bans and restrictions on wood felling in India, especially of teak.[388] These must have precipitated the decline in teak exploitation in the Red Sea. There are still a few south Asian woods, such as *Shorea* sp., used in Red Sea boatyards, albeit on a limited scale since their past popularity has definitely given way to pine wood, at least in the past three decades.

Almost all of our informants around the Red Sea[389] mention pine imports from European countries such as Austria, Italy, Romania, Sweden and Finland — with Sweden being the most commonly cited — as well as Russia. Indeed, pine is widely distributed and commercialised in Europe (Haden-Guest *et al.* 1956: 231, 240-241, 242-246). As we have seen, pine is designated by different names throughout the Red Sea regions including: *khashab abyaḍ* (Eng. White wood), *abyaḍ* (Eng. White), *Muskī* / *Moski* / *Mosku* (Eng. From Moscow (?)), *Rūmāni* / *Romāni* (Eng. From Romania), *Snawbar* / *Suneybar* / *Soneybar* / *Sinibar* / *Snobar* / *Sanebār* (Eng. Pine), *Suwweid*/ *Sweydi* / *Suweydi* (Eng. From Sweden). Some of my informants in Egypt used these names interchangeably to designate different types or quality of pine wood. Samples of

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[387] Refer to *baharzāf* in Chapter 8.

[388] Refer to *Sāg*/*Saj*/*Sāj*/*Sag*/*Say*/*Tek* in the Chapter 8.

[389] More specifically informants from Yemen, Saudi Arabia, Egypt, Sudan and Djibouti.

pine were identified by Gerisch[390] as belonging to either group of pines with window-like cross-field pits such as European species *P. nigra* and *P. sylvestris*, or pines with pinoid crossfield pits such as South European *P. halepensis*, and *P. pinea*. The wood providers I interviewed in Egypt did not inform me about species of pine *per se*, but rather the mechanisms of its import. Mark Moawad[391] said he meets his business partners in London to place orders for imported woods. These companies, he says, have pine saw-mills in Russia, Sweden and Finland. Samer Khairi[392] informed me that pine imports to Egypt arrive as sawn timber of different dimensions, via cargo ships. These planks are readily workable as they have been already dried in specialised ovens in the country of origin.

9.2.2.4 United States of America

The USA was only mentioned as a wood supplier in Egypt, for species such as pitch-pine, Douglas-fir and oak. It seems, however, a thing of the past. Samer Khairi, at Safwat Moawad company for wood import in Alexandria, told me that the last import of pitch-pine from the USA had been some 12 to 13 years previous. Other wood providers and boatbuilders confirmed this by stating that pitch-pine is no longer commercially acquired. The latter collect it in form of recycled beams and planks from abandoned houses. The main cause might be the rise in price, as Mark Moawad explains. He says pitch-pine is currently sold at 6000LE/m3, corresponding to 594 British pounds/m3,[393] which is more than a fisherman can afford.

Although we observed imported oak logs at Lahma shipyard in Rasheed, Khairi denied these were imported from the USA. He said oak is now industrially processed into veneers in China and Russia and imported at low cost, destined for furniture and parquet floors. Thus, it is not destined for marine applications. Douglas-fir is another wood that seems to have been imported in the recent past from the USA to Egypt. Boatbuilders Lahma and Abu al-Sayyid Shata said it is no longer commercially available.[394]

9.2.2.5 Discussion

The process of wood import and its exploitation in boatbuilding is embedded in social and economic relations between: the timber export company; the wood import company; the local retailer of imported timber; the boatbuilder; and the boat owner. The import company mainly deals with wholesale, but also small-scale retail trade.

[390] Gerisch Personal communication by email on 26th March 2012.

[391] Owner of Mark wood international, interviewed on 17th January 2012.

[392] Sales manager at Safwat Moawad company for wood import, interviewed on 17th January 2012.

[393] http://www.oanda.com/ [Accessed 24th September 2012].

[394] Refer to *Duglas/Doblesfir* in Chapter 8 for details on the export of this species from the USA.

Boatbuilders have the option of either buying wood from the importing company directly or through a local retail company (Figure 9.3).

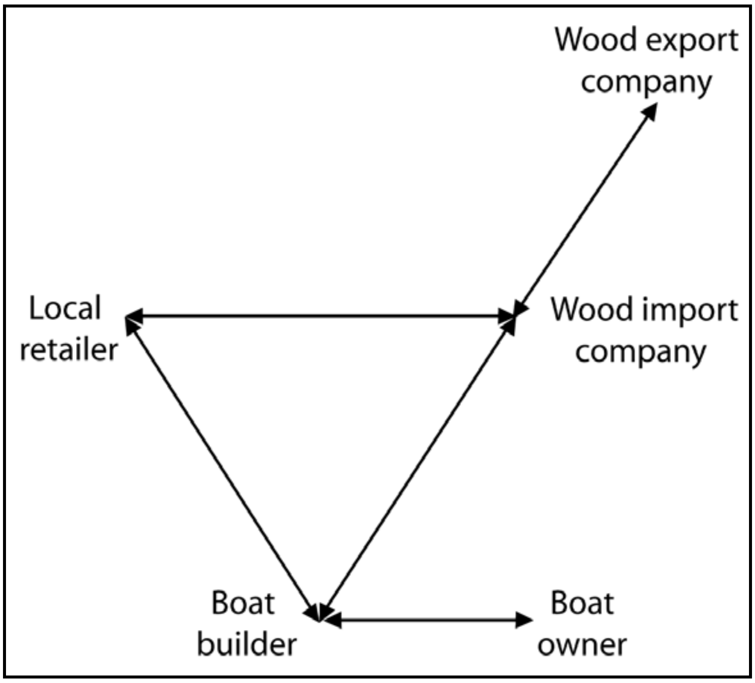

Figure 9.3: Exchange networks for imported timber.

From this schema (Figure 9.3), it is apparent that the boat owner does not have an active role in wood procurement. LeBaron Bowen (1949) provides a counter example of this in the case of Arabian dhows of Eastern Arabia. In the forties, he observed that it was the dhow owner who bought the wood from India and supplied it to shipwrights as a way to save costs (1949: 109). This practice is not applicable nowadays in the Red Sea, where foreign timbers are generally provided by wood import companies.

The transit of imported timber between supplier and customer does not only involve exchange networks between two or more countries. But, it can also involve local exchange networks between wood providers of a same country. I was able to observe this phenomenon on the Red Sea coast of Egypt. I visited *Sharikat al-Mansura,* a retail company for imported wood in Hurghada, which has been active for the past thirty years. The company's accountant Mohammad Morsi informed me that *Sharikat al-Mansura* is not a direct wood importing company. It acquires foreign timber from bigger wood import companies in Alexandria, and sells it to boatyards in Hurghada and Safaga, among other non-maritime customers.

The timber import/export flux also entails that some regions act as intermediary points of commerce between the two commercial poles. Noteworthy, is that these timber exchanges are on a quite small scale since wooden boatbuilding is an almost disappearing craft in present times; and most of the timber is used for repair works. Our ethnographic enquiry shows that modest timber quantities transit via Yemen to other areas of the Red Sea. As such, Khokha in Yemen is cited as providing pine to Djibouti by Ahmed Jaber Ali, a boatbuilder in Obock.[395] Since pine does not grow in Yemen (Hadri & Guellouz 2011: 7), it can only act as a transit region. Yemen also appears to play that role in terms of providing certain south Asian exotic wood species such as *jangal*[396] to Eritrea, and perhaps *jāwī* (*Shorea* sp.) to Saudi Arabia. The Gulf region, notably Dubai, is recorded as another transit region between south Asian woods and the Red Sea. As an example, Bilgaith informed me that *mantīk* (*Hopea* sp.) is imported from India via Dubai to Saudi Arabia.

Our ethnographic data is also indicative of the tangible shift in centres providing imported wood to the Red Sea (see Sections 9.2.2.3 and 9.2.2.4). For example: pine, the chief European and Russian softwood, is becoming more common for nautical applications than species of wood imported from the USA or South Asia.

It is apparent from the data above that people who build, repair, and use boats are generally aware of the sources of timber employed, but it is not always the case. This relates to the fact that boatbuilders deal with wood importers and providers. However, when asked about the origins of certain timbers, some boatbuilders simply stated the obvious: they get the wood from its seller.

Methods and means of transportation of imported woods to the Red Sea have radically changed over the past century. Long gone are the days where the likes of Villiers and Hawkins observed wooden sailing ships bringing Indian wood to the Arabian peninsula and the Gulf. Imported wood still arrives via maritime routes to the Red Sea, but in large metal motorized cargo vessels. Samer Khairi confirmed this to me, stating that all woods they import to Egypt come by ship. However, land routes are also an option for timber transport between neighbouring countries. In the illegal logging of teak from Sudan to Uganda, the logs were carried by trucks (VOA 2007).

The form of most of imported wood is as sawn timber i.e. squared thick planks. Thickness and length depend on the order placed by the wood importer, and what is commercially provided by the wood seller. An example of the range of wood products can be seen online at 'Bergs timber', one of the Swedish suppliers for Safwat and Mark Moawad import companies in Alexandria.[397] The only example of wood imported as

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[395] Interviewed by Agius on 22nd October 2009.

[396] Refer to *zangali*/*jangal* in Chapter 8 for more on this wood.

[397] http://www.bergstimber.se/ [Accessed 24th September 2012].

logs I observed were the imported *aru* (oak) logs at Lahma shipyard in Rasheed, Egypt. As for the quantity, boatbuilders unanimously state that they place orders with wood importers or providers for amounts they think would be proportionate to the length and overall size of a single boat.

9.3 Felling trees

This section essentially emanates from my ethnographic data in Egypt, where I had the chance to interview a local wood merchant, who also acts as a lumberjack, on tree felling operations.

9.3.1 Felling operation

Felling operations are usually led by a main lumberjack aided by two or more assistants. Atef Matar[398] tells me that he usually supervises problematic felling operations, such as in urban contexts where additional safety measures are implemented; for example, when a tree is felled near power lines. The rest of the time he sends his apprentices to do the job. To understand the skill of Atef Matar and his fellow woodsmen is to consider the dynamics and gestural synergy of human being, tool, and raw material (Ingold 2000: 352-353). As Ingold says: "Skill, in short, is a property not of the individual human body as a biophysical entity, a thing-in-itself, but of the total field of relations constituted by the presence of the organism-person, indissolubly body and mind, in a richly structured environment" (Ingold 2000: 353). Atef Matar says that a lumberjack starts the felling by climbing a tree and securing a rope at the top of the trunk. He first saws a horizontal V shaped scarf (with a 45° to 60° angle) on one side at the base of the trunk. This notch determines the direction of fall. A straight line is then sawn underneath it from the other side of the trunk, called a back cut (ForestWorks 2011: 36). Both cuts are done with a chain saw, and do not reach their respective opposite trunk edges. The lumberjacks then pull on the roped from the side of the V-shaped scarf (Figure 9.4). When a tree has imposing dimensions, Matar and his assistants fell it from the top down, progressively cutting sections off.[399] Such skilled practice involves qualities of care, judgment, and deftness, and is not just a mere imposition of mechanical force on objects; since it demonstrates how a practitioner is embedded in an environment and exemplifies his perceptual involvement with things (Ingold 2000: 353).

[398] Interviewed on 28th January 2012.

[399] For more on contemporary tree felling techniques and types of scarfs see ForestWorks (2011: 25-65).

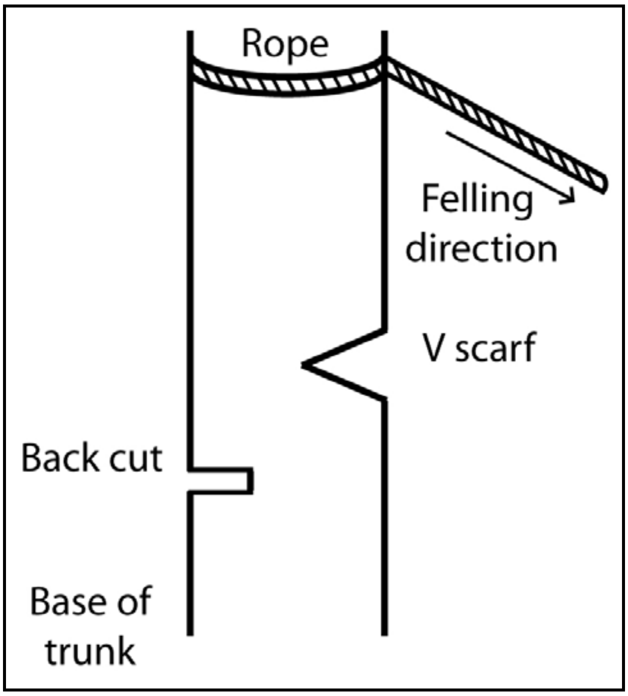

Figure 9.4: Sketch of tree felling operation as explained by Matar.

Meanwhile, such a felling technique has its resonance in ancient Egypt through a relief at Seti I's (1290-1279 BC) Temple of Amun in Karnak (Figure 9.5). The relief depicts the felling of stylized trees for the Pharaoh as two men with axes cut alternately the base of one tree, two others grasp ropes attached to the upper portion of the tree and guide its fall with ropes (Meiggs 1982: 16, 331; Wachsmann 1998: 311). This is an example of how ethnographic data can help the archaeologist in interpreting past practices.

Figure 9.5: Relief of felling operations by 'Lebanese princes' for Seti I on the north wall of the grand hall at the Temple of Amun in Karnak, Egypt (Wachsmann 1998: 311, Figure 14.4)

Once the tree is felled, the branches are adzed from the trunk, with a *balṭa* (Eng. Adze), and sold for charcoal production. Comparatively, the branches were cut from the trunk ahead of transportation in the past, as iconographic evidence from Pharaonic Egypt illustrates (Śliwa 1975: 45-46) (Figure 9.6). Lumbermen were at times aided by goats, which strip off the foliage and smaller branches. Also, sources from classical antiquity say that branches were trimmed upon felling (Pliny XVI.75.194).

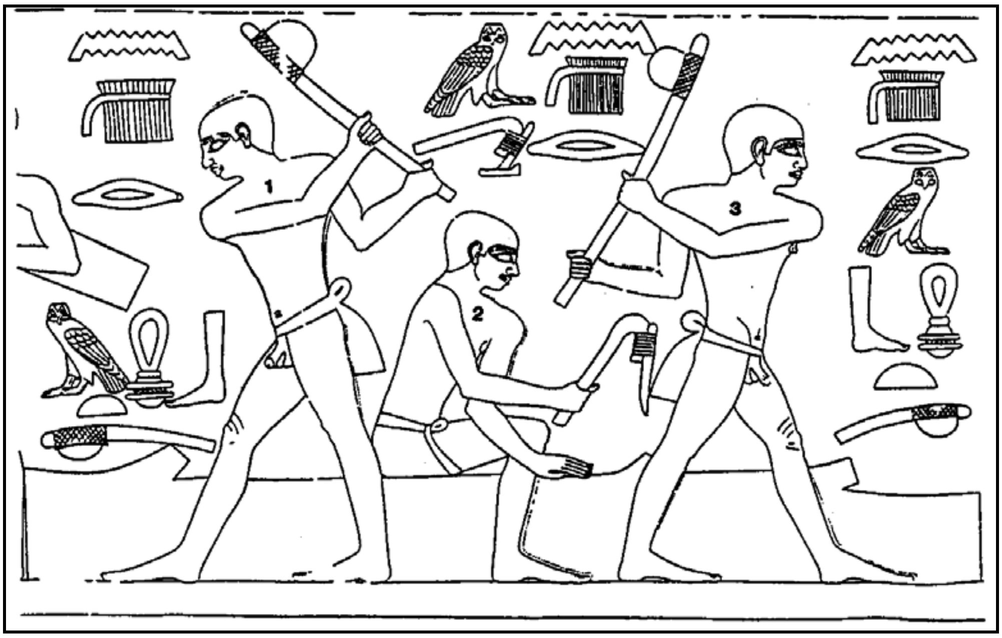

Figure 9.6: Relief from the Fifth-Dynasty tomb of Ti at Saqqara showing three carpenters processing a log subsequent to felling: Two carpenters remove the branches from a tree using axes (1 and 3), while a third (2) uses an adze to remove the bark (Rogers 1996: 16, Figure 3).

As for the time the felling operation takes, Matar says that this depends on the size of the trunk and its location. If the surrounding space is clear, sawing the trunk would not be time-consuming. But if the tree's location is problematic, such as in a narrow space or near a high-tension power cable, felling operations take more time due to extra safety precautions. The type of tree and its curves also play a part in the duration of the process. Logging straight-trunk trees is less time-consuming than cutting down one with curves; as the first type can be felled in one go. In the case of a naturally crooked tree, such as acacia or mulberry, felling these for boatbuilding entails preserving their natural curves. These crooks are cut as various parts first, in anticipation of logging the remaining trunk. Matar says that this method guarantees the prevention of crooks from being destroyed by the shock of felling the tree as a whole. This technique must have been used by ancient lumberjacks to make the most of wooden resources for boatbuilding, even there is no archaeological evidence for this. In his study on Roman marine carpentry, Rival (1991: 113-121) investigated the relationship between the morphology of trees and their felling. For experimental purposes, he reconstructed aspects of Aleppo pine trees that might have been used in the Roman cargo ships that wrecked at the Bourse in Marseilles and Port-Vendres I in southern France, in order to reproduce the carpenter's vision (Figure 9.7).

Figure 9.7: In this figure, Rival (1991: 116, Planche 2) superimposed the drawing of a frame from the Port-Vendres I wreck to the silhouette of an Aleppo pine tree.

9.3.2 Felling season

Local trees are felled in winter time, preferably from October to February, which is marked as a period of non-growth for the tree, which starts growing again in Amshir.400 Amshir is the sixth month of the Coptic calendar which lies between February 8 and March 9 of the Gregorian calendar. Wood merchant Atef Matar explains that during this period "there isn't any water in the trunk. If I fell the tree when it contains water, it would weaken the wood quality". What he means is that sap activity in a tree is

[400] Atef Matar interviewed on 28th January 2012, Hamdi Hassan Lahma interviewed on 14th January 2012.

at its low during a dormancy period. Indeed, autumn and winter are dormancy periods for a tree, where it does not produce new wood (Edlin 1956: 3). Also, in winter cultivators can dispose of the trees because they do not need them for shade, says Mohammad Abu el-Sayyid Shata.[401] However, Hajj Ali Abd el-Rahman el-Qassas[402] does not agree with Matar, and says that in winter the tree would have absorbed a lot of water from rainfall. Upon felling, this causes the wood to dry and distort, he adds. This is why he thinks that the best time for felling is late spring/early summer, starting the month of May.

The notion of a favourable felling season is more a thing of the past. In antiquity, trees were preferably cut in autumn at the end of the growth cycle of a tree (Meiggs 1982: 331). In addition to the autumn season, several Graeco-Roman authors also suggest other felling periods according to the tree species and their conversion processes (Figure 9.8).

Sources from the middle medieval period (5th-8th/11th-14th centuries) suggest different felling months throughout the year that related to the moon cycles, and that include: January, April to May, August, and October (See Section 6.2.3). Meanwhile, present-day tree harvest can technically take place at any time of the year, as the timing does not considerably affect the quality of the wood (Taylor 2003), and there are pros and cons in any season. Depending on the species, dry seasons are generally preferable for drier timber destined for construction, and to provide enough time for harvested logs and boards to season ahead of rainy seasons.[403] Also, in a rainy season there is much more damages to the soil and forest roads than in the dry season; however, a dry season entails potentially more hard work and risks of fire. The types of woodland also influence harvesting times: when broadleaved-trees lose their leaves in a dry season, they become lighter and easier to manoeuvre and to harvest without damaging other trees and plants. In modern agroforestry and plantation systems harvesting is more regulated by the crops at risk for the former system, and by the age of the plantation cycle for the latter system.[404] Once the tree is felled and transported to a boatyard or saw-mill it goes through processes of treatment, conversion and seasoning.

[401] Interviewed on 19th January 2012.

[402] Interviewed on 16th January 2012.

[403] Personal communication by email on 24th November 2014 with Dr. Marion Karmann, Monitoring and Evaluation Program Manager at the Forest Stewardship Council (FSC) International.

[404] Personal communication by email on 24th November 2014 with Dr. Marion Karmann, Monitoring and Evaluation Program Manager at the Forest Stewardship Council (FSC) International.

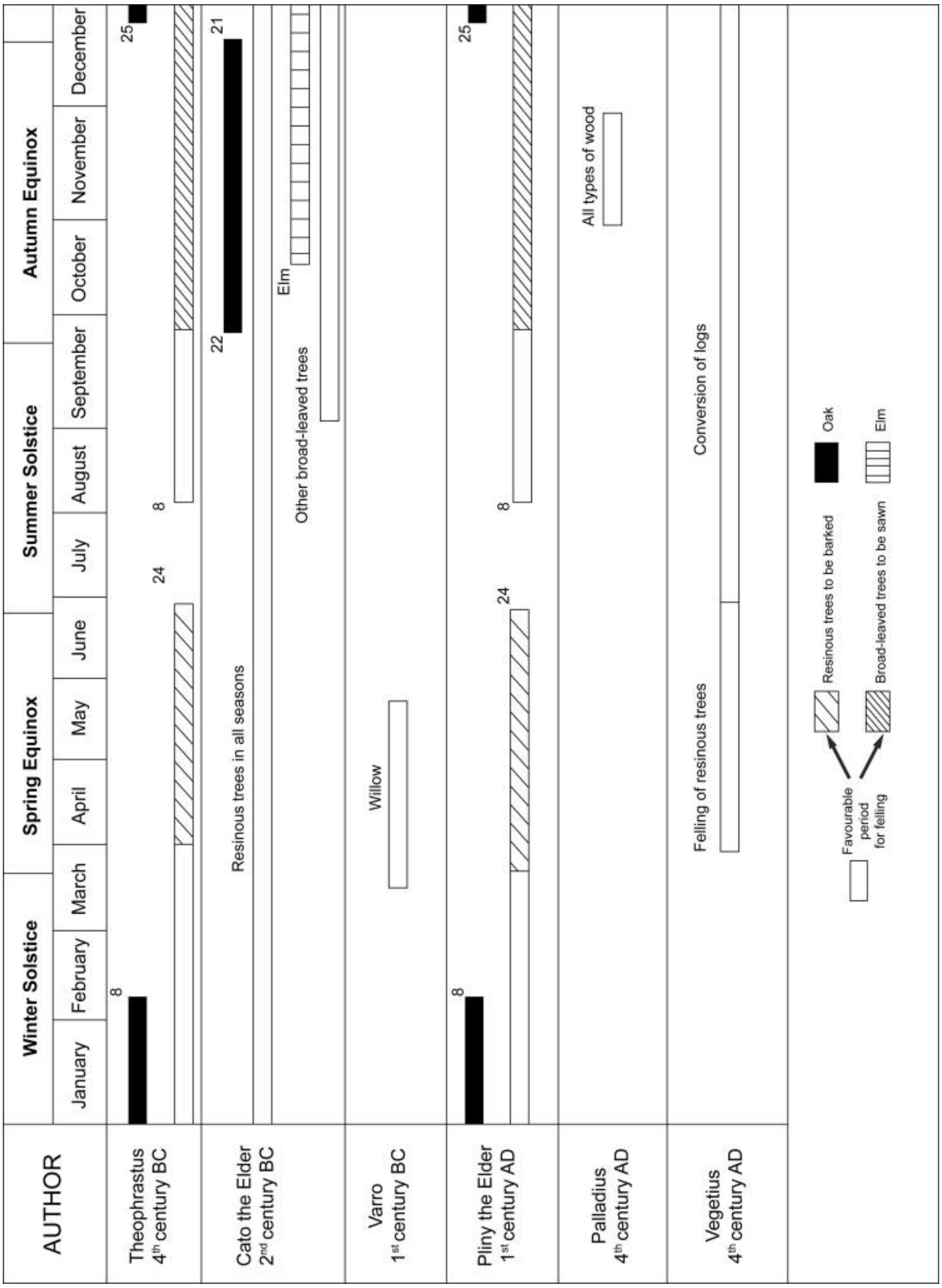

Figure 9.8: Favourable felling times in antiquity according to Graeco-Roman sources (Modified from Rival 1991: 100, Table 5).

9.4 Treatment and conversion

This section looks at the stages that a log undergoes from its felling to its transformation into a boat component. The boatbuilder starts off by stripping the bark, then he leaves the wood to season before converting it into its final shape. I will also explore how present-day technologies, and more importantly the boatbuilders' personal choices, have influenced these practices.

9.4.1 Stripping the bark

When stripped off, the bark of trees is used for charcoal production.[405] The same applies to timber scraps that are discarded from worked planks and other nautical components.[406] Egyptian boatbuilder Hamdi Lahma said that sawing the planks in the past, before the advent of mechanical saws, entailed removing the bark with an adze ahead of sawing. A shipwright would then have a clear surface to mark the signs and lines he would follow for either cutting planks out of the log or shaping a natural crook. He added that manual sawing is rendered easier by removing the bark since its rough surface damages saw teeth. Also, less effort is required for sawing a bare log.[407] The practice of stripping logs off their bark with an adze, ahead of sawing, stretches back as far as the Pharaonic period (Śliwa 1975: 46) (Figure 9.6). Archaeological evidence from the period shows that bark was much used for its ornamental value as well as for technological purposes such as tanning (Śliwa 1975: 18; Lucas 1989: 454). Hence, carpenters must have been keen on removing the bark ahead of the conversion process, as well as having more ease while sawing logs. However, in classical antiquity the bark was not always completely removed, as some of the frames of the Roman merchant ship Madragues de Giens indicate (Rival 1991: 105).

Recent technological developments, through the use of electrical chain saws and saw-mills, have altered this practice: the bark is removed simultaneously at the start of the conversion process; this is considered as time-efficient by boatbuilders. Independent of the technology available, the latter recommend stripping off the bark straight after felling the tree; especially if the log is to be left unused for a period of time. This makes the wood less vulnerable to insect attack from the larvae present underneath the bark and which feed on the sap in periods of tree growth, Lahma explained. However, this was not always the case in Roman times; boatbuilders left unused logs with the bark on in order to protect them from a hurried desiccation that would cause substantial splitting of the wood (Rival 1991: 105-106).

[405] Hamdi Lahma interviewed on 14th January 2012.

[406] Mahmoud Abd el-Maguid al-Qassas interviewed on 16th January 2012.

[407] Hamdi Hassan Lahma interviewed on 14th January 2012.

9.4.2 Conversion

The conversion process consists of turning raw wood into timber depending on the specific function it aims to fulfil. In Egypt, a log is placed length-wise on a saw cart, and cut through by a head-blade, following the dimensions required by a shipwright.[408] This produces flitches, or slabs of unfinished planks, called (pl.) *bulat* by my Egyptian informants. These are left to season (see Section 9.4.3) before they are fashioned into hull planking and structural boat components. The frames or frame components (floor timbers and futtocks) are fashioned by tracing a template on the surface of the wood slab with a carpenter's pencil ahead of chain-sawing (Figure 9.9, Figure 9.10).[409]

Figure 9.9: Boatbuilder Mustafa Migahid drawing a template onto a semi-converted floor timber, Lahma shipyard, Rasheed, Egypt (Photograph: author).

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[408] This is stated by all my Egyptian informants interviewed in January 2012.

[409] Hamdi Hassan Lahma interviewed on 14th January 2012, Mahmoud Abd el-Maguid al -Qassas interviewed on 16th January 2012, Mohammed Abu el-Sayyid Shata interviewed on 19th January 2012, Amm Hassun interviewed on 21st January 2012.

Figure 9.10: Migahid cutting a floor timber following the pencil –drawn saw lines (note the traces on the timber at the front), Lahma shipyard, Rasheed, Egypt (Photograph: author).

A log destined for a keel is produced by squaring it off with an electrical saw, rather than sawing it into flitches. Meanwhile, the surfaces are smoothed with an electrical hand plane (Figure 8.13). The technique of squaring off logs to convert them into structural elements of boats is known since antiquity, and was still practiced by Indian shipwrights at Tuticorin, Tamil Nadu until the 1960s (Rival 1991: 129, Planche 11). The log squaring was done with an axe, with a boatbuilder standing atop the log (e.g. in Figure 9.11). An example of archaeological evidence for this practice is the framing elements of the late 2nd century AD Bourse shipwreck found in Marseilles, Southern France, which were roughly squared (Rival 1991: 127, Planche 9).

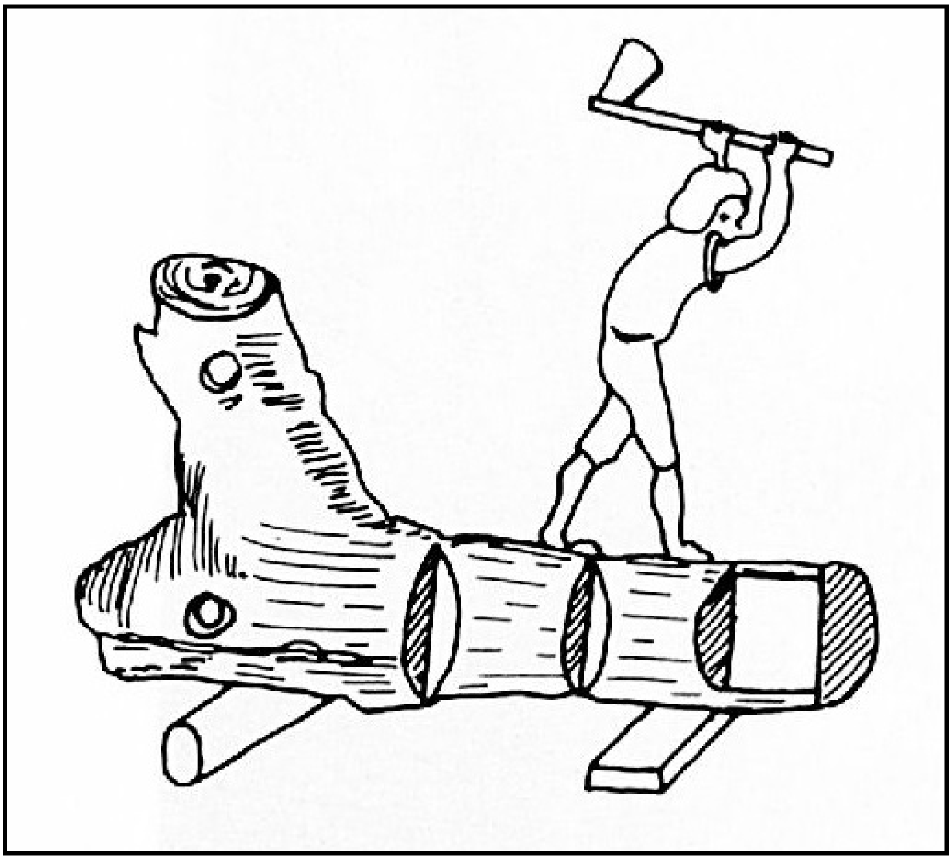


Figure 9.11: Squaring off a crook to produce a knee (Rival 1991: 132: Planche 14).

Conversion processes have changed with the advent of mechanical tools and saw-mills some thirty years ago.[410] In the case of sawing logs in the past, the stripped log was first marked with the directional lines to saw along. A string of wool, soaked with coloured paint or covered in a red powder (Ar. *ḥomra*), was set along the length of the log. The carpenter would hold the middle of the string and strum it, so leaving a straight paint line on the log surface. The process was repeated on the other side to match the first. Thus marked, the log would be raised horizontally on scaffolding (Ar. *ḥammāl*) and perpendicularly sawn by two carpenters each holding the end of a manual saw (Ar. *minshār yadawī*). One sawyer stood on the log or the scaffolding and worked from the top, with the other on the ground below.[411] My informants thus described what Madani (1986: 211, Plate 1) calls a "hanging saw" (Figure 9.12).

[410] Mohammed Abu el-Sayyid Shata interviewed on 19th January 2012.

[411] This is stated by all my Egyptian informants interviewed in January 2012.

Figure 9.12: Two sets of sawyers cutting planks with a "hanging saw" (Madani 1986: 211, Plate 1).

The same manual sawing method was described in the fifties by Greenhill (1957: 113-114) whilst researching the traditional boatbuilding practices of present-day Bangladesh. In Sri Lanka, manual sawing practices for building a *madel paruwa* sewn boat also involve the drawing of saw-lines. These are done with "a type of chalk line, but using a solution of carbon from old batteries in water instead of chalk" (Kentley 1987: 39; 2003a: 171). Subsequent to cutting unfinished planks with a manual saw, the carpenters would work them with an axe (Ar. *adum*), even the surfaces with an adze (Ar. *balṭa*), and smooth them with a plane (Ar. *fāra*). Noteworthy here is that the Arabic words for these tools were provided by my Egyptian informants. These words are also used in Suakin.[412] The horizontal sawing of planks is considered to date as far as the Roman period (Rival 1991: 136) (Figure 9.13).

[412] Agius personal communication by email on 18th September 2014.

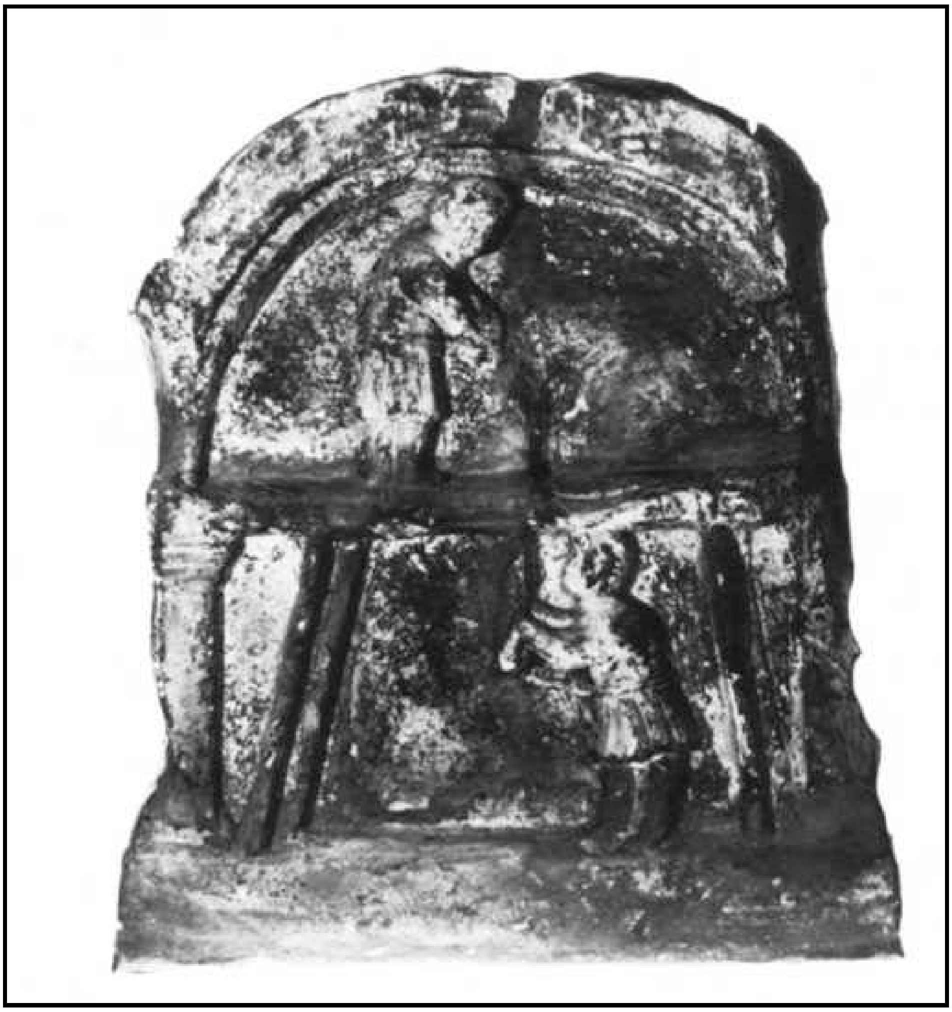


Figure 9.13: Hanging-saw figuring on the Roman funerary stele of Deneuvre, Esperandieu, VI, 4702 (in Rival 1991: 141, Planche 21).

Gale et al. (2000: 354) suggest that this sawing method might have been applied by Egyptian carpenters in the Pharaonic period, even if there is no proof for this. There is a substantial number of iconographic representations, from Pharaonic Egypt, of conversion processes taking place at boatyards (Śliwa 1975: 47). One of these is the technique of cleaving logs: Iconographic evidence from Sixth-Dynasty (2305–2118^{+25}) tombs depicts carpenters splitting a tree trunk into planks by mean of a lever (Gale et al. 2000: 354) (Figure 9.14). It is possible that cleaving was used from this period through to the Byzantine period especially for straight-grained trees (Rival 1990: 125).

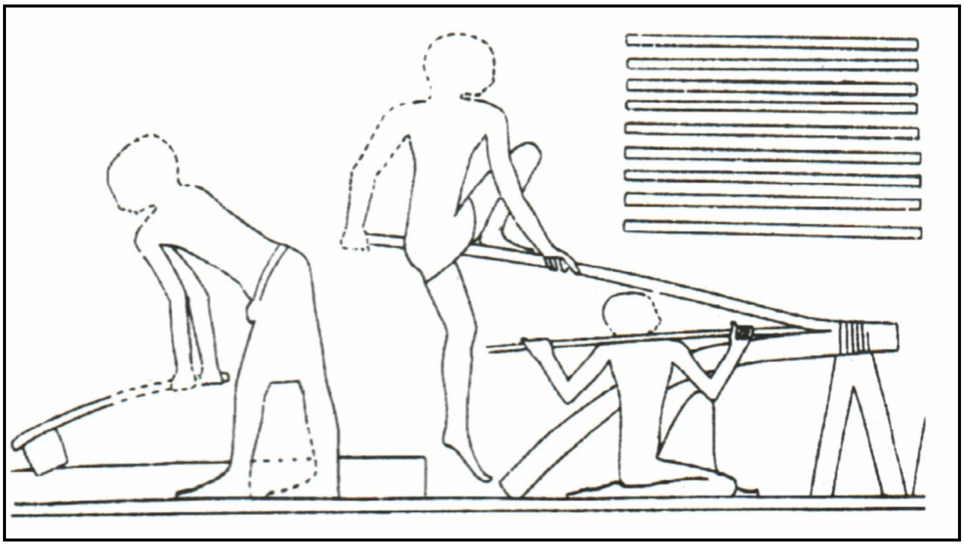


Figure 9.14: Scene from the Sixth-Dynasty tomb of Iteti at Deshasha showing craftsmen cleaving a tree trunk (Gale et al. 2000: 354, Figure 15.18).

Another conversion process was cutting a log from the top downwards with a pull-saw, while the log is tied with rope to a vertical post; and that is for logs not higher than the sawyer (Lucas 1989: 449-450; Gale et al. 2000: 354) (Figure 9.15). Meanwhile, taller logs would be placed at an angle, with the sloping board tied to a vertical post, as seen in Sixth-Dynasty tomb-chapel of Pepyankh at Meir, Egypt (Blackman 1953: Pl.XVIII) (Figure 9.16).

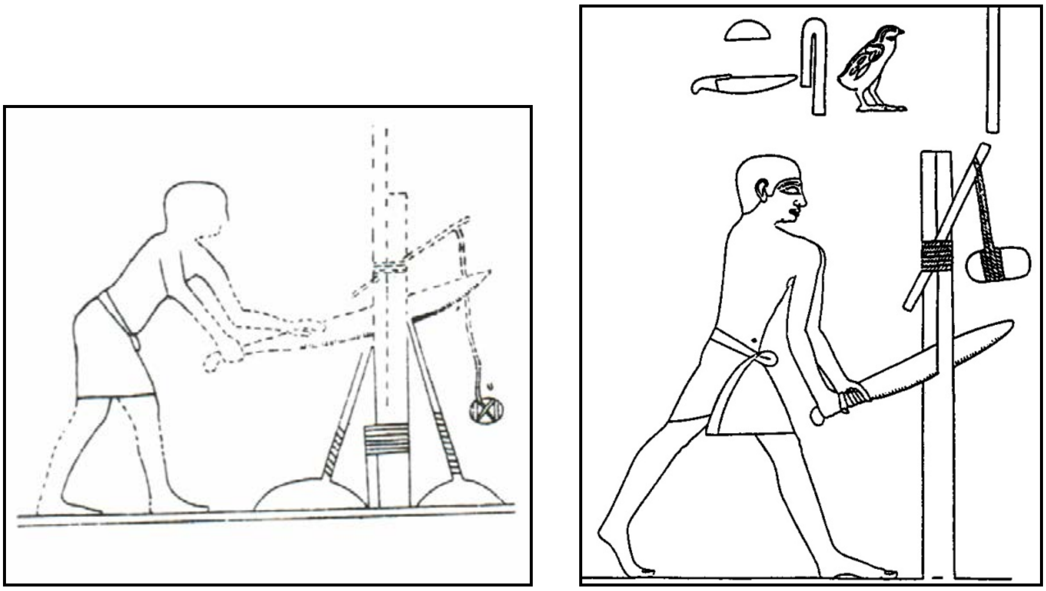


Figure 9.15: Iconographic representations of sawyers using a two-handed pull saw to vertically cut a log, from the tomb of Iteti at Deshasha (to the left) (Gale et al. 2000: 354, Figure 15.18), and the tomb of Ti at Saqqara (to the right) (Wachsmann 1998: 231, Figure 10.14).

Figure 9.16: Part of the relief on the north wall of the tomb-chapel of Pepyankh at Meir, Egypt (Blackman 1953: Pl.XVIII).

Conversion processes have indeed changed through time, but I believe such change is only technical and physical. Indeed, the process of sawing, the bodily engagement and synergy between a carpenter, a tool, and timber, and the coupling of perception and action transcend time and place. Such themes draw largely on Ingold's (2011) interpretation of manually sawing a wooden plank. What Ingold describes could be more appropriate to ancient use of a hanging-saw (Figure 9.12), before the advent of the electrical saw. However, it still can also be observed in ethnographic practices when boatbuilders use small axes and adzes, and even with electrical saws since, as Ingold (2011: 62) states, "no machine can be perfect [...] Even the most finely turned circular saw, is susceptible to irregularities and imperfections in the wood". The first theme is the "processional quality of tool use" (Ingold 2011: 53-55). Sawing a plank consists of a journey through a regular and repetitive but not monotonous movement. Such a process starts with a boatbuilder assessing which log he needs that would fit best to its dedicated space in a boat; preparing the necessary tools at hand; and demarcating the cutting line with paint or chalk on string on the material itself as it is prepped for sawing. These steps are also part of the engagement with the wood plank. Then comes the moment of implementing the sawing task, a moment carefully chosen by the boatbuilder, where he has positioned his body and tool accordingly, and his concentration is taken up by the sawing cut and the line to follow. The second theme is "the synergy of practitioner, tool and material" (Ingold 2011: 56-58), which emphasises the bodily engagement of a boatbuilder in the act of working a wood plank. The position of his hands and feet and the rest of his body, his eyes and ears monitoring the progress, the muscles of his body powering the saw and maintaining his balance, that is, the entanglement of the body, mind and gestures, the tool, the material, and the workplace that merge into the process of working a plank. Thirdly, the variations of sawing strokes coupled with the ones of the bodily engagement of the boatbuilder result in a seemingly regular and clean cut. This process results from "the intimate coupling of perception and action" (Ingold 2011: 56-58), through subtle adjustments and fine-tuning of the dexterity of an experienced boatbuilder come in play. Thus, to avoid errors persistent correction confers the boatbuilder's performance its working rhythm.

I will now look at the process of wood seasoning which is an intermediary phase in the conversion process, as it takes place between the production of flitches and the shaping of boat elements.

9.4.3 Wood seasoning

Wood seasoning is a water-removal process which "involves removing all of the freewater and part of the bound water down to the target equilibrium that is suitable for the finished item" (Hoadley 2000: 148).[413] "It is the most important stage in the process of traditional boatbuilding" says Swamy (1999: 134). Wood seasoning aims at reducing the moisture content of a piece of timber in anticipation of its nautical applications. As an example, Lahma recommends that the moisture content of a *kafūr* (Eng. eucalyptus) plank should not exceed 20%. This corresponds roughly to the 14% ± 3% moisture content recommended for all planking and 16% ± 3% for structural components such as beams, futtocks, floor timbers, stringers etc. (Sharma *et al.* 1974: 13). Wood seasoning renders the timber more stable and durable, lighter and stronger (Edlin 1956: 4; James 1966: 202; Reeb 1997: 1). It also reduces warping under the influence of weather conditions, and thus reduces repair works and costs.[414] It also bypasses issues of massive variations in shrinkage or swelling of nautical timber (Reeb 1997: 12).

Boatbuilders in Egypt season wood by means of natural drying, that is, air seasoning (James 1966: 202), and do not use specialised kilns.[415] I was able to observe the natural drying of planks of local timber at the Lahma boatyard in Rasheed. These were stacked

[413] For more on wood drying processes, methods and benefits see Hoadley (2000: 111-131, 147-157).

[414] Hamdi Hassan Lahma interviewed on 14th January 2012.

[415] Ali Ahmad Sherdi interviewed on 21st January 2012; Hamdi Hassan Lahma interviewed on 14th January 2012; Mohammed Abu el-Sayyid Shata interviewed on 19th January 2012.

in regular courses separated by small battens for free air circulation (Figure 9.17), or spread out on the ground (Figure 9.18). The seasoning method of stacking boards horizontally with spacers between them is illustrated in the Sixth-Dynasty tomb-chapel of Iteti (Figure 9.14), according to Gale *et al.* (2000: 355). They also suggest that boards may have set against the exterior walls of a carpenter's workshop. ancient Egyptian carpenters must have learnt from experience, just the same as my informants, that drying sawn wood is faster than drying a log as a whole, due to the increased contact of wood layers with sun and air.[416] In classical antiquity, another seasoning method was used to produce durable timber: that of girdling especially for ash and elm (Pliny XVI.74.192). This practice has its resonance in the contemporary practice of felling teak trees in south Asia (See Chapter 8 on *Sāg*). It can be speculated that such practice could have been adopted in the Red Sea regions in the past, if needed be.

Figure 9.17: *Kafūr* flitches drying in a stack ahead of use in a boat at Lahma shipyard, Rasheed, Egypt (Photograph: author).

Figure 9.18: Flat sawn planks of *aru* (oak) and *tūt* (mulberry) drying on the ground at Lahma shipyard, Rasheed, Egypt (Photograph: author).

[416] Mohammed Abu el-Sayyid Shata interviewed on 19th January 2012.

Most shipwrights I spoke with did not use a moisture content metre (see Sharma *et al.* 1974: 14). They trusted their sight and experience to determine suitable moisture content: They say that when timber dries it becomes darker in colour. A shipwright can also cut off a small sample of the drying log, and examine it by eye to see whether it is ready for work.[417] Thus, it is the experiential learning of boatbuilders that serves their expertise and judgement. Such experiential learning is reflected in the past as most Egyptian carpenters from the Pharaonic period could estimate the moisture content in timber to an extent that a suitable working range would be between 8% and 12% (Gale et al. 2000: 355). Indeed, timbers from the Khufu hull had a moisture content of 10% (Landström 1970: 28).

The seasoning process differs with the species according to Egyptian boatbuilder Hajj Ali Abd el-Rahman el-Qassas. He explains for example that *tūt* (Eng. mulberry) dries faster under the sun than *kafūr*, which takes up to two months to dry. Before drying *kafūr* planks, Hajj Ali immerses them in saline water for a month. He believes that the sea water replaces the sap which renders the wood more durable "because the surrounding water does not affect it any more" (Figure 9.19). Hajj Ali's boatyard is located on the fringe of Lake Burullus, and makes use of its brackish waters due to the contact of the lake with the Mediterranean to the north. Indeed, the water where the logs are submerged gradually removes the sap by dissolving it, and kills insect larvae that might be lodged in the wood (Rival 1991: 108). Seasoning wood through immersion ahead of drying is also used in traditional boatbuilding practices in Karnataka (Swamy 1999: 134). Swamy (1999: 134) says this process increases the durability of wood, and describes it as follows: after shaping the logs as required, the shipwrights immerse them (except teak wood) "in muddy or backwater for about 6 to 8 weeks". Subsequently, the logs are retrieved and dried in shade prior to boatbuilding. Brackish water was the preferred watery environment in antiquity for seasoning wood by immersion. This type of environment avoids the weakening of wood as it would happen in sweet water, or the attack by terredo when immersed in sea water (Rival 1991: 109).

[417] Hamdi Hassan Lahma interviewed on 14th January 2012.

Figure 9.19: Immersed *kafūr* planks in Lake Burullus at Hajj Ali boatyard, Egypt (Photograph: author).

Immersion in sea water still presents the advantage of preserving a timber's durability (Rival 1991: 109). This practice stretches back at least to the 4th century BC in the Mediterranean region: Logs of oak and pine were submerged in the Mediterranean Sea at different depths in order to obtain durable and high-quality timber (Theophrastus V.4; Palladius XII.15). In 15th century Venice, oak timbers were seasoned underwater for around eighteen months upon their arrival to the city's naval yard (Appuhn 2009: 98). Immersion would last from one to two years depending on the species, before logs are removed and air-dried (Rival 1991: 109).

The time required to dry freshly sawn wood planks and other hull parts varies between two months over the summer, and three months over the winter, says Lahma. Abu el-Sayyid Shata stretches this period to three or four months in summer time. Also, in Kuwait, Agius (2005: 29-30) was told that imported timber was left to season under the sun for two months before use in boatbuilding. While most of the timber species should be seasoned,[418] some should not undergo this process, according to Ibrahim Ali Musa al-Najjar.[419] He recommends that *ṣant* (Eng. Acacia) should not be left to dry, but used straight after felling because it becomes very hard to work and nail.

[418] See Hoadley (2000: 156, Table 8.2) for comparative ranges of drying time for some domestic wood species.

[419] Interviewed on 24th January 2012.

A last thing to consider is the difference in moisture content within the same timber piece. Lahma explains that a flat sawn plank dries differentially between its extremities and its core;[420] the extremities or parts close to the edges and surfaces tend to be drier than the inside. This is why the wooden nautical elements are not left to dry a second time after their conversion, but are used straight away in a boat's hull. By doing that, warping is avoided as a freshly-converted boat component is set in place and fastened to others.

This chapter has looked at ethnographic data related to timber exploitation processes in the Red Sea, along with a few comparative ethnographic examples from the Indian Ocean, as well as with existing scholarship on timber trade and wood properties. This approach has allowed a deeper understanding and interpretation of the different stages that a tree must undergo in order to fulfil its nautical role. The investigation of ethnographic processes of timber exploitation has also shed light on an otherwise obscure knowledge that archaeologists have of such processes in the past, due to the scarcity of historical and archaeological sources on the subject related to the Red Sea regions.

Present-day boatbuilders and wood merchants are careful when selecting a tree, since it has to produce good quality, durable and resistant wood. The same can be said about past shipwrights and timber agents who surely were keen on producing a durable vessel. Independently of the time frame such people understand the specificity of timber species suitable for particular boat components. The acquisition mechanisms have varied greatly between past and present. This can be explained through economic changes of the timber trade the area, as well as the advent of technological advances in travel, transportation, and export methods. Even if particular networks involved in wood acquisition differ from past to present they reflect a certain social structure involving boat owners, shipwrights, timber agents and lumberjacks.

The ethnographic data collected in Egypt on tree felling has resonances in ancient Egypt, even if now it has been modernized with the use of electrical equipment. Ancient and present-day lumberjacks removed branches upon felling to facilitate the manoeuvring and transportation of logs. They made the best out of wood resources as

[420] For more on this see (Hoadley 2000: 147, Table 8.1)

their felling ensured the preservation of natural crooks for curved boat components and straight trunks for the keel and planks. Concerning the felling season, ancient sources were in favour of the winter harvesting of trees just like the majority of my informants — even if modern silviculture practices felling at all periods of a year.

Subsequent to its arrival at a boatyard, a local tree undergoes several stages in preparation for its nautical use. In the past, the first step included stripping a tree's bark, although this was not always the case, as we have seen from evidence from the Roman Mediterranean. Long logs were converted into boards by sawing manually with a pull-saw. The hanging-saw was used as far back as the Roman period until the 1980s before the advent of the electrical horizontal saw. Natural crooks were squared into curved parts with axes and finished off with adzes, from at least the Roman period until the 1960s. Present-day boatbuilders use a portable electrical saw.

The final operation before further working the wood into its final shape is its air-seasoning. Boatbuilders both past and present understood that such an operation renders the wood stronger, more durable, and ready to be used in boatbuilding. This is today done either by stacking flat-sawn boards, or with planks laid flush on the ground; it might also have been the case in the past. Additionally, ancient sources attest to the practice of girdling trees before felling as a way of seasoning them. I have not been able to observe this in the Red Sea, but it was still practised in India for teak felling at the beginning of the 20th century.

Finally, landscapes where people operate and move about, social structures, and technologies have surely developed with time and so did the skills of lumberjacks and shipwrights. Independently of the period such skilled practices emulate the embeddedness of a practitioner in an richly structured environment and his perceptual involvement with things. When choosing, felling, or converting a tree, a craftsman uses his judgement and dexterity, and is enmeshed in the dynamics and synergy of body and mind, tool, and timber.

The issues on timber exploitation in this chapter offered the reader insights into past exploitation processes of nautical timber. Similarly, investigating the parameters that influence the use of wood in present-day Red Sea boatbuilding might also shed the light on past variables that came at play in the use of nautical wood.

10 Variables influencing wood use in Red Sea boatbuilding

As seen in the literature review for this study (Chapter 2), ethnographic research has thus far interpreted the use of timber in traditional boatbuilding practices in the Indian Ocean from a largely descriptive and functionalist perspective. Notions of wood price have at times been considered as main factors for wood selection, but they were not fully explored in their broader economic context. In the study of boats from a maritime ethnographic perspective, Blue (2003: 335) suggests that "in order for a comprehensive analysis to be undertaken we need to interrogate the ethnographic data, outline and examine a wider range of variables that influence boat shape, and then consider all variables in the same light". Despite the fact that Blue is referring here to a typology of boats and not to wood use, her approach is still relevant to the investigation of nautical applications of timber. Identifying a set of related variables in the ethnographic context provides the means to go beyond a functionalist perspective — without discarding it entirely — and offers a more comprehensive interpretation of the criteria dictating the use of wood in boatbuilding. During my personal ethnographic research in the Red Sea, I was able to identify a list of parameters which influence the choice and timber use in wooden boatbuilding. Thus, what follows draws on issues of environment, politics, economy, function, religious narratives and subjectivity. It has also implications for interpreting the data related to nautical wood use in the past.

10.1 Environment

The environmental criteria's influence on the choice of nautical timber are two-fold: First, the environment affords to the shipwright tree species for boatbuilding, and consequently it conditions the need for wood import. Second, the environment also relates to the context in which boats operate whether it being a river, a lake or the sea.

The first criterion pertaining to the affordance of an environment, and to tree species used in boatbuilding in the Red Sea regions were looked at in Sections 4.7.1 and 9.2, and in Chapters 3 and 8. It is through such theoretical appreciation that we can interpret the identification of species in archaeological wrecks as a result of the intricate relationship between a set of affordances and taskscapes.

As for the operational context of a boat, I will focus here on the choices of the boatbuilders I spoke with, in order to investigate whether there are differences in nautical application of wood between different bodies of water. It is quite challenging from the presently available textual and archaeological evidence to determine whether the different operational environments of a boat in antiquity and medieval times influenced in any way the use of timber. It is however a parameter that is worth considering should new evidence surface in the Red Sea regions.

Some of my informants tell me that timbers used in boat parts, which are exposed to open-air conditions, are usually more are affected by environmental factors, than internal structural components. The type of wood used in hull planking differs between the sea and the Nile, for example. Egyptian boatbuilders Hamdi Lahma[421] and Hajj Ali tell me that in a Nile river boat, the hull planking is preferably made with *kafūr* (eucalyptus), rather than *suwweid* (pine). They say *kafūr* is stronger and more durable than *suwweid* in a riverine context. They say *suwweid* can last in seagoing boats up to ten years, and only up to two years in river boats. Lahma explains this by the fact that sweet water is "heavier" than salt water, so it infiltrates the wood cells faster and more aggressively than the sea water, which reduces the wood's resistance against decay. Hajj Ali[422] gives a different time frame for *suwweid*'s life span in a boat: twenty years at sea and ten years in the Nile. As for the keel, the wood of choice is in both environments is *kafūr*. When I interviewed boatbuilders at Lake Burullus, in Egypt, they said that there was no difference between the types of timbers used in lake vessels or sea boats. This might be explained by the fact that the waters of Lake Burullus have a level of salinity related with its connection to the Mediterranean Sea.

10.2 Politics

Governmental policies towards tree plantations can affect the use of wood in boatbuilding. The ethnographic information I have analysed here projects the views of my informants, which I was not able to corroborate with official data from governmental agencies. For an appreciation of how regional political events and governmental policies influenced the use of local timber and the trade in imported timber in the past, the reader is referred to Chapter 6. This goes to show that the political element is crucial for an enquiry on wood use in boatbuilding, whether in the past or the present.

[421] Interviewed on 15th January 2012.

[422] Interviewed on 16th January 2012.

In the past few decades, a lack of governmental management of forests and tree stands in Egypt has apparently led to a decrease in wood resources in the country. Consequently, this has negatively impacted the country's wooden boatbuilding industry. One of my informants in Egypt deplores the fact that some of the finest local tree species used in vessel construction such as *sarsu* ᶜ (*Dalbergia sissoo*), *labakh* (*Albizia lebbeck*), and *kafūr lamūnī* (*Eucalyptus* sp.), have become rare, if not extinct. These species were renowned in the past for their strength and durability. The reason for this extinction appears to be a lack of support from the Ministry of Agriculture in providing saplings for cultivators to plant and grow. My informant considers these trees a precious resource for their owners. "If they are planted and grown in places where agriculture is rare, they become expensive, and constitute a good source of money", he says. He also tells me that in the past, some 30 years ago, the Ministry of Agriculture offered a wide variety of saplings, and provided related information to farmers and cultivators. The Ministry had the responsibility of educating these latter on the preservation of tree species. It also used to manage local tree resources to ensure their renewal. For example, old trees growing on the roadside would be removed and new trees planted in their place. Allegedly, this is not the case in present-day Egypt. I was told that the lack of interest from the government in the local wood resources of the country has led to their dramatic decrease, especially during the last ten years. An informant tells me that, as a consequence of this policy, a lack of good-quality wood resources has pushed people to work with metal boats.[423]

The Egyptian traditional wooden boatbuilding industry had also witnessed a set-back in the last decade because of bans from the government on fishing licenses. Most of the boatbuilders I spoke to said that since the state has stopped granting permits to fishermen and their boats, this has negatively affected demand for wooden fishing craft. The government's position was to protect the fish resources from intensive fishing. In the light of the ban, boatbuilders turned to the growing leisure boats industry, which emphasises the use of imported wood.

I am told that, in Alexandria, one cannot encounter a young generation of boatbuilders initiated to the craftsmanship of traditional boatbuilding.[424] This indicates that with time this craftsmanship will perish along with its carpenters. Recent governments are also to

[423] Interviewed on 28th January 2012.

[424] Interview with Egyptian maritime engineer Sarwat Ramzi in Anfushi boatyard on 12th January 2012.

be blamed here. I am informed that, under Abdel Nasser's presidency (1956-1970), the government subsidized traditional artisanal craftsmanship by establishing artisanal training (Ar. *tadrīb mihanī*) and craft schools (Ar. *madāris sanāyiʿ*). Every traditional boatbuilder would train around six people in the art of nautical craftsmanship, and both teacher and trainee were rewarded with governmental allowances. The government had also an equal opportunities policy, granting learning places to four persons without disability, and two with. This training programme is long dead in present-day Egypt, and some of the boatbuilders I spoke with considered it to have caused the demise of the traditional boatbuilding industry. Such narratives from my informants denote more of a nostalgic past, and concepts perhaps of an ideal form of governance. They do not consider the implications of global contemporary economical trends, which perhaps would have also influenced the economic policies of past governments.

Governmental policies are not always to blame. In the early 2000s, the Sudanese government encouraged boatbuilders to "form a cooperative in order to receive aid and grants toward their hiring of dhows and fishing equipment" (Agius 2012: 178-179). Hussein Ibrahim Muhammad, a 72-years-old chief of the boatbuilders in Suakin, told Agius that they constantly declined such help.[425] They thought that their acceptance of governmental aid meant that they would be forced to conform to the government's regulations on limiting dhow-size, and to pay taxes. Indeed, in the 1980s the government had imposed a 12-metre restriction on the size of dhows in order to counter weapon trafficking (Agius 2012: 180).

10.3 Economy

Economic parameters encompass available resources such as labour, funds, time, available markets and government intervention in providing saplings, controlling fishing policies and so on. The government's role with regard to subsidising crafts and limiting fishing licensing in Egypt has been detailed above. Thus, political decisions such as these have had direct negative consequences on the economic climate of the wooden boatbuilding industry. Our ethnographic research into wooden boatbuilding in the Red Sea has demonstrated the exploitation of both timbers local to the Red Sea as well as imported woods from around the world (Chapter 8). This globalised analysis of the timber economy in the Red Sea considers other timber sources than India, which was perceived by early scholars as the sole wood exporter for constructing Arabian and

[425] Interviewed by Agius on 20th November 2004.

Persian vessels (see LeBaron Bowen 1949: 108). Fluctuations in deforestation, government policies, wood prices and availability, all broaden the prospects of economic analysis of nautical wood. The predominance of commercialised local timbers in the Red Sea regions for carving, mainly but not exclusively, structural boat components also defies assumptions that these regions are entirely dependent on foreign markets.

The availability of funds is one of the major directives when choosing timbers to build a wooden boat. The use of certain species rather than others is most of the time dictated by a client's capital and preference. As such, Lahma[426] tells me that the timbers of choice for hull and deck planking are *suwweid* (pine) and *bichpine* (pitch-pine). If the client has the means, Lahma would employ *bichbine* which is rarer and of better quality, and thus more expensive than *suwweid*. Another client of Lahma's requested the use of imported *aru* (oak) for frames instead of local wood types, since he could afford to do so. Amm Hassun also tells me he follows the client's wishes when switching from a relatively affordable type of wood to a more expensive kind.

Most of the Egyptian boatbuilders I spoke to who were aged from 40 years old and upward said they exploit almost the same local timbers as their fathers did before them, but that the price has gone up since. As for imported timbers, availability plays a major role, as boatbuilders acquire the most common species to be found on the Egyptian market. I was informed that *suwweid* was most used for hull and deck planking nowadays, whereas other types such as pitch pine and Douglas fir had been exploited in the past. Lahma said these last two timbers are now very rare, usually as recycled roof beams in old buildings, and they are not imported anymore. The reason behind this is hard to pinpoint for boatbuilders. Lahma suggests that either the price of such woods has increased since the past, or they stopped being commercialised in their home country due to their possible extinction.

In the last few decades, high quality woods became harder to acquire for boatbuilding purposes mainly due to the elevated costs of such woods. As an example, Cooper was told in Yemen that a single board of *zangali* (*Shorea* sp or *Terminalia alata* or *Quercus* sp., evergreen/*Lithocarpus* sp.) from Malaysia used to cost 1000 YER, versus 4000

[426] Interviewed on 14th January 2012.

YER presently.[427] Thus in a short time span, woods have quadrupled in price. The rise in timber prices mirrors practices in hull construction. In many Red Sea countries where wooden boatbuilding survives, the import of good-quality south Asian woods, such as teak, no longer constitute the entirety of the hull as in the past. They are now mixed with other, cheaper woods, and are distributed as such: the tropical woods are used for the keel and lower planking, while the rest of the planking is made with imported pine. Tropical woods are thought to be more resistant and durable than pine and thus they are used in the submerged section of the hull that endures the greatest stress. Comparatively, Rajamanickam (2004: 133-134) also noted such practice of mixing different quality woods in India. He observed that "in the last 40 years, usage of different types of wood for different parts of the craft have come into practice due to difficulty in procuring good quality wood" (Rajamanickam 2004: 133-134). He says Indian shipwrights use teak for the keel and mango for the garboard and adjacent hull plank, and continue the hull planking with less expensive timber types such as: *maddi* (*Ailanthus malabarica* DC.), *bursi* (*Thespesia populiniea* [(sic.) *populnea*] (L.) Sol. ex Corrêa), and *thella bursi* (*Terminalia crenulata* Roth.) (Rajamanickam 2004: 134).

In the light of such ethnographic data on using different timbers in a same boat relative to price, we can speculate that this might be one of the reasons ancient shipwrecks hold a variety of wood species. Ancient records on timber prices are quite scarce (See Janssen 1975) but indicate that locally available woods were sought for their economic benefits versus imported ones, among other reasons (see Sections 7.3.1 and 7.3.2). Thus, price was always a major factor in nautical wood procurement despite the meagre evidence for this in the archaeological record.

Limited means in procuring imported woods to the Red Sea have also led boatbuilders to recycle planks from dismantled hulls. I was able to observe this at al-Hafa boatyard in Jizan, Saudi Arabia, where the yard was dotted with stacks of such planks, including a teak keel that Bilgaith claims to have used in several boats. Also, as previously mentioned, precious rare timber species are being recycled in nautical applications from originally being used as roof beams in abandoned buildings in Egypt.

[427] YER: Yemeni Riyal. 1000 YER= 2.86 GBP, 4000 YER= 11.46 (http://www.oanda.com/ [Accessed 3rd September 2012]. Umar Said Bahaydar, a 60-year-old boatbuilder interviewed by Cooper in al-Khukha on (?) February 2009.

The decline of the wooden boatbuilding industry in Egypt has also to do with available manpower. Ibrahim Ali Musa al-Najjar,[428] in his eighties, observed this phenomenon through his days working as a boatbuilder. He says with the rising costs of modern life people seek a faster financial income and "traditional boatbuilding needs time and patience". Thus, many boatbuilders turned to the nautical tourism industry, he added. I was also told in Egypt that several members of the maritime community emigrated to the Gulf countries in search of a different type of work, in addition to sons of boatbuilders who do not take on the hereditary craftsmanship of their fathers, in search of more profitable jobs.

Traditional wooden boatbuilding relies now only on fishermen, with modest income. The rising price of imported timber for hull planking has rendered it difficult to acquire. This perhaps is one of the main factors that pushed members of the maritime community to seek an alternative material to wood, such as metal and fibreglass. Thus, the wooden boatbuilding trade has witness a set-back in recent years due to the advent of metal and fibreglass. Indeed, Cooper was informed in Yemen that new boats are only built with fibreglass and there are no more wooden boats produced.[429] Also, the recent research of the MARES team has provided evidence for this being the case in the whole of the Red Sea. In Egypt, al-Arabi Mohamad al-Shuwwa says that fibreglass was introduced some 15 years ago. Boats are either built with underlying planking of a cheap kind of wood such as *abyaḍ* (a type of pine) and covered with fibreglass, or they are entirely out of this material. Such practices are very common across the Red Sea regions, where almost all fishing centres have a modest nautical fibreglass industry.

The qualities of fibreglass boats have been identically reported around all of the areas where Agius, MARES and I have undertaken research; and they are many. Our informants say that a fibreglass boat gains in speed and performance because it is lighter than a wooden boat. This is understandable considering the competition over fishing grounds; fishermen have been seeking fishing waters further away from the coast. The boats can be left in the water without rotting, and so the need to beach them for regular maintenance work for wood is bypassed. Even when beached, wooden planks incur the risk of splitting when dried, which obviously is not the case for fibreglass, says

[428] Interviewed on 24th January 2012.

[429] Ibrahim Abduh Mahdi, a 70-year-old boatbuilder interviewed by Cooper in Hodeidah on 22nd February 2009; Hassan Muhammas Abd Allah Khuwayf, age not noted, boatbuilder interviewed by Cooper in Hodeidah on (?) February 2009.

fisherman Mohamad Hasan Farj al-Karim in Egypt.[430] Fibreglass is not only gradually replacing wood in a boat's construction but in repair works as well. Abdo Shata[431] and Mohamad Hasan Farj al-Karim[432] informed me that refurbishing a wooden boat costs as much as covering it with fibreglass. Thus, fibreglass coating of hull planks is preferred (Figure 10.1, Figure 10.2) because it protects the wood, and the boat lasts longer at sea, they say.

Figure 10.1: Fibreglass coating on the inner hull planks of a *falūka* at the boatyard of Abdo Shata in Quseir, Egypt. Abdo Shata's hand is seen here while he explains the process of fibreglass coating of the inner hull planks, before he turns the boat over and coats the outer hull planking (Photograph: author).

Figure 10.2: Detail of the fibreglass coating on the inner hull planks of a *falūka* at the boatyard of Abdo Shata in Quseir, Egypt (Photograph: author).

[430] Interviewed on 25th January 2012.

[431] Interviewed on 24th January 2012.

[432] Interviewed on 25th January 2012.

Conversely, Dr Aylin Orbasli, an architectural regeneration specialist who was studying timber in old crumbled merchant houses on the Saudi Red Sea shore, told Agius[433] that timbers rot faster when covered with fibreglass, since it traps moisture and creates a humid enclosed environment. However, this is not always the case as the situation depends on the state of the nautical timbers used (in terms of their moisture degree) and how the boat is maintained. Indeed, the development of rot in timbers that have been glassed is called "dry rot" (du Plessis 2010: 45). It is caused by certain fungi that develop with a minimum amount of moisture before decay begins (Hoadley 2000: 42). Therefore, as long as the fibreglass remains intact without cracks and holes, the development of dry rot can be avoided.

Expenses are reduced when fibreglass coating is used because of the lesser wood quality and price, since the timbers of a vessel are covered and protected by the fibreglass material. Prados (1996: 110) and more recently the members of the MARES team also observed that the growing fibreglass industry in Yemen in recent decades is replacing the traditional wooden boatbuilding one. I have explored the advantages of fibreglass over wood in Section 4.4. However, some fishermen claim that they prefer still to use a wooden boat since it is more stable and does not slide across in water as easily as a fibreglass boat. When you throw the fishing line (Ar. *ṣunnāra*), the fibreglass boat will move you away from it, says Mohamad al-Karim.

Another competitive material to timber that has also contributed to the decline of wooden boatbuilding in the Red Sea is the use of metal. In Egypt, my informants told me that the metal industry for cargo boats has replaced the wooden one. They say metal boats started being built in Egypt in the sixties/seventies and are favoured for their waterproofing, stability in water, durability and few maintenance requirements. The added value over wooden cargo boats was that metal ones have a larger carrying capacity.

The constant rise in wood prices not only caused modification in the mix of woods in a hull, but has altered a boat's design. In the mid-forties Hornell (1946: 248) observed that the dugouts plying the Ganges River were being replaced by planked river boats since "the price of suitable tree trunks has become prohibitive for such a purpose." Also in India, Kentley (2003: 146) mentioned the emergence of a new type of sewn fishing boat as a substitute for another type, of which the expensive timbers have become

[433] In Yanbu al-Bahr on 14th May 2007.

increasingly rare. In the Red Sea, Prados (1996: 98; 1997: 186-187) discussed the decline of dugout *hūrī* imported into Yemen, the construction of which necessitates expensive, large, and mature timber. Such timbers have become a rare commodity due to substantial deforestation in South Asia, he says. "As a result, plank-built craft have become more economically viable than dugouts", he says (Prados 1997: 186-187). However, the MARES team members and I observed that boatbuilders kept building known wooden craft shapes, but using different materials.

10.4 Function

This section looks at the aim and role that a wood species plays in the constitution of a boat. The structural element is indeed crucial to the process of the selection of woods destined for boat parts. The ethnographic details related to specific tree species were developed earlier in Chapter 8, and so this reads more like an overview of the function criteria. As Rajamanickam (2004: 129) points out: "A suitable knowledge on the selection of raw materials is very essential to build a vessel with durability […] the kind of wood differs on the basis of parts of the boat". The suitability of a timber species, according to its physical and mechanical properties, for a certain boat component is attested in the archaeological record of Roman Mediterranean shipwrecks (Rival 1991: 8), as wooden shipwrecks are yet to be discovered in the Red Sea. Despite this, Rival's work and the archaeological evidence put forth in Section 7.2 are worth considering as they exemplify how the ethnographic record can provide us with a path for the interpretation of the archaeology.

Ethnographic data from the Red Sea has shown that timbers species for different boat components can be divided into three broad categories. The first includes timbers destined for a hull's structural parts such as the keel, stem and stern posts, frames, knees, stringers, and cross-beams. The second comprises wood species suitable for hull and deck planking, and superstructure elements; and the third species designed for propulsion elements such as rudders, oars and paddles, masts and yards. Thus, the accounts in this section foregrounds the voices of boatbuilders and other informants from maritime communities around the Red Sea and how they perceive a timber's function. They also consider the specific requirements for the wood for each boat component, such as durability, weight, resistance to stress and knocks, and retention of shape and size under various conditions.

10.4.1 The structural parts of the hull

The species of timber used in structural parts of the hull include local and imported species. Keels of boats in Egypt are generally made with local *kafūr* (*Eucalyptus* sp.). My informants explain this by saying that the *kafūr* tree is tall, with a straight solid trunk which produces resistant, durable wood. Indeed, a keel's timber should preferably be available in considerable lengths so as to avoid jointing (Sharma *et al.* 1974: 15). However, Lahma tells me his experience taught him that *kafūr* "does not like to be enclosed and thus cannot breathe", which makes it more vulnerable to biological degradation. Therefore the boat components that can be made of *kafūr,* are preferably the ones where the wood is exposed to outer environmental conditions. Such elements include the keel, but also others such as the keelson and stringers which are not enclosed on all their sides. Keels in boats of the south-eastern Red Sea are made with exotic imported woods from south Asia such as teak, *mantīk* (*Shorea* sp.), and *zangali* to name a few. Thus, they are all carved out from tall, straight, sturdy, resistant and durable wood types.

Information on the keelson only comes from my ethnographic research in Egypt, as boatbuilders in Yemen, Saudi Arabia and surrounding countries such as Djibouti and Eritrea do not use keelsons. My Egyptian informants agree that a keelson can be of *kafūr* because it needs to be long, and with large dimensions. Because the keelson is placed above the frames, *kafūr* seems like a good a choice since the wood can breathe. For longevity, it needs to be from a mature *kafūr* piece of timber that is dry, resistant, and felled at the right time, Lahma recommends.

As for curved structural parts of boats, boatbuilders around the Red Sea exploit natural crooks of locally available wood. These include species such as *Acacia nilotica*, *Conocarpus lancifolius*, *Morus* sp., *Tamarix aphylla*, and *Ziziphus spina-christi*. They all possess properties ideal for use in frames, knees, and stern and stem posts. Indeed, they are timber that are strong, hard, shock-resistant, and durable against insects and rot in "stagnant humid air conditions" (in the case of frames and knees) (Sharma *et al.* 1974: 15-16). Some boatbuilders use whatever local wood they can acquire, others prefer one species to another. I was told by several boatbuilders in Egypt that they would prefer *tūt* (Morus sp.) to *sanṭ* (*Acacia nilotica*) for its working abilities and its conversion into frames. They say *tūt* is easily nailed and worked, and dries at a suitable pace; whereas *sanṭ* is harder to work and nail, and almost impossible to work if dried.

However, Egyptian boatbuilders also look for durability and resistance against shock and pressure for structural parts such as the stem and stern posts; this is why *sanṭ* is preferable in these cases.

10.4.2 Hull planking and superstructure elements

Every part of the superstructure of a boat should be of light wood, so it does not affect the balance of the boat, recommends Lahma.[434] He says that in the past, hull planking in Egypt was made of imported pitch pine which was prized for its durability and water-proof nature because it contained "oils" i.e. resin. Most planking across the Red Sea nowadays is made with types of pine imported from Europe and Russia as saw-cut planks. Its workability qualities are appreciated by boatbuilders because it is of light weight, but is also relatively resistant to rot and stress, and easily worked, bent and nailed. Such qualities are ideal for hull planking (Sharma *et al.* 1974: 15). However, there are some instances where boatbuilders use a mix of wood species for hull planking; the reason being economical, as seen above, but not solely. In Egypt, the garboard strakes and three to four adjacent strakes are made out of preference from local *kafūr*, and the remaining planking from imported pine. Some of my informants claim that an entire *kafūr* hull would weigh the boat down. In Saudi Arabia, Bilgaith also used a mix hull planks, the lower planking made with imported South-Asian tropical woods, and the upper planking from imported pine. Both practices exemplify the use of more durable and shock-resistant timbers in the submerged parts of a hull than in the upper parts.

As for the uppermost hull timbers such as the gunwale and cap rail, Egyptian boatbuilders use *kafūr* because they say it is denser than *suwweid* and thus is more stable to nail to the remaining hull strakes. I am told this property is crucial for such a hull part, which requires stability and resistance to shock and stress from footsteps and operations across the boat, as well as to rubbing action from fishing nets.

Deck and cabin planking is made with *kafūr*, pitch pine or other species of pine. These latter are light-weight, easily worked and jointed, with moderate strength, and warp resistant against the action of alternating wetting and drying, and splintering (Sharma *et al.* 1974: 15).

[434] Interviewed on 14th January 2012.

10.4.3 Propulsion elements

The ideal timbers for masts and yards appear to be *funn* (*Calophyllum inophyllum*), *kafūr*, pine, and *mantīk*. These are chosen by boatbuilders essentially for their considerable length, strength, durability and elasticity, so they do not break under the stress of the wind. They should also be relatively light as not to weigh the boat down. Boatbuilders around the Red Sea are almost all aware of these properties that are also argued by Sharma *et al.* (1974: 16). Mast and yards of small fishing boats and *hūrīs* are made with bamboo, because it is light.

In Egypt, rudders are made out of *kafūr* in large Nile cargo boats because of the sturdiness it provides; whereas *suwweid*, a less durable wood, is an alternative in the case of smaller sailing boats. Finally, in Egypt and Yemen the most common wood used for the oars and paddles is pine because boatbuilders seek its straight-grain, light-weight, elasticity and strength.[435] A local wood substitute in both countries can also be employed because of its resistance to the rubbing action between the oar or paddle handle and the boat: *kafūr* in the case of Egypt and *muraymirah* in the case of Yemen.

10.5 Religious narratives

Ships have been argued to be symbolic components of ritual practices in maritime archaeology (Adams 2001), and less so in maritime ethnography (Simpson 2006; Ransley 2009). Religious influence and context have not been analysed thus far with regard to the nautical uses of timber, in both the related archaeological and ethnographical context of the Red Sea. "The origin of a boat is Noah's ark which was made with wood and not metal. Wood is much better than metal"[436]. This quote by Atef Matar, a Muslim local wood merchant I spoke with in Egypt, is indicative of the intrinsic religious conception of the raw material as a continuation of boatbuilding practices that go back to the origins of creation. In Islamic culture, Noah is considered as the primary naval architect and carpenter. This belief dates back at least to medieval times (Ibn Khaldūn 1956: I.731-732, 1996: 380-381) and persists until today in Egypt[437] and elsewhere.

[435] See Sharma *et al.* (1974: 16) for more details on suitable timber characteristics for oars and paddles.

[436] Interviewed on 28th January 2012.

[437] Mahmoud Abdel Maguid al Qassas, boatbuilder at Lake Burullus interviewed on 16th January 2012.

As for tree species, Mahmoud Abd el-Maguid al-Qassas[438] takes pride in the notion that Egyptian boatbuilders have been using the same types of woods "since the times of Noah". This highlights the fact that the types of wood employed have a long-lasting tradition of exploitation, anchored in people's belief systems. Historically, medieval Islamic sources report that Noah's ark was built with nailed teak planks (al-Ṭabarī 1989: I.359-361; Ibn al-Āthir 1987: I.56). According to my fieldwork in Egypt, teak is nowadays only used for decks in leisure boats, and not by traditional boatbuilders such as al-Qassas. Also, the 7th/13th century geographer Yāqūt (1988: II.179) says that Noah used *shamshād* wood to build his ark. Ibn Khaldūn (1956: II.159) identifies *shamshād* with *sanṭ*. I could not identify *shamshād* in relevant botanical literature (Mabberley 1998; Provençal 2010) or in Lane's lexicon. If indeed *shamshād* corresponds to *sanṭ* then it is an indicator of an ancient surviving practice of exploiting such wood in vessel construction.

In addition, there have been substantial fluctuations in the types of imported wood exploited in Egypt over the recent decades (see Section 9.2). This stresses the symbolic statement by al-Qassas which relates to the exploitation of local types of wood in Egypt, as these are endemic to the country. Lahma[439] says that the Qurʾān describes how Noah constructed his ark with frames that copied the shape of a cow's ribcage. This is why boatbuilders use local crooks of *tūt* and *sanṭ* for their frames, he adds. However, this anthropomorphic representation or metaphor does not figure in the Qurʾān. There are a few *sūrahs* (chapters) and *ʾāyahs* (verses) that mention Noah building the ark, but no reference to a cow's ribcage (See *Hūd* 11: 37-38; *al-Muʾminūn* 23: 27; *al-Qamar* 54:13-17). Even if this metaphor does not figure in the Qurʾān, it is of importance because it illustrates the perception of the boatbuilder and is "grounded in the body and in mental images of the world based on bodily experience. Such experiences and images are mediated through social experience and thus are culturally variable" (Tilley 2004: 22). As Tilley (2004: 23) says: "To be human is to think through metaphors and express these thoughts through linguistic utterances and objectify them in material forms. The essence of metaphor is to work from the known to the unknown, to make connections between things so as to understand them".

[438] Interviewed on 16th January 2012.

[439] Interviewed on 14th January 2012.

Lastly, almost all my informants in Egypt praised *Allāh* when describing how the local natural crooks of trees fit perfectly with the needs of the curvatures of a boat. They say He created trees in a way and a shape that provide shipwrights with suitable building material for their boats. This exemplifies how Muslim faith is a factor shipwrights assimilate in their interpretation of their own selection of timber for nautical uses.

10.6 Subjectivity

"Building by eye is a trial and error method of application, whilst it is also a product of traditional wisdom that is transmitted as a part of creative excellence of the people and a continuity of knowledge", says Bhattacharyya (2006: 248) about Balagarhi shipwrights. This statement highlights two major issues: the importance of visual mapping by boatbuilders and the emphasis on hereditary craftsmanship. These are inherent to traditional boatbuilding practices in the Red Sea. Boatbuilders I spoke to do not draw plans of boats they want to build but follow the standards they were given by their predecessors. They also trust their own experience and self-teaching in producing good quality vessels. Lahma[440] was the only boatbuilder in Egypt who uses his experiential conceptualisation as well as a drawn plan with plan, profile and section views. He says this way he unites science with experience, and produces better quality work than a naval architect who just follows his drawings, and other shipwrights who build by eye. Trust in experience applies also to the wood chosen by shipwrights. When asked how he knows which wood is of a better quality, boatbuilder Khalil Mohammad Khalil simply replies: "I can see it, from experience." For Lahma, nautical applications of timber go beyond just knowing which type of wood to choose and work with. He says: "Even if two boatbuilders use the same wood, it is not only about the types of wood you use but how you choose the wood, treat it, fell it, dry it, cut it, knowing how to associate a timber part with a boat part. This is the difference. It is how you use your experience to produce a long-lasting durable wooden vessel". The boatbuilder has a deep understanding of the limitations of timber applications in boats. Lahma claims that a boatbuilder should treat the wood plank "with sensitivity and not with force". It should be left to run "comfortably" along the vessel's hull with "no strains and the risk of breaking". Such craftsmanship needs "harmony, comfort, and sensitivity", he adds. Lahma also confers anthropomorphic characteristics to the raw material by saying: "the material (wood) does not speak. You are the one that needs to understand it".

[440] Interviewed on 14th January 2012.

Bhattacharyya (2006: 246) says that to Bengali shipwrights "a boat is conceived as an animated concept with bodily parts". This echoes anthropomorphic boat conceptions of my Egyptian informants, when they associate a vessel to a human being, or cow, which has a spine and ribs, referring to the keel and the frames, and a skin, referring to the hull planking.

On another note, Ibrahim al-Sayyid[441] unveiled a personal anxiety to me with regard to the exploitation of timber in vessel construction and the finite availability of this raw material. He confessed that when he was young he used to think that "the wood is going to end because of its excessive use, it was naïve of me. Then, I learnt that the person who fells a tree, plants another in its place". This is most probably true to Ibrahim al-Sayyid and the cultivators he knows, but as I have argued earlier, government aid for planting and providing saplings is almost inexistent.

In conclusion, this section looked at six parameters that influence the use of wood in boatbuilding, that is at how the environment, politics, economy, function, religion and subjectivity come at play when choosing and fashioning logs. Information here mainly draws on ethnographic data from Egypt, unless otherwise mentioned. Whenever possible I have attempted to highlight the implication of such parameters when interpreting past exploitation of nautical wood.

In the ethnographic record, the environment, i.e. the operational context of a boat, plays a part in the choice that boatbuilders make when choosing nautical timbers. Although, this parameter is not as yet evidenced in the textual and archaeological record, we need to consider it when interpreting ancient nautical timbers. Politics and economy are equally important when looking at past timber uses since these directly influence the species exploited, and offer a suitable context for understanding such exploitation. Independently of the period, the availability of local wood types largely depends on government policies and forest and wood resources management and ownership. Meanwhile, regional political and economic events directly influence the timber trade and the areas of provenance of tree species. Chapter 6 has demonstrated how regional political events and governmental policies influenced the use of local timber and the trade in imported timber in the past. As for the economic variant, it is clear from the

[441] Interviewed on 19th January 2012.

ethnographic record that economic shifts in recent decades have shifted available markets from south and south-east Asia and the USA to a rather European timber production. This is due to the rise in price of good quality exotic woods versus a cheaper availability of European and Russian pine. This is why I believe that in antiquity timber could have been harvested in areas rich with wood resources that are geographically close to the Red Sea such as the Zagros Mountains in order to mitigate potential high costs of imported timber from further afar such as from South Asia.

The functionalist variant plays a substantial role in the use of timber for certain boat components, and it is almost the only parameter that archaeologists consider when looking at nautical timber in ancient times. The ethnographic research presented here shows that structural parts are mostly made with local timber types that are readily available and exploited for their natural crooks. Some local timber types such as *kafūr* (eucalyptus) also have straight trunks that are suitable for keels and keelsons. They are also suitable for hull planks and superstructure elements, which are otherwise made with imported long planks. Local species are also used by boatbuilders for propulsion elements such as rudders and oars. These latter can also be made with imported species. Such versatility of timber species can aid the archaeologist in his/her interpretation without jumping to pre-conceived notions on wood use.

The last two parameters that influence the use of wood in boatbuilding in present-times, and that might have also done so in the past, are issues of religion and subjectivity. Religious narratives were apparent in the interviews I held with my informants. They praise Allah for creating straight trunk trees for their keels and naturally crooked ones for their curved boat components. They also envision themselves as the inheritors of Noah, the first boatbuilder, using the same types of timbers as he did. Can we assume that early Muslim shipwrights had the same aspirations? What can we say about the influence of other religions in the past on how shipwrights viewed themselves and the timber available to them? These are questions that might be worth considering in future investigations. Finally, the issue of subjectivity, by definition, is a personal experience that cannot be generalised or applied to other people or at other times. The feelings or the relationship that shipwrights, past or present, might have had with the wood they work and carve differ from one person to another. However, the sensory perceptions, that the materiality of timber entails, pushes any boatbuilder into engaging his senses while observing the wood, smelling it, hearing it, touching it, and feeling it bend or break under his stroke. It is such experiential work that allows boatbuilders of any period to trust that the raw material they are using will produce a long-lasting durable craft.

11 Conclusions

Writing in the 1980s, Boxhall (1989: 295) said: "I confidently predict that the Arabian wooden ships with their lateen sails and their crews, will outlive the age of Arabian oil. Such enduring and durable vessels continue to be built in East African ports such as Mombasa, Zanzibar, Mogadishu and Djibouti; in Yanbu and Jeddah, Mocha and Dubban in the Red Sea; in Aden and Mukalla on the South Arabian coast; at Sur, Sohar, Dubai and Kuwait in the Gulf; in large numbers at Beypore on the Malabar coast [...] and in the Maldives. And the Arabian seafarer passing his knowledge from father to son has apparently lost none of his age old skills". It is quite alarming that just a couple of decades later, Boxhall's predictions have failed. Arabian wooden boatbuilding has lost its former glory, and present times have rather witnessed a rapid decline in wooden boatbuilding. Meanwhile the related tangible and intangible maritime culture is fast disappearing, at least in the case of Red Sea and on the South Arabian coast. The Arabian seafarer and boatbuilder have adapted some of their precious skills to the advent of new technologies and materials. Meanwhile, fewer and fewer sons are taking on their father's craftsmanship as they seek better salaries, and living conditions in the oil and/or tourism industries.

My primary interest for this thesis arose from an urgent need to record vanishing practices related to the use of wood in Red Sea boatbuilding. To reach a deeper understanding of such practices, and in light of recent archaeological faunal scholarship on harbour and coastal sites of the Red Sea and the Arabian Sea — such as Myos Hormos/Quseir al-Qadim, Berenike, and al-Balid — this thesis has sought an appreciation of the use of wood in boatbuilding in the Red Sea from classical antiquity until present times. As timber from further afield was also resourced in the past alongside local tree species, the geographical context of this thesis has varied at times to include evidence from regions of the wider Indian Ocean, Egypt's Nile and the Eastern Mediterranean basin (e.g. in Chapters 6 and 7).

It is this author's hope that by relying on a multi-disciplinary approach she has attained a more rounded and all-inclusive in-depth study of the subject, thus proving that mutli-disciplinarity in the fields of archaeology and ethnography can produce a successful outcome. Such an approach draws on several auxiliary disciplines, including history, through a critical appraisal of primary sources; archaeology, through considering nautical timber datasets; ethnography, through fieldwork in Red Sea regions; science, through wood identification of related samples and botanical literature; and linguistics, through the study of ancient and vernacular nomenclature of trees.

This thesis has pursued three main objectives. First, it has attempted to assess, analyze, and interpret data on the use of wood in boatbuilding in the past in order to identify the timber species used, the arboreal resources exploited, and hence a potential origin for nautical timbers. It has also demonstrated how these latter are an integral part of a boat's narrative and multi-cultural identity, and not only an indication of its origin. Data on nautical wood has also delineated timber trade patterns in the Red Sea in classical antiquity and the medieval Islamic period. In addition, it has shed the light on ancient boatyards, the type of vessels constructed at these sites and the period of activity. To accomplish all of the above, it has drawn on classical and medieval Islamic literature of history, geography, botany, and travel accounts, in addition to archaeological resources (Chapters 6 and 7). Second, this thesis investigated contemporary wooden boatbuilding practices to document a rapidly vanishing aspect of maritime culture in the Red Sea. For this, it benefited from ethnographic data related to the use of wood in contemporary boatbuilding in Red Sea areas where Agius, the MARES Project and this author undertook ethnographic fieldwork and research. In doing so, it has sought in the first instance to present an inventory of vernacular names of nautical timber in the Red Sea (Chapter 8). It has also considered the processes that a timber-producing tree follows to reach its state as a boat component (Chapter 9), in addition to identifying variables and factors at play in such processes (Chapter 10). Finally, this thesis has attempted a comparison between past and present practices of using wood in boatbuilding and of wood trade by drawing parallels, whenever relevant to the discussion (Chapters 6 to 10). It has also, in these chapters, attempted to inscribe the use of nautical wood into a wider context of intermingling factors which range between geopolitics, socio-economics, cultural practices, and more subjective factors.

The theoretical and methodological approaches set out in Chapters 4 and 5 have framed the way we think about and process data on the use of wood in boatbuilding. Archaeological research contributes to a multivalent understanding of the use of trees by humans in a historic perspective, while ethnography is a research tool in its own right that has implications for the archaeological study on nautical timber. Ethnography can offer perspectives with which we can interpret the use of wood in boatbuilding in earlier times. Through the use of analogy, it can help filling in historical blanks by suggesting possible scenarios, and to a certain extent shed the light on archaeological implications where there is no proof. Most importantly, this thesis has divorced itself from an ethnoarchaeological approach in its processual sense. That is to say that past behaviours and material culture cannot be explicitly modelled through direct analogies on present experiences of boatbuilders and timber merchants and their associated social contexts. But, they can rather aim at reflexively addressing archaeological epistemology while broadening potential readings of archaeological material (Thomas 2004). Hence, there are several implications of a such reflexive and methodological tool for the fields of maritime archaeology and ethnography in studying the use of wood in boatbuilding in the past and present, and the communities who were and are involved in such practice.

The use of wood in boatbuilding has never figured as an exclusive subject in boat studies related to the Red Sea region, but was always a secondary issue. The present thesis did not seek to criticise the work of previous scholars on the subject, but to identify methodological and information gaps, and attempted to mitigate these by building upon earlier work (see Chapter 2); in the same way this author hopes that the present thesis will also serve as a stepping stone for future interest in nautical wood. When drawing on the earlier literary canon of ethnographies of 19th century imperial officers and 20th to 21st century scholars, this author found that information on wood types is often disembedded from its socio-cultural context. Timbers were perceived as passive materials disengaged from their materiality (see Section 4.4). Data was thus limited to the name and use of the wood, while lacking for example the correspondent socio-technological background; and the choices taken by boatbuilders, their perceptions of the properties of wood or any other impetus that may dictate such choices. Moreover, such studies dismiss networks of interaction between the material, the people, and the environment these people dwell in, and exploit for wood resources. Most of the ethnographic literature lacks a balance of archaeological, socio-historical and cultural identity and linguistic input necessary to a deeper understanding of the use of wood in boatbuilding. Thus, this author has sought to fill such gaps by a different approach in the ethnographic enquiry and its implications for an archaeology of boats.

One of main contributions of this thesis to the field of maritime archaeology is that it has identified, in one unique piece of research, relevant wood species used in boatbuilding in the Red Sea from classical antiquity and the medieval period. This task is quite challenging since the available historical and archaeological data is vague in its scope: it is patchy and inconclusive and presents a skewed picture of the species used in boatbuilding, whether such data concerns local timber or imported species. The data focuses on wood used in Egypt in particular, and there is almost no information on other regions of the Red Sea such as Sudan, Eritrea, and Djibouti. Both the literature and archaeology fail to provide an in-depth knowledge on timber trade networks, wood exploitation processes and the implication of broader issues such as agencies, phytogeography, and political, economic, social, and environmental parameters, which this thesis considered in its interpretative approach to the subject.

Despite all these caveats, this thesis has shown that species endemic to the Red Sea region were used in past boatbuilding to a greater scale than a prevailing scholarly focus on the importance and superiority of foreign woods has entailed. Such local species include acacia, balanos, cypress, sycomore fig, palm, lebbeck, tamarisk, sidr, poplar, and willow. Acacia appears as the principal wood, with an extensive exploitation that stretches back as far as the Pharaonic period. Other species were less commonly exploited, or perhaps only perfunctorily mentioned in the sources, such as lebbeck, palm, tamarisk, sidr and poplar. Nevertheless, they are all also present in the Pharaonic archaeology of Egypt. The timeline below (Figure 11.1) illustrates a chronological evaluation of local timber use from Pharaonic Egypt until the medieval Islamic period:

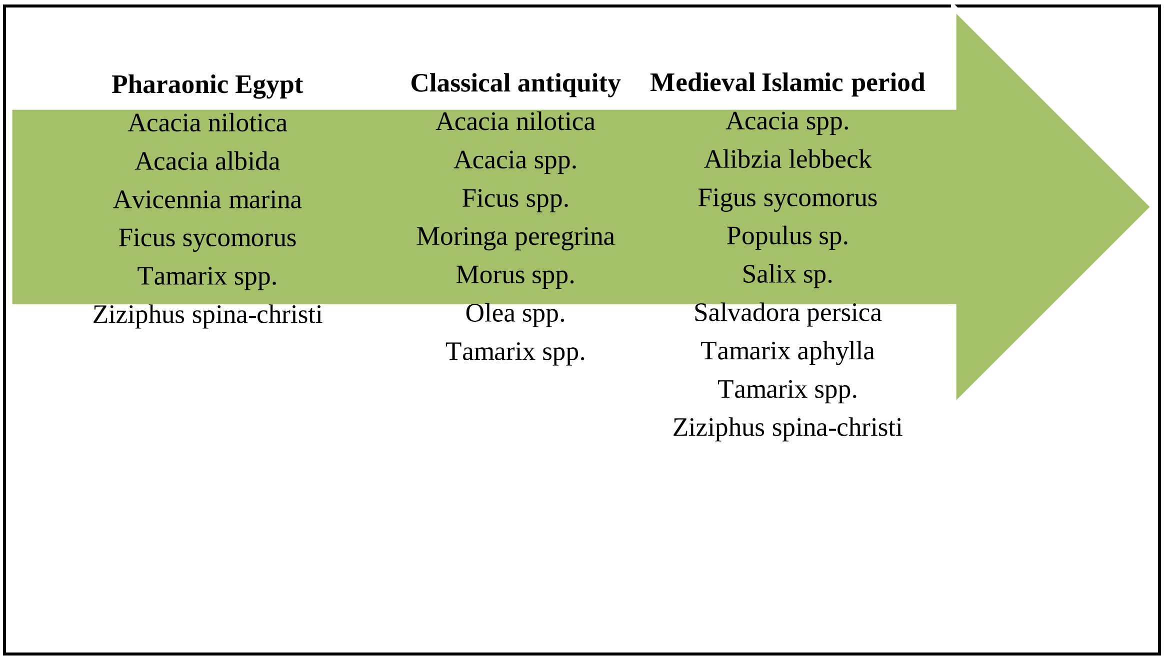


Figure 11.1: Timeline illustrating local timber species used in the Red Sea from textual and archaeological sources.

To support evidence from primary sources and archaeology on the importance of local timber resources, this thesis considered the phytogeography of the Red Sea regions (Chapter 3). In doing so, it demonstrated that these regions hold a wide area of local wood resources which are suitable for boatbuilding. These might very well have been exploited since antiquity, as relics of past forested areas are witnesses to this phenomenon. Arboreal resources include coniferous tree genera and species such as *Juniperus*; non- rosaceous broad-leaved trees such as *Olea* and *Quercus*; hydrophilous trees such as *Albizia*, *Populus*, and *Salix*; tropical vegetation trees such as *Acacia*, *Moringa peregrina*, *Salvadora persica*, and *Ziziphus*; tree species of steppes, deserts and salines such as *Balanites* and *Tamarix*; coastal salines trees such as the mangrove vegetation of *Avicennia marina* and *Rhizophora* sp. (Zohary 1973: 341-397, 458, 472, 602). Also, these resources are part of several habitats where the association of species offered to the timber seeker an array of choices. Trees producing long straight planks, must have been highly prized and targeted first for their timber for boatbuilding and other construction in ancient times. The diversity and local availability of the above-mentioned species present the boatbuilder with the possibility to rely on endemic species for structural, fastening, and propulsion elements, and also for short planks. This discredits the general consensus that the Red Sea and regions were completely denuded of forests in the past, and that imported wood was thus the only source of nautical timber. It also shows that if needed be a boat could be solely built with local timbers.

Moreover, the exploitation of these local species must have represented an economic gain for the Red Sea region since it was more likely cheaper than imported wood. This is one of the reasons that some of these species such as acacia, tamarisk and sidr are still used in boatbuilding in present-day Egypt, where a modest wooden boatbuilding industry survives. They were also used in the recent past in other Red Sea regions where wooden boatbuilding has today almost disappeared.

As to the functional use of these local timber species in the past, this thesis has also challenged the general assumption that tall straight trees were exploited for boat components requiring length, and relatively shorter and twisted trees only suited curved boat components. Such categorisation of timber species is not so clear cut. For example: it is generally assumed that acacia was solely used for structural components, but some of the textual and archaeological evidence indicates its use in hull planks as well: Herodotus (II.96) attests the use of acacia for short hull planks in Egypt, for example.

Also, ethnographic evidence from Sudan testifies to the use of acacia wood for the hulls of boats plying the Nile. Another example is the case of tall trees such as pine and eucalyptus. Pine is commonly thought as timber suitable for planking only. However, comparative evidence from shipwrecks in the Eastern Mediterranean, and from the 18th century modern Sadana and Sharm al-Sheikh wrecks, included structural components made with pine. More recently, eucalyptus is a tree which is quite polyvalent as it is used in both structural and planking elements, as attested in the ethnographic record from Egypt. Moreover, textual and archaeological evidence, with few exceptions, often falls short of indicating the functional role of timbers. Hence, both maritime archaeology and ethnography demonstrate that drawing systematic patterns with respect to the use of nautical wood is quite challenging. We can only confer a general character to the dichotomy that considers tall straight trees only suitable for long boat components, while relatively shorter and twisted trees only suit curved boat components. Hence, we need to keep an open mind to possible variations in the nautical use of tree species.

Another contribution of this thesis to the field of maritime archaeology is in that it has reassessed the prevailing notion in boat studies of the western Indian Ocean that regards India as the main, indeed only, source of timber exported to the Red Sea region throughout history. In doing so, it argued that the need for timber in these regions did not have to come solely from India since other forested regions could have also been resourced, such as the ones of the Zagros Mountains, the Elburz Mountains and other areas in northern Iran, adjacent to the Caspian Sea (see Sections 3.2.1 and 3.2.2). Such regions have, surprisingly, been dismissed from modern scholarly interest as timber providers to the Red Sea and most definitely to the Persian Gulf. In addition, regions of East Africa with their rich timber resources and their proximity to the Red Sea regions are and were considered as potential timber suppliers (see Section 2.3.3 and Chapter 6). Last but not least, the Mediterranean basin has always constituted a valuable timber resource for boats plying the Red Sea, whether these were built on location or on the Mediterranean coast of Egypt and carried overland or hauled via fluvial and maritime routes to the Red Sea (see Sections 0, 6.2.4, and 0). This is not to dismiss India as one of the main timber providers, especially in the medieval period (see Section 6.2), but the argument here is to put forth and stress other albeit no less important providers.

We also get a sense from the texts of how raw logs were shipped: that is, either loaded onto ships or towed in rafts behind them. However, the latter option can be quite challenging albeit impossible in open-seas. There is no such evidence from the archaeological record in the Red Sea, to this author's knowledge. These indicate that regions of the Red Sea could access wood resources through maritime commerce during the classical and medieval Islamic periods. However, textual and archaeological data on timber trade is insufficient to construct a comprehensive image of this trade in the past, not least the volume of timber carried, and whether such a trade was regular. Also the fact that Graeco-Roman and medieval Islamic period boats were constructed on the Mediterranean coast of Egypt and/or the Nile valley, dismantled and transported to the Red Sea coast where they were rebuilt, indicates that direct timber trade routes between the Mediterranean and Red Sea might not have been substantial. Meanwhile, in the current state of research, the lack of evidence for timber trade might be an indicator of an otherwise underestimated exploitation of local timber resources in Red Sea.

The question remains on where timber, that was acquired by either local exploitation or by importation, was processed for boatbuilding in past eras. Information about boatbuilding sites from primary sources and archaeology provides us with a few insights into the location of some of the boatbuilding activities in both classical antiquity and the medieval Islamic period. In the classical period, Clysma, Myos Hormos and Berenike appear as hubs for boatbuilding or rather boat assembly and boat repairing activity. In the Islamic period, such activities were located in Lower Egypt, for example al-Rawda, Bulaq, and Damietta; at Arwa in Middle Egypt; at Alexandria on the Mediterranean coast; and at al-Qulzum and al-Tur on the Red Sea coast. Other Red Sea locations also witnessed boatbuilding and repairing activities such as the Hijaz and Aden in Yemen. Indeed, the available evidence creates a somehow distorted image by not providing information on all actual boatyards that might have existed in the Red Sea, if only for the needs of local fishing communities. We also get an appreciation of the duration of boatbuilding activities at these sites. In a few locations in Egypt such as at Damietta and al-Rawda, there is a sense of an on-going industry lasting over several centuries, while other locations figure as occasional yards such as at Tur and Qulzum. The reasons for the location of boatyards and their duration of activity seem closely linked to geopolitics and economics of the time. Evidence from our ethnographic research can also suggest possible scenarios that explain why the location of boatyards is not always easy to discern in the archaeological record. In most Red Sea regions today, boatbuilding happens in open-air spaces such as coastal areas, people's courtyards, and even in modest workshops (see Section 5.3.3). Most of these places have little to no solid infrastructure and the material culture related to such places and activity can easily be non-existent in the archaeological record. Such occasional or small-scaled boatyards might have very well existed in the past around the Red Sea.

Another shortcoming of primary sources and the Red Sea archaeological record is the types of wooden boats constructed in the region. Generally, the texts only speak of naval craft, rather than for commercial or fishing purposes. Graeco-Roman and medieval Islamic authors mainly documented naval constructions of the elite which were large scale operations rather than being interested in more common or modest boat construction by the masses such as fishermen, merchants, and mariners (see Chapter 6). These were probably regarded as less compelling events. Also, little can be said about the overall type, size, and function of ships that were dismantled at Quseir, Berenike, and al-Balid for example. This lack of information should not overshadow the fact that more modest boatbuilding was bound to have happened in the past in order to meet the needs of maritime communities to travel and fish. We get a sense of this on-going activity from maritime ethnographic research in Egypt where fishing boats are still being built, albeit on a small scale.

One of the main contributions of this thesis to the field of maritime ethnography is the alphabetical inventory of more than 70 colloquial Arabic names of nautical timber types used in the Red Sea regions (Chapter 8; 12.3.7 Table 7). Vernacular names for timber usually figure in very few of the botanical references I have consulted, and in some of the ethnographic literature on south and southeast Asia. Hence, this thesis compiles a first-of-its-kind inventory on nautical timber types, the names of which were transcribed following the dialectal variants of our informants. I have also endeavoured, whenever possible, to sample known timbers for scientific identification in order to create correlations between vernacular names and binomial names (Tables 6 and 7). This has contributed immensely to our knowledge about the nomenclature and identity of nautical wood types. Still, there are timbers which remain scientifically unidentified, mainly for logistics reasons and call for the need for further ethnographic work. Such a lexicon of vernacular names pushes us to suggest that such a dialectal variation might have also existed in the past. The names conveyed by classical and medieval Islamic texts usually offer one, perhaps the standard, tree name. We have no insights as to the spoken names in the past but we must think that they might have been used by people in earlier times.

In order to understand how timbers came to be in a boat, this thesis looked at the people involved in the processes of boat construction, and what are the implications of history, archaeology and ethnography in the understanding of these people and their engagement with the world. Similarities between past and present were identified in this study with regard to the timber species used (See Chapters 6 and 8, and Section 7.2), and some of the practices involved in processing a log into a boat component (Chapter 9). This does not mean that these issues were experienced in the same way by people of the past and those of the present. Hence, the following draws on such similarities to suggest how correlations between history and archaeology on the one hand and ethnography on the other can be made when it comes to the people involved in the use of nautical wood.

First, it needs to be reiterated here that the present study has divorced itself from the previously accepted notion of perceiving the communities of the Red Sea regions as 'traditional' in the processual sense of the word. That is to say that these communities are immutable and unconsciously repeating practices inherited from the past. The present study trusts that human society is constantly coming into being with modifications of technology, artefacts, labour, and resources to name a few. It has shown that the so-called 'traditional' processes of timber exploitation rooted in the past are constantly under transformation and adaptation to new economic and social contexts and other variables. The maritime communities of the Red Sea are not rigid and fixed in time: They are actors as well as being acted upon. They are rather part of a 'living tradition' constantly adapting to changing historical, political, social, economic, technical and environmental conditions.

Second, the concept of skill should be considered in order to understand how what seems as similar processes of woodworking between past and present came into being. Such processes and the way they are perceived, lived and experienced by living Red Sea boatbuilders are highly temporally and culturally-situated. Present boatbuilders of the Red Sea have not inherited their skill and craftsmanship through a *savoir-faire* that has been imposed on them from the outside, but they developed their skills through verbal knowledge, bodily engagement in their material world, and the process of enskilment. This is most probably how shipwrights of the past also learnt how to master their art.

Boatbuilders, both present-day and ancient, have experienced the synergy between them, their tools and the materials they were working with, as well as the coupling of their perception and action. For example, while felling a tree, there is an intrinsic link in perceiving the correspondence between a tree part and its nautical counterpart (see Section 9.3). It is not a simple imposition of mental realities on material ones. Rather, it is through a continuous exchange between external events and internal representations, and through skilled action and engagement in the material world that wooden boat components are extracted from a log. Simpson (2006: 60) puts forth an interesting approach on how to focus on the human element in present boatbuilding practices, and it is this author's belief that it could also be applicable to the past. He says that a boat is a "human project rather than [...] a collection of physical objects [... it is] a social activity requiring intention, planning and organisation. It also follows that building a ship means a variety of things for those involved depending on their allotted tasks and position within the command hierarchy [...]. In fact, building a ship, for particular individuals, may involve little more than carrying timber back and forth or managing account books. It also follows that the majority of work in shipyards is routine, repetitive and somewhat tedious. For apprentices, tedium comes from the fact that at first they have very little to do and later because they get to perform the same task over and over again, in effect learning many skills for the first time and then relearning them to the point of habitude through repetition" (Simpson 2006: 60).

The concepts of bodily engagement with the world and the landscape in which boatbuilders dwell and its temporality are a third hermeneutic tool through which we can view and relate past and present practices of exploiting timber in boatbuilding. The bodily engagement and materiality are interwoven in socio-cultural developments through time, as both humans and their material world are mutually shaping and creating each other. This was exemplified in this thesis in the way that timber resources were constantly being modified with the introduction of new species (see Chapter 3); and more recently the use of new materials such as fibreglass and metal. Change is also perceived in its influence on socio-economic schemes around the boatbuilding and fishing industries, in addition to the personal experiences of people who built and used these boats of a period. Also, whether in the past or present, nautical wood seekers have dwelt in a socially constructed taskscape imbued with their daily activities. By the same token, people have always been connected to their environment not in a deterministic sense but through the affordances it provides them. Thus, taskscapes use and modify affordances, which in turn instigate a set of taskscapes. This was clear throughout the present research through wood procurement from different sources in different times; the introduction of new tree species to Red Sea areas; the changing location of timber import hubs. Thus, Red Sea landscapes were modified in time through the introduction of non-endemic arboreal species used in boatbuilding. Congruently, this shift in the arboreal landscape altered boatbuilding practices as new species were introduced and new networks of procurement explored.

The fourth issue that shows what ethnography can offer in terms of its implications for past experiences of Red Sea boatbuilders is a look at the intangible perceptions of present-day boatbuilders. Through the use of vernacular language and their sensory perceptions, boatbuilders conveyed several metaphors associated with timber related to its strength, and other physical characteristics, in addition to places of origin. They also conferred human and animal feelings and sounds to the wood they worked. Whether boatbuilders and wood agents of past era did the same is not known, but there must have been a degree of personal engagement with the material through their own senses, language and perceptions.

Finally, our ethnographic enquiry shed light on issues of social identity and gender of boatbuilders and boat owners that are often absent from archaeological studies on Red Sea boats. Craftsmen are social actors with a life context through which they perceive the significance of their world and creations. This life context is embedded in what is defined as 'social labour' (Costin 1998: 4). Tasks related to wood use in boatbuilding activities observed in the Red Sea were gender-specific, with male wood providers, boatbuilders and owners. The majority of my informants were Muslims, and some others Copts. Most belonged to families of boatbuilders and such craftsmanship reflected upon their status among the community of boatbuilders, fisherman and boat owners. Thus, any archaeological enquiry about past communities involved in boatbuilding should, if possible, suggest possible scenarios on their life context.

In conclusion, this thesis suggested an alternative way of thinking about wooden watercraft, as a result of the implications it gathered from both maritime archaeology and ethnography. It proposes that one should think about boat identity not in terms of its "origin" but rather by following and reconstructing a boat's "narrative". Boats plying the Red Sea and the wider Indian Ocean reflect the multi-cultural diversity of ethnicities involved in building and crewing these boats, as well as timber agents and funders. Such a multi-cultural identity is part of a boat's narrative as seen through a vessel's materiality; its timbers, which originate from a multitude of places; through the places it has been at; the cargo and personal things it carried; and the people who intermingled with it ranging from timber agents, to boatbuilders, to the owners, crew and passengers. Red Sea watercraft, through their timbers, embody the intermingling of places, environments, people and the things they create. The mixture of several species of timbers reflects this diversity in a boat's history and constitution that is constantly undergoing changes, refurbishments and repairs. Such a narrative continues beyond the life of a boat through plank recycling and wood shavings.

The mutli-disciplinary approach adopted in this thesis succeeded in producing substantial research on the Red Sea maritime tangible and intangible cultural heritage. The use of timber in boatbuilding in the Red Sea in the past and present times is not merely functional and environmentally determined. It is rather the intermingling of a more complex number of factors which have wider implications for how the environment, people and materials are constantly shaping each other and coming into being.

12 Appendices

12.1 Appendix 1: List of informants

Dionisius A. Agius

Egypt fieldwork- list of informants- March 2002-2003- February 2004

No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Ibrahim Ali Musa	Dhow builder	72	Quseir	Five generations of boat builders.	31st March 2002
2	Muhammed Saeed al-Sabbagh	Dhow builder	30	Quseir	From Rashid (near Alexandria); trained by his uncle; 15 years experience in boatbuilding.	7th March 2003
3	Ali Hamza	Sea captain	65	Quseir	35 years experienced at sea.	8th March 2003
4	Muhammad Mahmoud	Sea captain	50	Quft	Experienced on the River Nile.	18th March 2003
5	Saad Ali Hasan	Sea captain	63	Mersa Alam		31st March 2003
6	Kamil Muhammed Abu Lubb al Burri	Boatswain	68	Quseir	Started life at sea from the age of 9 years.	9th February 2004
7	Abbas Muhammed Ali Daud	Sea captain; head of the fishermen cooperation	81	Quseir	Father and grandfather experienced at sea.	10th February 2004

8	Ali Hussein Ahmed Ibrahim	Sea captain	53	Quseir of Abu Hibaya tribe	Father and grandfather experienced at sea.	11th February 12thFebruary 2004
9	Mahmud Saad Ibrahim	Sea captain	67		Awayna of the Ababda tribe.	12th February 2004
10	Duwi Toufiq Mahmud	Boatswain	64	Quseir		21st February 2004
11	Hasan Muhammed Hamd Allah	Boatswain	55	Mersa Alam of the Ababda tribe	Started life at sea from the age of 12.	22nd February 2004
12	Salah Baraka Muawwad	Fisherman		Mersa Alam		22nd February 2004
13	Ata Bishar Mhammed	Farmer and rope maker	43	Qale, Quft on the River Nile		23rd February 2004
13	Atiya Saad Sikiyan Guta	Boatbuilder	59	Quseir		26th and 27th February 2004

Dionisius A. Agius Sudan fieldwork- list of informants- November -December 2004					
No	**Name**	**Occupation**	**Age**	**Comments**	**Interview date**
1	Muhammad Nour Saleh Othman	Dhow builder	42	Of Nigerian origin.	23rd November
2	Muhammad Hasan Mahmud	Guard	50	Information on trade and the Suakin Island.	
3	Hussein Abd al-	Sea captain	120	Born in 1884 and	24th

	Hamid Abd Allah	and fisherman		lived on the island; information on trade and the population of Suakin.	November
4	Hussein Ibrahim Muhammad *aka* Hussein Baloum	Master boatbuilder	72	Originally from Port Sudan; 56 years experience.	29th November and 1st December
5	Hashim Mohammed Nour Manninay	Dhow builder	30	Learnt the trade from his father Mohammad Nour Manninay.	29th November
6	Mudassir Mousa Othman Mohammed *aka* Takrouni Fallati	Dhow builder	44	Assisted in the past Hussein Ibrahim Muhammad in building *sanbūqs*; of Nigerian origin.	2nd December

Dionisius A. Agius **Saudi fieldwork- list of informants- May 2007**					
No	**Name**	**Occupation**	**Age**	**Place**	**Interview date**
1	Ali Hamid al-Zimi	Dhow builder	48	Yanbu al-Bahr	12th May
2	Ibrahim Khalil al-Sharif	Guide		El Wejh	13th May
3	Rashid al-Balaw	Guide		El Wejh	13th May

Dionisius A. Agius **Yemen fieldwork- list of informants- 2009**						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Muhammed al-Ghaili	Dhow builder	65	Hadhramaut residing in Aden.	30 years as carpenter in Hadhramaut	7th February 9th

					and Dokka, Aden; building *zaʿīmas* and *sanbūq*.	February
2	Hafiz Umar Awad	Fisherman	35	From inland; resides in Seera, Aden.	Sailed mainly on *galabas* to Somalia and Hadhramaut.	9th February
3	Ahmad Qahtan	Fisherman	60s	From inland; resides in Seera, Aden.	His ancestors were fishermen; sailed on *galabas* and *sanbūqs*.	9th February
4	Ibrahim Muhammad Abduh al-Anbari	Dhow builder	60s	From Khokha; resides at Dokka, Aden.	40 years as carpenter in Khokha; built *sanbūqs*, *ʿobrīs*, and *galabas*.	10th February
5	Ali Ibn Ali Salim	Dhow builder	36	Khisa, Bureiqa (Aden).	Assisted his father since he was 17; built *galabas* and planked *hūrīs*; is building fibreglass *galabas*.	10th February
6	Mohammed Ali Abdallah al-Najjar	Dhow builder	90	Fuqum (Aden)	Ancestors dhow builders; built *zaʿīmas*, *sanbūqs*, and *galabas*.	10th February
7	Basim Ali Bin	Fisherman	19	Khor al-	Sailed on	12th

	Ali			Ghoreira.	*galabas*.	February
8	Abdo Umar Bilghaith	Dhow builder	46	Khor al-Ghoreira	Ancestors carpenters; built *sanbūqs*; today does maintenance.	13th February

John P. Cooper Yemen fieldwork- list of informants- February 2009						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Abduh Balgayth	Boatbuilder		Hudayda Yemen		22nd February
2	Hassan Muhammad Abd Allah Khuwayf	Boatbuilder		Hudayda Yemen		
3	Ibrahim Abduh Mahdi	Boatbuilder	70	Hudayda Yemen		
4	Salim Hadi Shangi		55	Fuqum Yemen		
5	Umar Said Bahajdar	Boatbuilder	60	Khokha		
6	Wehhab	Boatbuilder	30	Khokha		
7	Muhammad Qasim Duwaylah		60	Nakhodah Yemen		
8	Ali Muhammad Muhibb	Captain	60	Khokha		
9	Hussein Ahmad Fares	Trade (?)		Salif		
10	Muhammad Ali and	Boatbuilders		Salif		

	Hussein Ahmad					

Dionisius A. Agius Djibouti - October 2009						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Kamil Hassan	Director		Djibouti City; Ministry of Higher Education		10th October
2	Ziad Ahmed Khizari	Navigator	48	Djibouti City; Port de Pêche; also known as Tarzan.		12th October 13th October
3	Houmed Barkat Siradji	President	55	Tadjoura	Président du Majlis a Tadjoura; local historian.	15th October
4	Ahmed Muhammad	Master builder	59	Tadjoura and Rassali		
5	Gumaani				Yemenite origin.	19th October
6	Ibrahim Abu Bakar	Dhow owner.		Tadjoura	Owner of zārūq in Rassali.	19th October
7	Ahmad Jaber Ali	Boatbuilder; fisherman.	45	Obock	Learnt boatbuilding from Abd al-Ali Joumeeli.	21st October 22nd October 24th October

						26th
8	Sadek Yakoub Abdallah	Sea captain	55+	Obock	Trained under Ali Mohamed Abdallah.	22nd October
9	Youssef Omar Mohamed	Sea captain	77	Obock	From Khor Angar; long experience at sea.	22nd and 24thOctober
10	Ali Marani	Old fisherman.		Djibouti		28th October

Dionisius A. Agius Saudi Red Sea Coast- Jizan and Farasan Islands – January 2010 and May 2010						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Abdo Mohammed Isa Aqili	Pearl diver; also acted as a guide.	46	Muharraq village (Farasan Island)	SCTA employee for Farasan Islands; pearl diver since the age of 8.	10th January 11th May
2	Ibrahim Ahmed Bilghaith	Dhow builder	55	Jizan.	Builds shrimp trawlers and racing *hūrīs*.	10th January 11th May 12th May
3	Ibrahim Abdallah Muftah	Historian, folklorist and ethnographer	70	Farasan Island	Poet and author of books on Farasan.	11th January 25th May
4	Ahmed Mohammed Shahhar	Fisherman	56	Jizan	Knowledge in sailing.	12th January 11th May
5	Ala Allah	Boat model	45	Muharraq	Without a job;	15th May

	Abdo Hasan Mujawir	maker.		village (Farasan Island)	his father a dhow builder.	
6	Sheikh Muhammad Isa Muhammad Aqili	Pearl diver	76	Farasan Island	His father was a pearl diver.	18th May
7	Muhammad Uthman Mahmud Hanas	Pearl, kukyan and sea cucumber diver.	70	Sayer village (Segid Island)	Father was a diver.	24th May

Lucy Semaan Saudi Red Sea Coast- Jizan and Farasan Islands –May 2010						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Abdo Mohammad Issa Aqili	Pearl diver; also acted as guide.	46	Muharraq village (Farasan Island)		14th May
2	Ibrahim Bilgaith	Shipbuilder	55	Al-Hafa; Jizan		11th May
3	Ibrahim Muftah	Historian, folklorist and ethnographer. Poet and author of books on Farsan.	70	Farasan Island		25th May
4	Muhammad Othman Mahmoud	Pearl, Kukyan and sea cucumber	70	Sayer, Farasan Island.		24th May

	Hanas (Abu Suleiman)	diver.				
5	Shaikh Mohamad Issa Mohamad Aqili	Pearl diver	76	Farasan Island	His father was a pearl diver.	18th May

Dionisius A. Agius **Eritrea –Massawa and Adulis- February and March 2011**						
	Name	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Idris Daud Ali	Fisherman	50		Deputy to Hasan Madani, Head of Fisheries; muallad.	22nd February
2	Hamid Suleiman Hamid	Dhow builder	50	Tuwalet, Massawa		23rd February
3	Ali Suleiman Hamid	Dhow builder	48	Tuwalet Massawa		23rd February
4	Muhammad Nour	Employee and guide	40s	Department of Fisheries, Ministry of Mariner Resources, Massawa Branch		
5	Isa Muhammed	Fisherman	31	Sikalat Lamba, Massawa; from Dihil Island.		24th February

6	Siraj Muhammed Siraj.	Researcher	41	Bori, south-east Zula village.	Ecoculture and marine biology.	28th February
3	Bilal Muhammad Ge'der	Fisherman	45	Treter, north of Sikalat Lamba, Edaga behind the Salina.		1st March

Lucy Semaan **Egypt-January 2012**						
No	**Name**	**Occupation**	**Age**	**Place**	**Comments**	**Interview date**
1	Samer Khairi	Sales manager at Safwat Moawad company for wood import		Alexandria		17th January
2	Mark Safwat Moawad	General manager and owner of ""Mark wood international"		Alexandria	Egyptian company for import& trading wood. A sister company to his father's Safwat.	17th January
3	Sarwat Ramzi	Maritime Engineer for metallic boats	46	Anfushi (Alexandria)	Spent most of his childhood in the boatyard.	12th January
4	Yusif Ahmad Maaruf	Boatbuilder	57	Anfushi (Alexandria)	Learnt his art from his	12th January

					father.	
5	Hajj Ali Abd el Rahman el Qassas	Boatbuilder	66	Burullus Lake	Builds fishing boats and ships.	16th January
6	Mahmoud Abdel Maguid al-Qassas	Boatbuilder	49	Burullus Lake	He learnt his boat building from his father.	16th January
7	Khalil Mohammad Khalil	Boatbuilder	60	Hurghada	He learnt the trade from his father.	22nd January
8	Mohammad Metwalli	Boatbuilder and repairing work.	40	Hurghada	Interviewed in the Gam^ciyya boatyard.	22nd January
9	Ibrahim Ali Mousa al Najjar	Master boatbuilder	72	Quseir	Started working at the age of 20. From a family of boatbuilders.	24th January
10	Abdo Shata	Boatbuilder	58	Quseir	Mainly builds wooden fishing boats but also leisure boats. Hereditary craftsmanship.	24th January
11	Mohammad Hasan Farj al Karim	Fisherman	?	Quweih	From the Ababda tribe have a settlement in Quweih.	25th January
12	Abed al Hamid	Fisherman	47	Quweih	Brother of Mohammad .	25th January

	Hasan Farj al Karim					
13	Al Arabi Mohammad al Shuwwa	Boatbuilder	29	Quseir	He builds fishing and leisure boats.	24th February
14	Hamdi Hasan Lahma	Boatbuilder	48	Rasheed	Family of boatbuilders. Hereditary craftsmanship.	14th January
15	Ali Ahmad Shirdi	Boatbuilder	40	Safaga	He learnt the craftsmanship in Port Said from his maternal uncles.	21st January
16	Hasan Hussein Hammuda aka El-Amm Hassun	Boatbuilder	60	Safaga	All his family were boatbuilders. He is a master boatbuilder.	21st January
17	Ibrahim al Sayyid	Boatbuilder	30	Suez shipyard	Hereditary craftsmanship.	19th January
18	Mohammad Abu el Sayyid Shata	Boatbuilder	53	Suez	He started boatbuilding at a very young age.	19th January

12.2 Appendix 2: List of place names

English	**Arabic**
Aden	^{c}Adan
Ahwab	Ahwāb
Alexandria	Iskandariyyah
Ansina	Anṣinā
Arwa	Arwa
Aydhab	^{c}Aydhāb
Babylon	Bābil
Baghdad	Baghdād
al-Balid	al-Balīd
Basra	al-Baṣrah
Bulaq	Būlāq
Cairo	al-Qāhirah
Dahshur	Dahshūr
Damascus	Dimashq
Damietta	Dumyāt
Fustat	Fusṭāṭ
Alaya	al-^{c}Alāyā
Girga	Jirjā
Hajlij	Ḥajlīj
Hijaz	al-Ḥijāz
Hormuz	Hormoz
Qais	Qays
Jeddah	Jiddah or Jaddah
Kira	Kīra
Kufa	Kūfa
Massawa	Maṣṣawa^{c}
Medina	al-Madināh
Mecca	Makka
Minab	Mīnāb
Muscat	Masqaṭ
Najd or Nejd	Najd

Qalyubia	al-Qalyūbiyya
Qulzum	al-Qulzum
Quseir al-Qadim	Quṣayr al- Qadīm
Roda	al-Rawḍa
Rosetta	Rashīd
Sanaa	Sanᶜāᵓ
Siraf	Sīrāf
Sohar	Ṣohar
Sur	Ṣūr
Tihama	Tihāma
Tur	al-Ṭūr
Zafzaf	Zafzāf

12.3 Appendix 3: Tables

12.3.1 Table 1: Table of tree species used in boatbuilding in Egypt in the Pharaonic period

Scientific name	Hieroglyphic name	English name	Site/Boat	Use
Acacia nilotica (L.) Willd. ex Delile	*sndt*	Acacia	Khufu vessel (c. 2600 BC)	Tenons
			Ayn Sukhna (c.1700 BC)	Tenons and cylindrical batons
			Lisht timbers (c.1950 BC)	Tenons Planks
			Mersa Gawasis (1550 to 1400 BC)	Tenons, dowels and dovetails Planks Steering oar/rudder Blade 2

				Lower part steering Oar/rudder Blade 1
Acacia albida Del./ *Faidherbia albida* (Delile)A.Chev.	?	White Acacia	Mersa Gawasis (1550 to 1400 BC)	Upper part Steering oar/rudder Blade 1
Avicennia marina (Forssk.) Vierh.	?	Mangrove	Mersa Gawasis (1550 to 1400 BC)	Plank (hull?)
			Khufu I & II vessels (c. 2600 BC)	Hull planks
			Dahshur boats	

Cedrus libani A. Rich.	*‘š (?) Mrw (?)*	Cedar	(Carnegie c. 1830 ± 170 BC and Field museum c. 1949 ± 47 BC)	Hull planks
			Lisht timbers (c.1950 BC)	Timber Frame (?)
			Ayn Sukhna (c.1700 BC)	Hull planks 1 cylindrical baton
			Mersa Gawasis (1550 to 1400 BC)	Hull planks Deck beams
Ficus sycomorus L.	*nht*	Sycamore fig	Matariya boat (c. 2450 ± 50 BP)	Hull planks
			Khufu I (c. 2600 BC)	Tenons
			Mersa Gawasis (1550 to 1400 BC)	Upper structures (?) (Deck planks?)

Juniperus excelsa M.Bieb/ *J. communis* L.	*'š (?) Mrw (?)*	Juniper	Khufu I vessel (c. 2600 BC)	Hull plank
Quercus sp. L.	?	Oak	Ayn Sukhna (c.1700 BC)	Hull planks
Tamarix sp. L.	*isr*	Tamarisk	Lisht timbers (c.1950 BC)	Planks
			Abydos (?) (c. 3050 BC)	Planks
			Mersa Gawasis (1550 to 1400 BC)	Dowels
			Dahshur boats (Carnegie c. 1830 ± 170 BC)	Tenons
Ziziphus spina-christi (L.) Willd.	*nbs*	Sidder or Jujube	Khufu I hull (c. 2600 BC) Matariya boat (c. 2450 ± 50 BP)	Tenons

12.3.2 Table 2: Trees used in boatbuilding mentioned by classical authors

Greek/Latin name	English name	Scientific name	Use	Region	Reference
Abies	Silverfir	*Abies pectinata* Lmk.	Boatbuilding	?	Pliny (XVI.18.42)
άκάνθα άκάνθα μέλαινα	Acacia	*Acacia* spp. Mill. *Acacia nilotica* (L.) Willd. ex Delile	Short hull planks, Boatbuilding, Mast, Frames, Ribs in boat	Egypt	Herodotus (II.96) Pliny (XIII.19.63) (?) Theophrastus (IV.2.8)
Βάλανος Balanus	Balanos or Ben-nut or Behen-nut	*Moringa peregrina* Forssk.	Boatbuilding	Egypt	Theophrastus (IV.2.6) Pliny (XIII.17.61)
Δρῦς	Oak	*Quercus* spp.L.	River and lake vessels Keel of trireme False keel of cargo ships	? ?	Theophrastus (V.4.3) Theophrastus (V.7.1- 3)

			Boatbuilding	Zagros Mountains	
Έβενίνων	Ebony	*Diospyros* spp.L.	Boatbuilding (?)	India	*Periplus Maris Erythraei*, Chapter 36
Έλάτης	Fir silver-fir	*Abies* spp. Mill. *Abies alba.* Mill. *Abies pectinata* Lmk.	Yard-arms masts Oars Triremes Log boats Boatbuilding	? India	Theophrastus (V.1.5-12) Theophrastus (V.7.1- 3) Pliny (XVI.18.42, 76.201-203) Strabo (XI.7.4; XV.1.29)
Φίλυρα	Lime	*Tilia* spp. L.	Decks of long ships	?	Theophrastus (V.7.5)
Ίτέης	Willow	*Salix* spp.L.	Coracles Vessels	Mesopotamia	Herodotus (I.194)
Κέδρος Cedrus	Cedar	*Cedrus* spp. Trew. *Cedrus libani* A.Rich.	Boatbuilding Triremes	India	Theophrastus (V.7.1- 3) Strabo (XV.1.29)

				Syria and Phoenicia Cyprus	Pliny (XVI.76.203)
Κυπάρισσος	Cypress	*Cupressus* spp.L.	Boatbuilding	Mesopotamia	Arrian (VII.19.4)
Larix	Larch	*Larix* spp. Mill.	Sea-going ships	?	Pliny (XVI.79.219)
Μελία	Manna-ash	*Fraxinus ornus* L.	Frames Outrigger cheeks Vessels	?	Theophrastus (V.7.1- 3) Theophrastus (V.7.2- 3)
Μυρίκη	Tamarisk	*Tamarix* spp.L.	Rafts	Egypt	Herodotus (II.96)
Olea	Olive	*Olea spp*.L.	Sea-going ships	?	Pliny (XVI. 79.219)
Οξύα	Beech	*Fagus sylvatica* L.	Boatbuilding Keel and false	?	Theophrastus (III.10.1, V.7.1- 3)

Fagus			keel for small cargo vessels		Pliny (XVI.73.185)
Πτελέα	Elm	*Ulmus* spp.L.	Frames, Vessels, Outrigger cheeks	?	Theophrastus (V.7.1- 3)
Πίτυς	Aleppo pine	*Pinus brutia* Ten.	Triremes Frames of triremes	Cyprus ?	Theophrastus (V.7.1- 3) Theophrastus (V.7.2- 3)
Πεύκης	Pine Black pine	*Pinus* spp. L. *Pinus nigra* J.F.Arnold	Shipbuilding Cargo ships Keel of cargo ships	India ?	Theophrastus (V.1.5-12) Strabo (XV.1.29) Theophrastus (V.7.1- 3)
Πλάτανος		*Platanus orientalis* L.	Frames	?	

	Plane		Vessels		Theophrastus (V.7.1- 3)
Σασαμίνων	Sissoo	*Dalbergia sissoo* Roxb.	Boatbuilding	India	Periplus Maris Erythraei Chapter 36
Συκάμινος	Mulberry	*Morus nigra* L.	Frames Outrigger cheeks, Vessels	?	Theophrastus (V.7.1- 3) Theophrastus (V.7.2- 3)
Σαγαλίνων	Teak	*Tectona grandis* L.f.	Boatbuilding (?)	India	Periplus Maris Erythraei Chapter 36
Tibulus	Tibulus	*Pinus sylvestris* L.	Light galleys	Italy	Pliny (XVI.17.39)

12.3.3 Table 3: Trees used in shipbuilding mentioned by the medieval Islamic authors

Arabic name	English name	Scientific name	Use	Region	Reference
Athl	Tamarisk	*Tamarix aphylla* L. Karst.	Boatbuilding	Egypt	Al-Maqrīzī (2002: II. 130)
Buqs	?	?	(Boatbuilding ?)	Egypt	Al-Nuwayrī al-Iskandarānī ([fl.8th/14th century]; 1970: IV.7)
Ḥawr	Poplar	*Populus* L..	Warship (ghurāb)	Egypt	Al-Maqrīzī (1957: IV.2.688)
Jummayz	Egyptian Fig	*Ficus sycomorus* L.	Warships (ghurāb)	Egypt	Al-Maqrīzī (1957: IV.2.688)
Al-libakh	Lebbek	*Albizia lebbeck* L. Benth.	Hull planking	Egypt	al-Baghdādī (1998: 64) Yāqūt ([d. 626/1229], 1988: I.266) al-Qazwīnī (1960: 149) al-Maqrīzī (2002: I.555, 2004: IV.2.1039)

Narjīl	Coconut	*Cocos nucifera* L.	Boatbuilding	Maldives and Laccadives, Yemen, Oman	Al-Idrīsī ([fl. 548/1154]; 1989:75)
Qarū	?	?	Boatbuilding	Egypt	Al-Nuwayrī al-Iskandarānī ([fl.8th/14th century]; 1970: IV.7)
Sāj	Teak	*Tectona grandis* L.f.	Boatbuilding Cargo ship (Jalba) War galley and Cargo vessel (Qurqūr)	Red sea Arabian sea Malay Archipelago	Al-Masᶜūdī (1861: I.365) Ibn Jubayr (1907: 70; 2008:65) Al-Maqrīzī (2002: I. 551) Al-Bakrī (200: I.144) Ibn Sīdah (1965: X.26 XI.18)
Sanawbar *Snūbar*	Pine	*Pinus* L.	Warships	Egypt	Ibn Taghrībirdī (1963-1971: XI.29-30) Al-Nuwayrī al-Iskandarānī ([fl.8th/14th century]; 1970: IV.7)

Sanṭ	Acacia	*Acacia* spp. Mill.	Boatbuilding Galley (*shīnī*)	Egypt	Aphrodito papyri Ibn Mammātī ([d. 578/1182] 1988: 112, 289-290, 310 note 177) al-Maqrīzī ([d. 845/1442] 2002: I.298, 736)
Shūh	Cicilian fir	*Abies cilicica* Ant. & Kotschy Carriére	Boatbuilding	Egypt	Al-Nuwayrī Al-Iskandarānī ([fl.8th/14th century]; 1970: IV.7)
Sidr	Sidr	*Ziziphus spina-christi* L. Willd.	(Boatbuilding ?)	Egypt	Al Baghdādī (1789:33)

12.3.4 Table 4: Tree species used in archaeological timbers from classical antiquity and the medieval Islamic period

Note: The Belitung timbers present two sets of data, one has been analysed by CSIRO and the other by Nili Liphschitz (NL).

Uses / Timber	Planks	Stempost	Frames	Keelson	Beam	Anchor shank	Wood shavings	Structural elements	Rigging elements	Fastening elements	Unidentified Components (General use)
***Acacia* sp. Mill.**	Quseir al-Qadim						Myos Hormos Quseir al-Qadim Berenike	Heracleion-Thonis		Myos Hormos Berenike	
***Afzelia* sp. Sm.**	Quseir al-Qadim Belitung (NL)	Belitung (NL)	Belitung (NL)	Belitung (NL)		Belitung (NL)					

***Alnus* sp. Mill.**									Myos Hormos		
***Cedrus libani* A. Rich.**	Berenike										
***Dalbergia* sp. L.f.**									Myos Hormos	Myos Hormos	
***Ficus* sp. L.**	Quseir al-Qadim			Belitung (CSIRO)			Quseir al-Qadim			Heracleion -Thonis Matariya	Heracleion-Thonis Matariya
***Juniperus procera* Hochst. ex Endl.**	Belitung (NL)										
Luehea divaricata	Al-Balid										

***cf. Olea* L.**									Myos Hormos		
***Pinus* sp. L.**	Berenike						Myos Hormos Quseir al-Qadim Berenike				Heracleion-Thonis
***cf. Pomoideae* Juss.**									Myos Hormos		
***Quercus* sp. L.**	Heracleion -Thonis Berenike						Myos Hormos		Myos Hormos	Myos Hormos	
***Salix* L./ *Populus* L.**										Quseir al-Qadim	
***Salvadora persica* L.**										Quseir al-Qadim	

***Tamarix* sp. L.**							Myos Hormos Quseir al-Qadim Berenike		Myos Hormos	Myos Hormos	
***Tectona grandis* L.f.**	Myos Hormos (?) Berenike Al-Balid				Al-Balid Belitung (CSIRO, NL)		Berenike		Myos Hormos Berenike	Myos Hormos	
***Terminalia* sp. L.**	Al-Balid (CSIRO)										
***cf. Wrightia* R.Br.**									Myos Hormos		
***Ziziphus spina-christi* (L.) Willd.**										Matariya	

12.3.5 Table 5: Tree species used in boatbuilding from ethnographic data

Vernacular name according to informant	**Tree species**	**Use(s) according to informant**	**Informant**	**Country and location**	**Provenance of wood according to informant**	**Additional information from Informant as featuring in fieldwork notes of DAA, JPC, and LS**	**Remark**
Abyaḍ	*Pinus* sp. L.	Planks	Hafiz Umar Awad, 35 years old, fisherman from inland, resides in Seera, Aden, sailed mainly on *galabas* to Somalia and Hadhramaut	Yemen, Aden		The *hūrī* we are seeing is a dug out of *anba* and the planks added to it were *abyaḍ*. There was a piece of timber laid at the bottom of the flat-bottomed *hūrī* to protect it from begin ruined when pulling and pushing in the water. The ribs are called *gidaᶜ* made of *muraymirah*	Dionisius Albertus Agius (DAA) fieldwork, Yemen 2009, interviewed on 9th February 2009
Abyaḍ	*Pinus* sp. L.	Planks	Ibrahim Abduh Mahdi, Master boatbuilder (*Muᶜallim*), 70 years old, al-Hudaydah boatyard. He had worked as a boatbuilder all his life, around 50 years. He built large *sanbūqs*	Yemen, Hudayda	Imported		John P. Cooper (JPC) fieldwork, Yemen 2009, interviewed on 22nd February 2009
Abyaḍ	*Pinus* sp. L.	Planks	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Imported	The boards (*liḥān*) we bring from outside, whether from minayba (Malaysia?), Russia, Italy, Sweden, from any country of wood – the red, and the white [woods], *sweidi* .	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Abyaḍ	*Pinus* sp. L.	Planks for *hūrī*	Ziyad Ahmed Khizari (aka Tarz*an*), 48 years old, a navigator	Djibouti, Djibouti city	Imported from Yemen	He showed various species of timber *aḥmar*, *zangali* from Yemen and India. *Abyaḍ* from Yemen. You find *damas* in Djibouti. *Damas* is called Laurier du Yemen. *Barzaf* from Yemen. When the *Muraymira* grows, it strangles other roots. They make biscuits our of damas in Kenya.	DAA fieldwork, Djibouti 2009, interviewed on 12th October 2009
Abyaḍ	*Pinus* sp. L.	Stringers	Ziyad Ahmed Khizari (aka Tarz*an*), 48 years old, a navigator	Djibouti, Djibouti city		JPC said to discard this as the use is not correct.	DAA fieldwork, Djibouti 2009, interviewed on 13th October 2009
Abyaḍ (al-)	*Pinus* sp. L.	Planks	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Imported	Lighter but of poorer quality of course less expensive, the *muski* is better and can last one good year.	DAA fieldwork Sudan 2004, interviewed on 29th November 2004

Abyaḍ (al-)	*Pinus* sp. L.	Planks	Mudassir Mousa Othman Mohammed aka Takroumi Fallati, 44 years old, of Nigerian origin, boatbuilder, assisted in the past Hussein Ibrahim Muhammad in building *sanbūqs*	Sudan, Suakin			DAA fieldwork Sudan 2004, interviewed on 6th December 2004
Abyaḍ=Moski	*Pinus* sp. L.	Yards	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada		50 years ago with sailing boats.	Lucy Semaan (LS) fieldwork, Egypt 2012, interviewed on 22nd January 2012
Aḥmar	*Khaya* sp. A. Juss./*Shorea* sp.Roxb.ex Gaertn.	Planks	Ibrahim Abduh Mahdi, Master boatbuilder (*Muʿallim*), 70 years old, al-Hudaydah boatyard. He had worked as a boatbuilder all his life, around 50 years. He built large *sanbūqs*	Yemen, Hudayda	Imported		JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
Aḥmar	*Khaya* sp. A. Juss./*Shorea* sp.Roxb.ex Gaertn.	Planks (Upper planks for the *sanbūq*)	Salim Hadi Shangi, Bir Fuqum village, Little Aden, 55 years old. Never used a sail in his life	Yemen, Fuqum		About the *sanbūq* [code: XXX]: He said the lower planks were *sāg* because it lasted longer, and because corrosion of the iron nails did not cause the enlargement of the nail hole in the wood [it did not take rust from the nails]. The upper planks were *aḥmar* "Redwood", which were implicitly not as good.	JPC fieldwork, Yemen 2009, interviewed on 10th February 2009
Aḥmar (al)/Jāwī	*Khaya* sp. A. Juss./*Shorea* sp.Roxb.ex Gaertn.	Planks, keel	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Imported from Java	Very strong. The wood can last 2 years and nothing can happen to it, also *sūs* would not attack it. He used *muski* and *abyaḍ*.	DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Aḥmar (khashab)	*Khaya* sp. A. Juss./*Shorea* sp.Roxb.ex Gaertn.	Pseudo-keel	Hafiz Umar Awad, 35 years old, fisherman from inland, resides in Seera, Aden, sailed mainly on *galabas* to Somalia and Hadhramaut	Yemen, Aden		Piece of timber laid at the bottom of the flat-bottomed *hūrī* to protect it from begin ruined when pulling and pushing in the water	DAA fieldwork, Yemen 2009, interviewed on 9th-February-2009

Aḥmar (khashab)	*Khaya* sp. A. Juss./*Shorea* sp.Roxb.ex Gaertn.	Planks	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Imported	The boards (*liḥān*) we bring from outside, whether from minayba (Malaysia?), Russia, Italy, Sweden, from any country of wood – the red, and the white [woods], *sweidi* .	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
ʿAlāya		Planks hull and deck	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed		Durable, long-lasting, excellent wood. The other [good quality wood] is the *ʿalāya*. It was used in the past of less quality than the *bichpine*. And the third type is *duglas*, the least good quality.	LS fieldwork, Egypt 2012, interviewed on 14th January 2012
Alob		General	Muhammad Nour Saleh Othman, 42 years old, boatbuilder of Nigerian origin	Sudan, Suakin		In Rutana dialect, DAA has no more information about it	DAA fieldwork Sudan 2004, interviewed on 23rd November 2004
ʿAnba	*Mangifera indica* L.	Dug-out *hūrī*	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*			DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
ʿAnba	*Mangifera indica* L.	*Hūrī*	Ala Allah Abdo Hasan Mujāwīr, 45 years old, from Muharriq, his father was a carpenter. He built *hūrīs*. Now he has resigned	Saudi Arabia, Farasan	Imported from India	Abdo Hassan Mujāwīr, his father, was a carpenter (boatbuilder), died at the age of 80.	DAA fieldwork, Saudi Arabia 2010, observed on 15th May 2010
ʿAnba	*Mangifera indica* L.	Log *hūrī*	Hafiz Umar Awad, 35 years old, fisherman from inland, resides in Seera, Aden, sailed mainly on *galabas* to Somalia and Hadhramaut	Yemen, Aden			DAA fieldwork, Yemen 2009, interviewed on 9th February 2009
ʿAnba	*Mangifera indica* L.	Log *hūrī*	Ahmed Qahtan, in his 60s, fisherman, from inland resides in Seera Aden, his ancestors were fishermen, sailed on *galabas* and *sanbūqs*	Yemen, Aden	Imported from Malabar	DAA: he used *manḥūt* (*maḥfūr*) (Eng. Carved) dug-out from Malabar. The dug-out is from *ʿanba* or *kushi* from Malabar. Wooden boats are better, fibre gets hot and the wood can bear the sun. the wooden *hūrī* is more stable than the fibreglass.	DAA fieldwork, Yemen 2009, interviewed on 9th February 2009
ʿAnbar	*Mangifera indica* L.	*Hūrī*	Ahmed Muhammad Gumaani, 59 years old, master builder from Khokha, Yemen	Djibouti, Tadjoura		DAA: I took pictures of white timber (*ʿilb dhakar*), very red wood (*ʿilb untha*), less red type *meyti* from Somalia, the Djiboutians call it *nūr al Yaman*. The Afaris call it *ʿilb Kurra*. The white timber where the *meyti* was is called *marymara.*	DAA fieldwork, Djibouti 2009, interviewed on 20th October 2009

Anba	*Mangifera indica* L.	*Hūrī* logboat	Ziyad Ahmed Khizari (aka Tar*zan*), 48 years old, a navigator	Djibouti, Djibouti city		He showed various species of timber *aḥmar*, *zangali* from Yemen and India. a*byaḍ* from Yemen. You find *damas* in Djibouti. *Damas* is called Laurier du Yemen. *Barzaf* from Yemen. *Muraymira* when grows strangles other roots. They make biscuits our of *damas* in Kenya.	DAA and JPC fieldwork, Djibouti 2009, interviewed on 12th October 2009
ᶜArg	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Frames	Basim Ali Bin Ali, 19 years old, fisherman in Khor al-Ghoreira, sailed on *galabas*	Yemen, Khor al-Ghoreira			DAA fieldwork, Yemen 2009, interviewed on 12th February 2009
ᶜArj	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Frames	Ibrahim Abduh Mahdi, Master boatbuilder (*Mu ᶜallim*), 70 years old, al-Hudaydah boatyard. He had worked as a boatbuilder all his life, around 50 years. He built large *sanbūqs*	Yemen, Hudayda	Local		JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
ᶜArj	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Frames, Stempost (*hinnām*), Sternpost, lower sternpost (*samaka)*	Isa Muhammed, 31 years old, fisherman from Dihil Island, met at Sikalat Lamba, Massawa	Eritrea, Massawa	Local		DAA fieldwork, Eritrea 2011, interviewed on 24th February 2011
ᶜArj	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Frames	Bilal Muhammad Ge'der, fisherman, 45 years old, at Treter, north of Sikalat Lamba, Edaga behind the Salina	Eritrea, Treter	Local from the Wadis	Red wood	DAA fieldwork, Eritrea 2011, interviewed on 1st March 2011
ᶜArj	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Inner stempost (*Buṭān*), Frames	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Local from Sabiya	Used for *jafla* and *ᶜamud el jafla* (Cross beams and their supporting timbers) since it is very shock-resistant. It is a local wood found in Jiz*an*, harvested in plantation areas. Also present in Sabya in *Jizan*.	LS fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
ᶜArj	*Conocarpus lancifolius* L./*Ziziphus spina-christi* L. (Willd).	Mast	Ahmed Mohammed Shahhar, 56 years old, fisherman who knows a lot about sails	Saudi Arabia, *Jizan*		Preferred to the *sidra*	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th, 12th May 2010
Aru	*Quercus* sp., deciduous	Frames	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported from USA, Yugoslavia [sic]	*Aru* is more expensive than our local wood but the client wanted a better quality wood and was ready to pay, and we got these planks for a good deal. They came to the shipyard as logs.	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012

Aru	*Quercus* sp., deciduous	Keel, Bow (*Badan*), Divisions (*Tashtīb*)	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Imported	Used for leisure boats.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Aru	*Quercus* sp., deciduous	Cabin of leisure boats	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Lake Burullus	Imported		LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Aru	*Quercus* sp., deciduous	Frames straight	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported from Russia or France		LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Aru	*Quercus* sp., deciduous	Rudder (*Daffa*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from Turkey, Greece, Lebanon		LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Aru	*Quercus* sp., deciduous	For the stairs and round/curved forms (*dawaranāt*) in leisure boats	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daᵓahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Imported	Light brown colour.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Atal	*Tamarix aphylla* L.	Frames (*shilmān*)	Salah Baraka Muawwad, Fisherman, age not given, Mersa Alam	Egypt, Mersa Alam			DAA fieldwork Egypt Mersa Alam, interviewed on the 22nd February 2004,
Atal	*Tamarix aphylla* L.	Frames and Internal stempost support (*buṭāna*)	Atiya Saad Sikiyan Guta, 59 years old, from Quseir	Egypt, Quseir			DAA fieldwork Egypt, Quseir, interviewed on the 26th and 27th February 2004
Atel	*Tamarix aphylla* L.	Frames (*Dilaᶜ*), Stempost (*hinnām*) and Sternpost (*samaka*)	Ibrahim Ali Musa, boatbuilder, age 72, in Quseir, five generations of boatbuilders	Egypt, Quseir	Local from the Nile Valley		DAA fieldwork Egypt Quseir, interviewed on 31st March 2002
Athal	*Tamarix aphylla* L.	Frames, Stern, Prow	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu al-Bahr	Local		DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007

Athal	*Tamarix aphylla* L.	Frames	Abdo Mohammed Isa Aqili, 46 years old, pearl diver since the age of 8, also acted as a guide from Muharraq village (Farasan Islands). SCTA employee for Farasan Islands	Saudi Arabia, *Jizan*			DAA fieldwork, Saudi Arabia 2010, interviewed on 10th January 2010
Atl	*Tamarix aphylla* L.		Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daᵓahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Local	*Atl* is used but not so much because it is not as good as the rest of the local woods.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Atl	*Tamarix aphylla* L.		Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local	*Atl* is a good wood but we use it for other things such as small *falayik.* It should be used immediately after logging it because if it dries, it cannot be nailed.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Atl	*Tamarix aphylla* L.		Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada		Is not used in boatbuilding, maybe only for small freighters of 4 metres long, the ones that take us from the coast to the [anchored] boats; if the *atl* is covered, it melts because it absorbs water so it gets heavy and friable. Some people use it. But it is not allowed to use in big boats. It is very soft, more than the *Moski* and the *abyaḍ*, but when it is gets dry it becomes strong like the *sanṭ*, you cannot nail it. But when it is supple it feels like a watermelon.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Atl	*Tamarix aphylla* L.		Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada		Is present in Upper Egypt (Ar. Saᶜīd) from Qina and northward. We used to use it since 15 years. It is used in small boats and medium sized ones. It is not water resistant and with practice we stopped using it. We use it for frames.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Atl	*Tamarix aphylla* L.	Frames	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local from Upper Egypt	It is a weak wood. It is a light wood but not strong.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Atl	*Tamarix aphylla* L.	Frames (*Shalmān*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local	Third in strength after the *sanṭ* and the *tūt*. It is a bit supple easily to work with. It does not grow as much as the *sanṭ*. Whitish wood.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Atl	*Tamarix aphylla* L.	Frames, Inner stempost (*Biṭān*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local		LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Atl	*Tamarix aphylla* L.	Frames	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		Brown colour. It is a cheap wood. If it gets in contact with water it becomes like a sponge, whereas the *tūt* and *kafūr* are more resistant. It comes from Qina. A *ṭornata* of *atl* is sold for 300LE, so it is cheaper that the *tūt* which costs 700 LE for the *ṭornata*. It does not last long in water, after a year or so if you nail it you find it very soft.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Atl	*Tamarix aphylla* L.		Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al-Sabeh	Local	There is not much *atl* here but it is present more in the mountains of Tahrir, and al-Amriyya. It is not used for boatbuilding because it is a weak wood and might easily break and is not water resistant. It could be used for small objects like kitchen utensils: rolling pins and mortar and pestle, and for tables	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Atl	*Tamarix aphylla* L.	Frames (*Shilmān*)	Duwi Toufiq Mahmud, boatswain, 64 years old, from Quseir	Egypt, Quseir	Local from the Nile valley	The nail goes in ne*atly* with *atl* wood	DAA fieldwork Egypt Quseir interviewed on 21st February 2004
ʿAyn/ Zengili ʿAyn	*Artocarpus hirsutus* Lam. (S Ind)	Keel	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden	Imported from Malabar		DAA fieldwork, Yemen 2009, interviewed on 7th February 2009
Baharzāf	*Eucalyptus* sp. L'Herit.	Mast	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Imported from Ethiopia		DAA fieldwork, Djibouti 2009, interviewed on 22nd October 2009
Ballūt	*Quercus* sp. L.	Keel, Bow (*Badan*), Divisions (*Tashtīb*)	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Imported	Used for leisure boats.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012

Bamboo	*Bambusa* sp. Schreb.	Mast	N/A	Yemen, Mocha		DAA personal observation: bamboo used as a mast for a *hūrī*	DAA fieldwork, Yemen 2009, observed on 15th February 2010
Bamboo	*Bambusa* sp. Schreb.	Mast and Yard	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daᵓahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir			LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Bantek	*Lagerstroemia lanceolata*/ *L. microcarpa* Wight	Planks	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Imported from India		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Barzūma	*Conocarpus lancifolius* / *Melia* sp. L.	Frames	Abdo Mohammed Isa Aqili, 46 years old, pearl diver since the age of 8, also acted as a guide from Muharraq village (Farasan Islands). SCTA employee for Farasan Islands	Saudi Arabia, *Jizan*			DAA fieldwork, Eritrea 2011, observed on 10th January 2010
Bashkīl	Bambusa sp. Schreb.	Treenails	Ali Ibn Ali Salim, 36 years old, boatbuilder, from Khisa in Bureiqa (Aden), assisted his father since he was 17, built *galabas*, and planked *hūrīs*. He is now building fibreglass *galabas*	Yemen, Aden		DAA: The *firmāl* (yard) are held together by a treenail made of bamboo (*bashkīl*). It is strong and durable.	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Bashkīl	Bambusa sp. Schreb.	Yard	Ali Muhammad Muhibb. Captain, about 60 years old. With lots of input by a younger man called Wahib	Yemen, Khokha		The yard is called *tirmāl*.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Bashkīl	*Bambusa* sp. Schreb.	Yard (*Tirmān*)	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Imported from India	The *tirmān* c. 10m long is of *bashkīl* from India and the two pieces added on each end of the *tirmān* are made of *baharzāf* from Ethiopia.	DAA fieldwork, Djibouti 2009, interviewed on 22nd October 2009
Bashkīl	*Bambusa* sp. Schreb.	Mast	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Kenya or Egypt	Cheap	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Bashkīl	*Bambusa* sp. Schreb.	Yard	Ahmed Mohammed Shahhar, 56 years old, fisherman who knows a lot about sails	Saudi Arabia, *Jizan*	Imported from Egypt, Asia, Bangladesh	Sail for *hūrīs*	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th, 12th May 2010

Bachbay	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planking	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Lake Burullus	Imported	When a person has the financial means, he chooses not to use *suwweid* but uses *bachbay* for the planking. It is stronger and more durable than *suwweid*. So it is more expensive than the *suwweid*. Can be found in old buildings and palaces.	LS fieldwork, Egypt 2012, interviewed on 16th January 2011
Bachbayn	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planking	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported	It is a first degree wood. It is an expensive wood so no one gets it anymore. It is very resistant and is not attacked by shipworms (Ar. *ʿIrza*) and does not get darker with water. It contains oils, smells nice like incense (*bakhkhūr*). I used it for planking of leisure boats. It has not a lot of knots which is of better qualities. To bend it we use warm water to make it supple and make it curved following the sides of the hull. Once it is nailed it is very hard to take the nails out, because the wood is very strong and resistant. It can be used everywhere in the boat. 50 years ago the *bachbay* was used in the planking instead of the *suwweid*. It was used in the roofing of houses in the form of squared planks of 15cm side. Boatbuilders would get it and cut it into planks manually, so it was hard work.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Bachbayn	*Pinus rigida* Mill.	Chassis (A type of seat for the fixed motor), planking	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		It lasts long because it contains oil. Incense is made from the wood shavings. It is a rare nowadays because it is expensive. It is found in old houses. Although it is a strong wood it does not break when slightly curved for the hull planks. The planks are bent and fixed with a *zaragina* on each frame. It is not very tall, its maximum length is 6 metres. Therefore if used for a keel it is made like the *mogana* and *zen*, several pieces glued together. It is a straight wood which do not correspond to the shape of a stempost because it cannot be curved.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planks	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria		A beautiful wood in the sea [probably meaning suitable for nautical uses]. It is a wood *shiḥmah* as it is called in the popular slang (Ar. *baladī*) [meaning Greasy] and it holds oils and its smell is nice. The sawdust is used for incense.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planks hull and deck, mast, yard	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported	The bichpine used nowadays from the USA does not compete, quality wise, with the *bichpine* used in the past. The latter can last 200, 300, 400 years in good condition. It used in old buildings, a historical ancient *masjid*. Durable, long-lasting, excellent wood. The deck is planked with *suwweid* or it can be from the American *bichpine*, it will depend on the client. If he pays more it would be from	LS fieldwork, Egypt 2012, interviewed on 14th January 2012

						bichpine which is more expensive and with a quality slightly better than the *suwweid*. from the local woods, the mast (Ar. *ṣāri*) would be from *kafūr*. But if there is old *bichpine* [he means not from the States] it is better because it is lighter; and everything in the upper structure of the boat should be of light wood, its better, so it does not affect the balance of the boat. For the yard it's the same: *bichpine* or *kafūr*. If these two are not available *suwweid* might be used and the parts could be joined together with *Ghera baḥrī* (Eng. sea glue). It would be stronger than *kafūr* if done this way. Hamdi Lahma shows us a tall beam of *bichpine*. He also called the wood *ʿAzizi*. We took pictures of it. It was taken recently from a house perhaps 200 years old. It was not used yet in a boat yet. Excellent wood. This is the wood that was used at the times of his father for small boats propelled by *migdaf* or by sail or small motor. It was used for the planking (Ar. *qishra khārigiyya*). It is the wood that is nowadays switched with *suwweid* (*finlandi*, *rusi*, *sweidi*, the best of them being the *finlandi*). *Bichpine* is oily and this keeps it from absorbing sea-water, it doesn't get influence by the water therefore it lives for a long time. The scent is beautiful like incense and it is used as such. If a boat is made with it, it lasts for a long time (Ar. *muʿammira*) because it and its small parts is not influenced by water. LS: in the times of your father, when they used *bichpine*, was it preferable for sea-going ships or river boats? HL: It is best for both, it lasts a long time because it is protected by the fact that it doesn't absorb water. Since it contains oil matter, this doesn't allow water absorption in its tissues. LS: how long does a *bichpine* hull last for? HL: It lasts 20 years in Mediterranean Sea, and in the Nile River 10 years.	
Bichpine	*Pinus rigida* Mill.	Mast	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Imported		LS fieldwork, Egypt 2012, interviewed on 21st January 2012

Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planking	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada		It is expensive so no one uses it. For example it is 5000 LE/m3. It was used in the past for big boats such as *lanshat* and *balansat*. Used in the planking. It is resistant to the shipworm because it contains oil. It is imported from Sweden [doesn't know from where]. It is the highest quality of woods. It is used from before the times of my teacher. It was used 40 years ago.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)		Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada		I have not used it but no one now uses it. It used to in the past during my father's times for the planking. It can be bent with certain devices. In the past, people use to be patient, in these times no one is patient. It might be used for a keel because it is a straight wood which cannot be used in the skeleton since it has no curves. was used in the past for the planking in large fishing boats of 13-14 metres in length, 5 metres in width, and 3 metres high. These boats were called *Gatira*. It used to have a sail (Ar. *gili*)	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Mast	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus			LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Keel, Planking, Mast (*Ṣāri*), Yard (*Arya*), Deck	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from the USA	It is very expensive, we used to use it for the planks but the demand stopped so it is not present nowadays. It used to be imported as *kutal* (squared thick planks) and we would cut it following the dimensions and thickness we needed depending on the dimensions of the boat. It is better than the *kafūr* because it doesn't absorb water and its weight is heavy and strong. It is full of oil. To curve a wood such as the bichpine because it is very strong we use either hot water or steam, we immerse the plank in hot water or put it in a steam room for an hour, the wood comes out supple; because the oils it contains when it becomes hot it turns the wood supple. Since the bichpine has become rare, if there is an urgent need for it we search the wood merchants who go to the ancient big mansions and palaces and take the bichpine from the roofs.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)		Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir		[When asking him if he had heard of it he said it is the same as the *Moski*, he called it *khashab Moski bachabay*]	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Bichpine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)	Planking of big fishing boats	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir		It is found in old abandoned houses. It is imported from Sweden. No one uses it nowadays because it is rare. When you cut it you can see oil dripping from it. you can find a log of 8-10 metres long.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Bithchbine	*Pinus* sp. L./ *Pinus rigida* Mill.(?)		Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Imported	It is a good wood and is water resistant. If you used it in a boat, it lives as long as the boat	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Blāw (aṣfar)		Keel	Ibrahim Abu Bakar, owner of the Zaruk in Rassali which was built in Khokha in 2000	Djibouti, Tadjoura		The used *blaw* (*aṣfar*, Eng. yellow) for the keel of the *zaʿīma*. [DAA does not recall what is *blaw*, no recording]	DAA fieldwork, Djibouti 2009, interviewed on 19th October 2009
Bomba	*Bambusa* sp. Schreb.	Yards	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada			LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Damas	*Conocarpus lancifolius* L.	Frames, Knees	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden		Stronger than *muraymirah*	DAA fieldwork, Yemen 2009, interviewed on 7th and 9th February 2009
Damas	*Conocarpus lancifolius* L.	Frames, Keel	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden	Local	Strongest wood, also called *smūr* in Hodeida	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Damas	*Conocarpus lancifolius* L.		Wahhab, Man in 30s, from Khokha, Boat owner of a small plank *hūrī*	Yemen, Khokha		Says *damas* in Aden is the same as *ʿurj* in Tihamah.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009

Damas	*Conocarpus lancifolius* L.		Muhammad Ali (MA) and Hussein Ahmad Faris (HAF). Hussein is a boatbuilder, and the son of a *muʿallim*	Yemen, Salif		JPC: The conversation took place at al-Salif, at the location where there were three unfinished, abandoned vessels, one a large *sanbūq*, which constituted the old boatyard Ahmad Faris. JC: What is this? Is this *damas*, or *ʿurj*. In Aden they say *damas*. HA: There are people who say *damas*, there are people who say *ʿilb*. Every region gives it a name. MA: It is all one tree.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Dangala	*Avicennia rasofora* sp. L.	Frames	Siraj Muhammed Siraj, 41 years old, researcher in ecoculture and marine biology, originally from Bori south-east Zula village	Eritrea, Massawa		Siraj: *Avicennia rhizophor*. LS: Two types of mangrove: the *shūra*, small, called *Avicennia marina* and the *dangala*, big called *Avicennia rasofora*. The latter is red and used for *shalamīn* of the *sanbūq*. They believe the wood should not be cut in full moon because the wood gets powdery (*ifatfat*). The *samk* (sap) of the mangrove is good to cure teeth that are aching.	DAA fieldwork, Eritrea 2011, interviewed on 28th February 2011
Daymān			Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Imported from Yemen		DAA fieldwork, Djibouti 2009, interviewed on 22nd October 2009
Daymān		Frames (*shalamīn*)	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock			DAA fieldwork, Djibouti 2009, interviewed on 24th October 2009
Doblesfir (Douglas-fir?)	*Pseudotsuga taxifolia* P. menziessi (Mirb).	Masts, Planking	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from Russia	It resembles the *bichpine* but it does not contain oil. It was used 30 years ago in the 1980s but not anymore.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Duglas	*Pseudotsuga taxifolia* P. menziessi (Mirb).	Planks hull, Deck	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported	*Duglas* was not of good quality. If I had to choose between *duglas* and *suwweid* I would choose *suwweid*. Hatshepsut's ship was made with *duglas* imported from France, and I think it was the only bad thing in this boat. I would have preferred to use another type of wood. They chose it because they said that it is the closest type of wood available nowadays that has the same characteristics than the wood used in antiquity. If we chose the *bichpine amerkani* it would have been better.	LS fieldwork, Egypt 2012, interviewed on 14th January 2012
Dum	*Hyphaene thebaica* L.	Ropes	Muhammed Nour, 40s, employee and guide, department of fisheries, ministry of Mariner Resources, Massawa Branch	Eritrea, Massawa		He pointed to a tree type *karakan* for *damas* (the leaf is like a spear) no one mentioned using damas here for dhow timber. We took pictures of *doum* palm tree on the island from which rope and baskets and other things are made.	DAA fieldwork, Eritrea 2011, observed on 1st March 2011

Duyman		Frames	Ali Ibn Ali Salim, 36 years old, boatbuilder, from Khisa in Bureiqa (Aden), assisted his father since he was 17, built *galabas*, and planked *hūrīs*. He is now building fibreglass *galabas*	Yemen, Aden	Local	*Muraymara* as strong as d*uyman*	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
ʿElb		Frames, Samka, Hinnām, Keel	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden	Local	For the local woods, we use what is available [when asked about the keel he said *nafso* meaning same as *ʿelb* and *mraymra*, which is doubtful]	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
ʿElb		Frames	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Local	Strongest wood, from local farms, plantations, gardens.	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Ferrer		Paddles	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Imported	It comes in planks of 10x10, 10x12. It is imported. It could be replaced by *suwweid*. It should be from a light wood so it cannot be from *kafūr* or *tūt* because the person manning it will get tired.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Finnī		Mast (*ṣāri* (15 metres long/15 inches wide), Yard (*Farmal*, pl. *faramīl*) which is 25 metres long	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from Sudan		DAA fieldwork Egypt Quseir, interviewed on 31st March 2002
Funn	*Calophyllum inophyllum* L.	Mast	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden	Imported from Malabar	DAA: They imported teak from merchants	DAA fieldwork, Yemen 2009, interviewed on 7th February 2009
Galaqto			Youssef Omar Mohamed, sea captain, 77 years old, Obock, from Khor Angar, long experience at sea	Djibouti, Obock	Local	[Recording not clear]	DAA fieldwork, Djibouti 2009, interviewed on 22nd October 2009

Gandal		Frames	Muhammad Uthman Mahmud Hanas, in his 70s, from Sayer village on Segid Island, pearl, kukyan and sea cucumber diver. Father was a diver. His uncle used to make *hūrīs* close to the present house here were interviewing him (in the courtyard outside the house)	Saudi Arabia, Farasan	Local	They brought the wood for the ribs from the islands of Zafzaf and Kira.	LS interview and DAA fieldwork, Saudi Arabia 2010, observed on 24th May 2010
Gazwarīn	*Casuarina* sp. L.	Not used	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada		Is not used in boatbuilding because it cracks and [the tree] is very curved and small. It is used as umbrellas. It is not resistant to maritime conditions, the sun, and the wind	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Gazwarīn	*Casuarina* sp.L.		Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir		It is tall, and it is used as the *kafūr*. But we don't use it a lot because it splits under the sun. it is local from the Nile Valley.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Gazwarīn	*Casuarina* sp.L.	Frames	Abbas Muhammed Ali Daud, Sea Captain; Head of the Fisherman cooperation, 81 years old, Quseir, father and grandfather experienced at sea	Egypt, Quseir	Local from the Nile		DAA fieldwork Egypt Quseir, interviewed on 10th February 2004
Gazwarīn	*Casuarina* sp.L.	General	Hashim Mohammad Nour Manninay, 30 years old. boatbuilder. Learnt the art of boatbuilding from his father Mohammad Nour Manninay	Sudan, Suakin	Local	Found in Egypt. It's the Egyptian eucalyptus tree	DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Gazwārīn Sudāni	*Casuarina* sp.L.	Keel	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Local	It was used in the big cargo boats destined for the Lebanon that were built during the times of my father. It replaces the *kafūr* in the keel because it is very tall and sturdy. It can reach 20-25 metres. It used to grow in Egypt in al-Saᶜid. But his cultivation is modest, it is not much available. We built a ship with it of 35 metres in length, its height was 5 metres, and around 10 metres in width; it used to run Alexandria-Beirut and carried salt but it was sunk by Israel. We had built it in Alexandria on the Karmūz sea (?) near the harbour entrance. That was around 1965.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012

Gazwarina	*Casuarina* sp.L.	Keel (*Hirāb* or *Arina*), Mast (*Ṣāri*), Tiller	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	A bit rare to find. Very tall and straight wood.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Gazwarina	*Casuarina* sp.L.	Not used	Atef Matar, 50s, wood merchant, from Birket al sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	Not used for boatbuilding because the grain is weak and it does not live in water.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Gazwarina Sudani	*Casuarina* sp.L.	The keel or the lower part of the stern where the machine gets fixed	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It is present nowadays in *muntazahat* in Alexandria (large forest areas that existed in the past under the kings from the time of Faruq and they hold rare tree species that are not renewed).	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Ghāb	*Saccharum officinarum* L.	Oars or paddles (*Matraḥa* or *Ḥaddafa*)	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Local from the Nile		LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Gimmayz	*Ficus sycomorus* L.		Muhammad Mahmoud, captain of a transport ship at Quft, 50 years old	Egypt, Quft			DAA fieldwork Egypt Quseir, interviewed on 18th March 2003
Gimmez	*Ficus sycomorus* L.	Not used	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada		It is not used in boatbuilding as it is sponge-like. It can be used for sofas.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Gimmez	*Ficus sycomorus* L.	Not used	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada		It is not used in boatbuilding. It is very soft.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012

Gimmez	*Ficus sycomorus* L.	Not used	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	It is not used in boatbuilding because it has the consistency of a sponge. It absorbs water and sinks	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Gimmez	*Ficus sycomorus* L.	Structural parts	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local	It might be used in the skeleton like the *sanṭ*. Red colour. Strong wood, stronger than *atl*.[that is weird].	LS fieldwork, Egypt 2012, interviewed on 24 January 2012
Gimmez	*Ficus sycomorus* L.	Not used	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	Is not used in boatbuilding. It is a soft wood	LS fieldwork, Egypt 2012, interviewed on 24 January 2012
Gimmez	*Ficus sycomorus* L.	Not used	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	Used for *ᶜafsh el musallaʾ* and electricity boxes, poorly exploited.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Gimmēz	*Ficus sycomorus* L.	Not used	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Local	*Gimmēz* is a type of wood that was never used in shipbuilding. It is a wood that when it is cut, its weight is lessened, so we used just as a support (pl. *shayyalāt*, or sg. *sanda*) for the boats. It is a feeble wood; it is not water or friction resistant. It was used for electrical boxes.	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012
Gimmēz	*Ficus sycomorus* L.	Not used	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local	It can't be used in boatbuilding. It does not give enough width and is very heavy. It cannot serve in its shape as a tree. It drinks a lot of water and gets soft in sea water, it is not solid.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Ḥagrīt	*Balanites aegyptiaca*? L. (Del)	Frames	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Local		DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Ḥajlīj	*Balanites aegyptiaca*? L. (Del)	Frames	Mudassir Mousa Othman Mohammed aka Takroumi Fallati, 44 years old, of Nigerian origin, boatbuilder, assisted in the past Hussein Ibrahim Muhammad in building *sanbūqs*	Sudan, Suakin		Also *Ḥajlīt* or *sashuk* tree. The terms are in Rutana (Cushitic language of the Beja). DAA doesn't have an Arab equivalent	DAA fieldwork Sudan 2004, interviewed on 6th December 2004

Ḥajlīt	*Balanites aegyptiaca*? L. (Del)	Futtock (upper)	N/A	Sudan, Suakin	Local	DAA: I saw a man cutting, shaping a piece of wood from the *ḥajlīt* tree which was to serve as a *siyali* (opt parts of frame)of a *zarūq*. The wood is very strong and local	DAA fieldwork Sudan 2004, observed on 28th November 2005
Halīj	*Balanites aegyptiaca*? L. (Del)	Stempost (*Hinnām*), Frames	Idris Daud Ali, 50 years old, fisherman, deputy to Hasan Madani, Head of fisheries	Eritrea, Zula	Local	[Conversation bit confusing]	DAA and JPC fieldwork, Eritrea 2011, interviewed on 22nd February 2012
Hardī	*Ziziphus ziziphus* (L.) H. Karst./ *Z. jujube* Mill. (?)	Floor timbers (*Hadārī*)	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock		He said for the *hadaris* he used *hardo* (Afari Kusra) DAA: this information is slightly different from what he said in the first interview.	DAA fieldwork, Djibouti 2009, interviewed on 24th October 2009
Hātel/Hātil		Frames	Idris Daud Ali, 50 years old, fisherman, deputy to Hasan Madani, Head of fisheries	Eritrea, Zula	Local	[Conversation bit confusing]	DAA and JPC fieldwork, Eritrea 2011, interviewed on 22nd February 2013
ʿIlb	*Ziziphus spina-christi* L.	Stern, Stempost	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden	Local from Muhafazat Hodeida		DAA fieldwork, Yemen 2009, interviewed on 9th February 2009
ʿIlb	*Ziziphus spina-christi* L.	Frames (*khums*: one of the floor ribs)	Abdo Umar Bilghaith, 46 years old, boatbuilder, Ancestors carpenters, built *sanbūqs*, today does maintenance	Yemen, Khor al-Ghoreira	Local	[Recording too bad]	DAA fieldwork, Yemen 2009, interviewed on 13th February 2009
ʿIlb	*Ziziphus spina-christi* L.	Frames	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Local from the mountains	JPC: [man pipes in "or *ʿArj*" – interviewee says "I told him. *ʿilb*]. LS: might have suggested that *ʿArj* is the same as *ʿilb*.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
ʿIlb	*Ziziphus spina-christi* L.	Frames	Ahmed Muhammad Gumaani, 59 years old, master builder from Khokha, Yemen	Djibouti, Tadjoura		Afari name: *Kurra*	DAA fieldwork, Djibouti 2009, interviewed on 17th,18th October 2009

ʿIlb	*Ziziphus spina-christi* L.		Ahmed Muhammad Gumaani, 59 years old, master builder from Khokha, Yemen	Djibouti, Tadjoura		DAA: I took pictures of white timber (*ʿilb dhakar*), very red wood (*ʿilb untha*), less red type *meyti* from Somalia, the Djiboutians call it *nur al Yaman*. The Afaris call it *ʿilb Kurra*. The white timber where the *meyti* was is called *marymara*.	DAA fieldwork, Djibouti 2009, interviewed on 20th October 2009
Itil		Frames	Saad Ali Hasan, sea captain, 63 years old, Mersa Alam	Egypt, Mersa Alam			DAA fieldwork Egypt Mersa Alam, interviewed on 31st March 2003
Jangal		Planks	Isa Muhammed, 31 years old, fisherman from Dihil Island, met at Sikalat Lamba, Massawa	Eritrea, Massawa	Imported from Yemen		DAA fieldwork, Eritrea 2011, interviewed on 24th February 2011
Jāwa	*Shorea* sp. Roxb.	Not used	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from India	A type of wood that used to come from India. It was used to produce some nice smell products like the incense because it had a nice smell. It was not used for boatbuilding	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Jāwī	*Shorea* sp. Roxb.	Planks	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*		Red wood. *Jāwī* is the same as *zangali*/*jangali* in Yemen. They get *jāwī* because *sāj* is expensive (JPC)	DAA fieldwork, Saudi Arabia 2010, interviewed on 10th January 2010
Jāwī	*Shorea* sp. Roxb.	Planks (bottom planks)	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Java	Second best to teak, red wood. Same as *zangali* which is the Yemeni word. LS: called as such in Ji*zan*, corresponding to the Yemeni *zangali* [bit of confusion here]. The word *zangali* is originally from Oman. *Jāwī* is a local wood bought from the wood shops: in Jeddah there is a trader called Bashikh. Another trader is Fawz*an*. *Jāwī* is the same as *khashab al aḥmar*. *Khashab aḥmar* could mean other types of wood following the colour.	LS fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Jāwī	*Shorea* sp. Roxb.	*Sanbūq* planks	Muhammad Uthman Mahmud Hanas, in his 70s, from Sayer village on Segid Island, pearl, kukyan and sea cucumber diver. Father was a diver. His uncle used to make *hūrīs* close to the present house here were interviewing him (in the courtyard outside the house)	Saudi Arabia, Farasan	Imported from India via Aden	They used *jāwī* red wood	LS fieldwork, Saudi Arabia 2010, observed on 24th May 2010

Kafūr	*Eucalyptus* sp. L'Herit.	Keel	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Local	Some boatbuilders like it some others do not. They don't like it because it is heavy. If the owner wants a boat that is fast, the *kafūr* might slow it down because it is very dense, so what is needed is a wood that is light so it gives less weight to the boat. [The people who like *kafūr*] they want it because it is stronger than any other material in the fastening. Its porosity is strong [meaning doesn't absorb water easily] and it's a hard wood. From experience the boat that is built with *kafūr* lasts, durable (Ar. *muʿammer*).	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Local	The keel can be made of *kafūr* in small fishing boats [he earlier meant by small 20-25 meter] *kafūr* is resistant in water. *Kafūr ʿAla Lamun* is more resistant than plain *kafūr*. Because it drinks from the lemon tree planted next to the *kafūr* tree. *Kafūr* is better than *mogono*.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel, Keelson (*Mīda*), Hull planks, Stringers, Cross-beams, Deck beams, Paddle, Oar, Mast, Yard, Stern oar, Sheer plank, Wale (?) (*Zinnār*) and Caprail (*Ghaṭa* or *Baṭūs*)	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed		*Kafūr* is used for the keel because the local type can reach heights of 20m or more. Since the wood of the keel should be one piece so *kafūr* does the job. However, it is a wood that is neither extremely good nor bad. The tree should be planted in a dry place, without much water around, and it should be more than 50 years old. So when I cut it to make a keel of it, it doesn't warp or splits. So when it's mature it's better. When it grows fast, it might crumble fast as well, so it is better to have grown slowly. It is a reddish wood, when dried it becomes brown. Stringers (pl. *arbiṭa*) are made with *kafūr* because it provides lengths of 5metres to 8metres which would provide more strength to the hull than to use short span stringers. Using a lesser number of links between the frames and opting for a single long stringer would give me more strength [he means probably the unity (?) of the hull elements] . The Stern oar is made with *kafūr* in big Nile boats, because its size is big, it might reach 3-4 metres long so he [the skipper] would be able to turn the boat around fast and have a greater control over it. The sheer strake is made with *kafūr*, because if it was in *Suwweid*, it can be easily nailed. Its porosity is not very strong or thick. But the *kafūr* porosity is thick therefore it is nailed and the nails are pulled (?) with a bit of difficulty. The sheer is the end of a boat and I need it to be strong. It is covered by the *baṭūs* (cap rail), it is nailed to this sheer plank which is called	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012

						the *zinnār* (belt). Therefore the *baṭūs* needs to be nailed to a strong wood, it's best if both *baṭūs* and sheer plank are from *kafūr*, this way I would have rendered this place [ship part] strong and resistant since it is exposed to shakes, hits, friction and steps of people. This ship part should be made with *kafūr* wood that is well dried so it cannot be influenced by the weather conditions. If it has a humidity percentage of more 18 to 20% it will warp, then I would need to refurbish it, because it might create space with its adjacent planks and let water in and would need caulking. Therefore to avoid all this, the wood needs to be dried. The *mīda* (keelson) can be of *kafūr* because it needs to be long, and with a big dimensions. And since it is placed above the frames then it is not enclosed. It would be from a piece of timber that is dry, resistant, old, felled at the right time, therefore it would serve the purpose for a long time. *Arbiṭa* from *kafūr*. These are set by number of four in the bottom of the ship, four on the bilge, and 4 near the deck structure. *Dekke* under structure of deck i.e. transversal (pl. *ʿAwared*) and longitudinal (pl. *Arbita uwwaliyya*) deck beams made with *kafūr*. The boats called Lutsi, the 3 fishing Nile river boats made fully with *kafūr*, propelled with two paddle oars and a sail made with plastic which is not the main means of propulsion. The boats are around 7m from the top.	
Kafūr	*Eucalyptus* sp. L'Herit.	Keel and the Tirs (stern), stringers, caprail (ghata), cross beams (garya)	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga		Red wood, it is tall and straight with no curvatures. Handles the water, it lives in water for a long time; it can last for 15 years. We choose a 'clean' piece that does not have worms (*sūsa*). We get the timber piece depending on the demand for example width 7 cm or 10cm thickness 8cm. As for the lansh, we get planks that are thicket and wider. Stringers are better done with *kafūr*. The front 1/3 of the boat is called *el-tult el edmāni* and it is preferable that it's built with *kafūr* [the top planking of it].	LS fieldwork, Egypt 2012, interviewed on 21st January 2012

Kafūr	*Eucalyptus* sp. L'Herit.	Keel, Stringers, Caprail (*Baṭūs*), Rubbing strake (*Berwāz*), Stern oar (*Daffa*)	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local	One of the characteristics of the *kafūr* is its length. It is tall so I can manage its length as I wish. Red wood. Strong wood. It provides length and width because it is straight and is water resistant. We could use it as planks too instead of the *suwweid*. It is better than *bichpine* and *suwweid* but it takes time to make. If it stays for a long time in the sun, it gets very dry and cracks. The *daffa* is made from *kafūr* is it doesn't break for its solidity.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*)	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Local from Upper Egypt	It provides long beams. It is a reddish wood. It cannot serve in the frames. It is widespread in Upper Egypt.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb* or *Garīna*), Stem (*Muʾakhira*), Caprail (*Baṭūs*), Keelson (*Mīda*) and some elements of the upper structure [he doesn't say which]	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Local	Red wood. It is strong and resistant against shocks and in water. It is better than the *mogono* or *tek* because it is in one piece and not glued layers. It is straight so it's good for the keel. It comes from Misr [he means Cairo], and Kafr el sheikh. It can last up to ten years. It needs to be kept wept, otherwise it cracks. The caprail in large boats is preferably made with *kafūr* since it is more resistant than *Suwweid*.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Trabel* or *arīna*), Caprail (*Baṭūs*), Rubbing strakes (*Zennār* of three planks below the caprail), deck beams or cross beams, Cabin (*kabīna*), Mast (*Ṣāri*) and yard (*ʾerya*), Rudder (*Deffe/Daffa*)	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Local from Upper Egypt	The *kafūr* is tall and straight, strong and resistant in water no matter if it is salt or sweet. The tree could reach 30 metres, and it would be 25-30 years old, the tree grows slowly and it produces better wood. The older it is, the stronger and more solid the timber for boatbuilding is. It is brought from Upper Egypt. The *daffa* is made with small planks	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Trabel*), Rubbing strake (*Zinnār*), (*Baṭūs el kabs*) (at this level there is the deck inwards), Rubbing strake (*Zunnār el bordi*), Caprail (*Baṭūs*), Rubbing strake of the caprail (*Berwāz*), Stringers	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Local	These are used in the interior of a boat. The local woods are also called *khashab akhdar* because they are planted, they come from the earth in Egypt.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012

		(*Rubāt*), Mast.					
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*), Keelson (*Mīda*), Stringer (*Rubāt*), Rising wood (*Quntura*), A longitudinal piece of timber that is on top of the keel towards the end of the boat (Silaḥ), Crossbeams (*Dawaqīs*).	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Local	*Kafūr* is a red wood. God makes it [the tree] tall, high, straight and big so it suits the keel which is the spine of the boat. A keel made of *kafūr* will last much longer than the one made of *mogana* planks glued together with epoxy because the *kafūr* log is in one piece and therefore more resistant. The *quntura* is slightly wider than the keel it is put there to seal the inner sides of bottom planks. If the *kafūr* has 'drunk' a lot of water where it was planted, the wood fissures when used in boatbuilding. It cannot be made into a frame because it will break. The lower part of the trunk might reach a diameter of 1m20 to 1m50. It can lasts up to 35-40 years in a boat.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb* or *Arina*), Stringers (*Arbita*), Crossbeams (*Dawaqīs*), Keelson (*Mīda*), Mast (*Ṣāri*), yard (*Arya*), Rudder (*Daffa* or *Sukkān*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	Tall wood. It cannot be used for the frames because it is straight (Ar. *ʿidil*), therefore it will break if it shaped as a frame. It has a straight grain that is not suitable for curvy shapes. It is planted on the small canals or waterways since it holds the earth [with its roots] and it drinks a lot of water. Good quality *kafūr* is planted where there is water. When it dries it becomes harder to work with and it splits under the sun. As a keel it can last as long as the boat is functional if the boat does not hit anything.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel, Mast (*Dagal*), Rudder (*Daffa*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local	The tree grows very tall up to 12- 15 metres. It is water resistant and is not attacked by the shipworms (*burma*). If a carpenter needs a long keel, he can link several pieces of *kafūr* together. [tried to ask him if there are other types of *kafūr* hinting to *kafūr limūn* but he didn't say]. Red wood.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*), keelson (*Mīda*), Mast (*Ṣāri*, *dagal*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	It is used for the keel because it is water resistant and a strong wood, and because it is straight. Therefore it cannot be used in frames or boat parts there are curved because it will break. It has a straight grain if I try to make out a curved shape from it, it will break.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Kafūr	*Eucalyptus* sp. L'Herit.	Keel, Crossbeams (*Dawaqīs*), Keelson (*Mīda*).	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Local from Sharqiyyah	Red colour. It is the spine of the boat, like the one of the human being. It is the most resistant in water. It might last up to 20 years. It is better than *suwweid* because it is more resistant [to shock and weight]. It is a straight tall wood, from 13-20 metres, so it suits straight boat component.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*, *Trabel*, *Arina*), Planks (lower planking) and *marayin* (?)	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	Red wood. Dark red for old and light red for young wood. It is used for keel (Ar. *Hirāb*, *trabel*, *arina*), planks and 'marayin' in boatbuilding. It is water resistant; it can 'live' for 50 years in water. It is tall and straight, this is why it is good for the keel. For example we might need a keel that is 15 metres long, we cannot find this length in *tūt*, *sanṭ*, *labakh* or *sarsu ᶜ* trees. God in his wisdom made it such that the *kafūr* is the one that offers long timbers and is water-resistant. The lower planking in a boat is from *kafūr* to handle the shocks or hits and the rest is *suwweid* (54'40). The *kafūr* is stronger than the *suwweid*. But the planking cannot be made solely from *kafūr* because it weighs the boat down. *Kafūr* baladī: it comprises several types, but these types do not have names. They look alike but the trunks are slightly different in their grain, in the quality and the durability. The bad quality wood splits under the sun.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Kafūr	*Eucalyptus* sp. L'Herit.	Keel	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*			DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*), Bow (*Ṣadr*), Prow (*gadaḥ*)	Duwi Toufiq Mahmud, boatswain, 64 years old, from Quseir	Egypt, Quseir		Straight wood	DAA fieldwork Egypt Quseir interviewed on 21st February 2004
Kafūr	*Eucalyptus* sp. L'Herit.	*Hirāb*	Atiya Saad Sikiyan Guta, 59 years old, from Quseir	Egypt, Quseir			DAA fieldwork Egypt, Quseir, interviewed on the 26th and 27th February 2004
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*) and stern (*qadaḥ*) (See photo C 11-12)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local from the Nile Valley		DAA fieldwork Egypt Quseir, interviewed on 31st March 2002

Kafūr	*Eucalyptus* sp. L'Herit.	Keel, Hull	Muhammed Saeed al-Sabbagh, boatbuilder from Rashid, 30 years old, 15 years of experience in boatbuilding, learnt his trade from his uncle. He worked in Damietta, Hurghada, Sharm al-Sheikh, Luxor and Quseir. He worked also in Piraeus, Greece for a couple of years. He built boats for tourism and fishing	Egypt, Quseir	Local from Rashid, Qailubiyya and Upper Egypt		DAA fieldwork Egypt Quseir, interviewed on 7th March 2003
Kafūr	*Eucalyptus* sp. L'Herit.	Keel	Muhammad Mahmoud, captain of a transport ship at Quft, 50 years old	Egypt, Quft		Tall and strong wood, up to 14metres long	DAA fieldwork Egypt Quseir, interviewed on 18th March 2003
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*)	Saad Ali Hasan, sea captain, 63 years old, Mersa Alam	Egypt, Mersa Alam			DAA fieldwork Egypt Mersa Alam, interviewed on 31st March 2003
Kafūr	*Eucalyptus* sp. L'Herit.	Mast	Abbas Muhammed Ali Daud, Sea Captain; Head of the Fisherman cooperation, 81 years old, Quseir, father and grandfather experienced at sea	Egypt, Quseir	Local to the Nile		DAA fieldwork Egypt Quseir, interviewed on 10th February 2004
Kafūr	*Eucalyptus* sp. L'Herit.	Keel (*Hirāb*)	Ali Hussein Ahmed Ibrahim (Abu Hibaya). Sea captain, 53 age, Quseir of Abu Hibaya tribe, father and grandfather experienced at sea	Egypt, Quseir			DAA fieldwork Egypt Quseir interviewed on 12th February 2004
Kafūr	*Eucalyptus* sp. L'Herit.	Cross-beam	Ali Hamza, sea captain, 65 years old, worked for some 35 years	Egypt, Quseir		*Hirāb*= keel, *Shilmān*= frames, *Jisūr*= cross-beam	DAA fieldwork Egypt Quseir, interviewed on 8th March 2003
Kafūr Lamūnī	*Eucalyptus/Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson.		Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It is a tree scented with the smell of *lamūn* (Lemon), because it is impregnated with *lamūn*. It is more durable than metal. It has a special set of tools to fell it and cut it. It cannot be felled with any saw. If the chain of the saw is not of good quality such as from Germany or Sweden, it doesn't work with the *kafūr lamūni*; and the teeth of the saw must be sharpen well. The *kafūr lamūni* is originally *kafūr baladī* but when it is a small sapling, it gets impregnated with the *lamūni*	LS fieldwork, Egypt 2012, interviewed on 28th January 2012

Kafūr Lamūni	*Eucalyptus/Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson.	Masts	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Local	It is of better quality than the *kafūr* and whiter. It is resistant to the sun and doesn't crack. It is more expensive. It is from the wood types that are strong. It has no link with the type of wood, it's just a name	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Kafūr Rukhāmi or Kafūr Lamūni	*Eucalyptus/Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson.		Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed		Shows us a boat of which is the keel is made of *kafūr rukhāmi*, also called *kafūr lamūni* which is grafted (*matʿum*) with a Lime tree. It is also called *kafūr al-afranji*. It might be that the original tree is a *kafūr* and it is linked with a lime tree or vice versa. [He explains how but can't really understand]. On the seed of the tree you put a piece of the other tree and you bind them with a plaster and so it starts growing. Or on the trunk you make an incision and affix a piece of the other tree	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012
Kamar	*Eucalyptus deglupta* (?) Blume.	General	Hussein Abd al-Hamid Abd Allah, sea captain and fisherman, 120 years old, born in 1884, he lived on the island, had information on trade and the population of Suakin	Sudan, Suakin	Imported from Java		DAA fieldwork Sudan 2004, interviewed on 24th November 2004
Kandala		Frames (*Shalamīn*)	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Local	He used two *shalamīn* of *Kandala* from inland. This is red wood, the rest of the *shalamīn* is *dayman*	DAA fieldwork, Djibouti 2009, interviewed on 24th October 2009
Kandala			Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Godoria		Ahmed said that there are four types of *kandal*, one type is used for the frames of boats. *Kandal* is an afari word. From Sept Freres islands	DAA fieldwork, Djibouti 2009, observed on 26th October 2009
Khashab Abyaḍ		?	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported from the USA	Has a wide grain. It resembles the *bachbine*.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Khashab turki		Skeleton	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from Turkey	There was a wood type that was imported from Turkey. Yellow colour, it is called *khashab turki*. He would be used for the skeleton.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Khayzaran	Bamboo	Yard	Abdo Mohammed Isa Aqili, 46 years old, pearl diver since the age of 8, also acted as a guide from Muharraq village (Farasan Islands). SCTA employee for Farasan Islands	Saudi Arabia, *Jizan*	Imported from East Africa	At al-Hafa building site, the *tarman* (yard) is made of *khayzaran* bamboo from East Africa or Yemen(Tihama coast), some grow in the deep valley in J*izan*. The rope which is lashed around the bamboo is of Doum palm fibre. Yard for racing *hūrīs*	DAA fieldwork, Eritrea 2011, observed on 10th January 2010
Kūshī	*Bridelia restusa* Spreng (?)	Log *hūrī*	Ahmed Qahtan, in his 60s, fisherman, from inland resides in Seera Aden, his ancestors were fishermen, sailed on *galabas* and *sanbūqs*	Yemen, Aden	Imported from Malabar/India	[Not very clear because too many people talking at the same time. Someone says all timbers are brought from Indian]	DAA fieldwork, Yemen 2009, interviewed on 9th February 2009
Labakh	*Albizia lebbeck* L.	Stem, Frames	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Local	Durable in water, same colour as *ṣant*	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Labakh	*Albizia lebbeck* L.	Stem (*Badan*), Stern (*Qūs el khalfi*), Frames	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local from Sharqiya, Alexandria, Kafr el Sheikh, Damietta, Damanur, el Mahallah	Looks like *ṣant*. These three woods are robust, the front of the ship hits a lot of things such as water, quays. So they are resistant against shocks. They are durable in water. They are naturally curved and it forms the shape that we need for our boat. So we just draw a forma on it and cut it	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Labakh	*Albizia lebbeck* L.	Frames	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Local	These are used in the interior of a boat. The local woods are also called *khashab akhdar* because they are planted, they come from the earth in Egypt.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Labakh	*Albizia lebbeck* L.	ʿAfsha, all parts of a boat	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Local	It is a beautiful wood that does not gain in volume and does not narrow down. However, it is prone to worm attack. It is put in sensitive places [here I did not understand which piece he means, something that has to do with the motor fixation to the boat]. It can be used anywhere in the boat. [Explains again here the *ʿafsha* and where to use the *labakh* but can't understand where, still!]	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Labakh	*Albizia lebbeck* L.	Frames (*ʿIdān*), Stempost (*Badan*), Lower sternpost (*Samaka* or *Wistaniyya*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	Very rare. It got extinct. Beautiful wood, a mix of brown and yellow colours	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Labakh	*Albizia lebbeck* L.	Frames (*ʿIdan*), Stempost (*Badan*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	It is a white wood.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Labakh	*Albizia lebbeck* L.	Lower sternpost (*Wisṭaniyya*), Stempost (*Badan*), Frames	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		Brown and white colour.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Labakh	*Albizia lebbeck* L.	Stern (*Baṭṭikha* or *wisṭaniyya*)	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	Good quality and luxurious wood, it has become a bit extinct in Egypt because people did not pay attention to its cultivation. It is used for boatbuilding for the *baṭikha* or *wistaniyya* (stern) because it holds the propeller of the motor and can handle the strain from it; and other productions such as objects for spoons, trays and skewers. (45'19) it has three colours, from the inside out brown, then white and then yellow. The bark is *shitaf* (?). It is used for frames in boats. It does not break easily; it is a bit supple so it can absorb shocks without bending. Can reach a height of 7 metres.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Labakh (al-)	*Albizia lebbeck* L.	Skeleton (*ʿAdm*)	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada		It is expensive, not very used but if used it can be used in the skeleton (Ar. *ʿAdm*)	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Laurier and Jujube	*Ziziphus ziziphus* (L.) H. Karst./ *Z. jujube* Mill. (?)	Frames	Ali Mar'ani an old fisherman from Djibouti who owned a *hūrī* and sailed using paddle as a quarter rudder	Djibouti city	Imported from Yemen	They used laurier and jujube which comes from Zabid near Khokha and Hodeida	DAA fieldwork, Djibouti 2009, observed on 28th October 2009
Malabarī	?	Keel, Stempost (*Hinnām*)	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Imported from Malabar	For the planks they could be 6x6, 8x9, 6x9 [Thickness x width?]	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009

Mantīk	*Shorea* sp./ *Lagerstroemia lanceolata* L.	Mast, Keel	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from India via Dubai	Good quality wood. LS: It is like *kafūr* but stronger. It also used for the yard. *kafūr* wood comes from Egypt.	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Marantī	*Shorea* sp. Roxb.	Beams on the supports of the awning (top cabin)	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Kenya	LS: *Marantī* imported from Kenya is used on the top part of the cabin on the deck. It has the value of *sāj*. [here we wonder if it is as durable and resistant as *sāj* to the shipbuilders why use it in the top of the cabin and not for the keel where the greatest stress of weight and waves action is]	LS fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Maraymirah	*Melia azedarach* L.		Abduh Balgayth, age (?), boatbuilder, worked 8 years as a carpenter	Yemen, Hudayda	Local		JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
Matchubayn (Swedish)		Keel (*Hirāb*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir			DAA fieldwork Egypt Quseir, interviewed on 31st March 2002
Miraymirah	*Melia azedarach* L.	Frames	Ibrahim Abduh Mahdi, Master boatbuilder (*Muʿallim*), 70 years old, al-Hudaydah boatyard. He had worked as a boatbuilder all his life, around 50 years. He built large *sanbūqs*	Yemen, Hudayda	Local	What about boatbuilding? Can you tell me a little about the timbers? A: There is the *shilmana* … Q: Yes: what type of wood is used? A: Any. Either out of *ʿarj* or *miraymirah*. The planks are white (*abyaḍ*) or red (*aḥmar*). Q: And they are local or from overseas? A: No, it is from the locality (*balad*), though some is from outside, from timber merchants. Q: Do you use the *aḥmar* and *abyaḍ* [planks] in the same places on the vessel? [we are interrupted]	JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
Mītī		Mast	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden	Imported from Somalia	Ibrahim: looks like *muraymirah*. DAA: mast of small boats. No more info on miti. Tom Vosmer: "All I know is that miti is the Swahili word for tree. I've never heard it used as a type of wood"	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Mītī		Frames	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Imported from Somalia		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009

Mogana			Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported from France and Africa	It is imported from France, Africa because they are warm countries. planks of 25 cm thick are glued together with epoxy to make a keel. It can last less than 10 to 15 years but comes a time where the glue will fade away and the keel will be destroyed. This is why we prefer to do the keel with *kafūr* so we deal with 'the thing that God created'. is used for floor parquet (*ardiyyat*). Some people use if for frames but these would not be curved. They are straight [don't understand how] called Suka [?]. The trunk is not very wide therefore the frames cannot be curvy. But this is done in leisure boats not in fishing boats because it is expensive.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Mogana		Planks, Keel, Rudder (*Daffa*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from France, Indonesia from Java	Costs 7000LE/m3. It can be layered to provide long dimensions, however the *kafūr* can be naturally tall	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Mogana		Not used	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir		He did not use *mogana* because it is used in leisure boats for the decks (*kortat*)	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Mogana		Living rooms and decorations in leisure boats, Keel, Stempost	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	It is imported from Italy and France	Planks glued together with *ḥabu* (?) and oil.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Mogana and Zān		Decoration and cabins for the interior of the leisure boats	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir			LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Mogana Sāg		In the cargo ships for the floors	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez		There is a type of wood called *sāg*, *mogana Sāg*, which is used in the cargo ships for the floors because it is very strong and can resist heavy materials such as metal. It is imported from Africa. It is still used nowadays, even in metal cargo boats, kutal of *mogana*. *Sāg* would be placed under the cargo because it is very strong and does not break. These kutal would be placed on the deck, and *kortāt*. This type of wood cannot be used in boatbuilding because it is very hard to be worked or nails. It used to be fixed to the quays so if a boat would hit the quayside, it would hit the wood and not the quay. Now it is replaced with *caoutchouc* (natural rubber).	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Mogona, Zan and Tek			Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Imported	Imported woods that are used in leisure boats	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Mogono		Keel, Frames	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Imported	In most of the tourism boats the keel is made from layers of *mogono* planks of 5cm thick, joined by a strong 'marine' glue *aboxy* (Epoxy). can also be used for the framework of the tourism boats. The planks were joined with long nails.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Mogono Fransawi		Frames	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Imported	African but called *mogono* fransawi	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Mogono or Tek			Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Imported	Can be used in keels. Planks of these woods are glued together one on top of the other.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Mogono, Zan, Qontar, and aplacage		Leisure boats upper structures	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Imported	The woods used in leisure boats are expensive woods. For example a m3 of *zan* is 5000 LE and a m3 of *suwweid* is 2500LE.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Moski	*Pinus* sp. L	Planking	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Imported	I always have used *moski* since I started working. *Suweid* is the same as *moski*. And there is *bayāḍ*. They are different qualities of the same wood.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012

Moski	*Pinus* sp. L	Planking (*Qiswa*), Mast (*Dagal*), Yard (*Faramān*), Caprail (*Baṭūs*), Cross-beam (*Garya*), Rudder (*Daffa*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from Sweden, and Russia	The frames should be strong like the ribs of the human being and the *moski* is light and can break. The *moski* was used since the times of my grandfather. Nothing can replace the *moski* in planking because it is supple and easy to work with	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Mosku	*Pinus* sp. L	General	Hussein Abd al-Hamid Abd Allah, sea captain and fisherman, 120 years old, born in 1884, he lived on the island, had information on trade and the population of Suakin	Sudan, Suakin	Imported from India	Very long beams of 6 metres (12 *dhiraʿ*)	DAA fieldwork Sudan 2004, interviewed on 24th November 2004
Mraymara	*Melia azedarach* L.	Frames, Mast, Stempost (*Hinnām*), Sternpost (*Samka*), Pole of oar, Keel	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden	Local	For the local woods, we use what is available [when asked about the keel he said *nafso* meaning same as *ʿelb* and *mraymra*, which is doubtful]	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Muraymara	*Melia azedarach* L.	Frames	Ali Ibn Ali Salim, 36 years old, boatbuilder, from Khisa in Bureiqa (Aden), assisted his father since he was 17, built *galabas*, and planked *hūrīs*. He is now building fibreglass *galabas*	Yemen, Aden	Local	*Muraymara* as strong as *duyman*	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Muraymara	*Melia azedarach* L.	Kirda	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Local		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Muraymara	*Melia azedarach* L.	Stringers	Ziyad Ahmed Khizari (aka Tarz*an*), 48 years old, a navigator	Djibouti, Djibouti city		JPC said to discard this as the use is not correct.	DAA fieldwork, Djibouti 2009, interviewed on 13th October 2009
Muraymara	*Melia azedarach* L.	Frames	Ahmed Muhammad Gumaani, 59 years old, master builder from Khokha, Yemen	Djibouti, Tadjoura			DAA fieldwork, Djibouti 2009, interviewed on 17th,18th October 2009
Muraymara	*Melia azedarach* L.	Frames	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Local	For his *hūrī* he used *muraymara* for the frames (a generic term) but mostly *dayman*	DAA fieldwork, Djibouti 2009, interviewed on 24th October 2009

Muraymara	*Melia azedarach* L.	Frames	Abdo Mohammed Isa Aqili, 46 years old, pearl diver since the age of 8, also acted as a guide from Muharraq village (Farasan Islands). SCTA employee for Farasan Islands	Saudi Arabia, *Jizan*		DAA: John got the following information sidr and ardj are the same; *Muraymara* and *athal* are used for ribs. Planks are imported from Russia? Australia? And Java (teak). *Muraymira* is also medicinal for measles and small pox. Bilghaith said *muraymirah* could not be used in boatbuilding, not good. Although he said that *nīm* and *muraymirah* are the same and they use *nīm* for frames	DAA fieldwork, Eritrea 2011, observed on 10th January 2010
Muraymira	*Melia azedarach* L.	Frames	Hafiz Umar Awad, 35 years old, fisherman from inland, resides in Seera, Aden, sailed mainly on *galabas* to Somalia and Hadhramaut	Yemen, Aden		Strong wood	DAA fieldwork, Yemen 2009, interviewed on 9th February 2009
Muraymira/Muraymara	*Melia azedarach* L.	Frames	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden			DAA fieldwork, Yemen 2009, interviewed on 7th and 9th February 2009
Muraymirah	*Melia azedarach* L.	Frames	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Local from the mountains		JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Muskī	*Pinus* sp. L	Planks	Abbas Muhammed Ali Daud, Sea Captain; Head of the Fisherman cooperation, 81 years old, Quseir, father and grandfather experienced at sea	Egypt, Quseir	Local to the Nile		DAA fieldwork Egypt Quseir, interviewed on 10th February 2004
Muskī	*Pinus* sp. L	Planking	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Imported from Sweden, or Canada		DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Muskī	*Pinus* sp. L	Mast	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga		Mast, a bit thick so it doesn't break	LS fieldwork, Egypt 2012, interviewed on 21st January 2012

Nabag	*Ziziphus spina-christi* L.	Frames	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Local		DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Nabaq	*Ziziphus spina-christi* L.	General	Muhammad Nour Saleh Othman, 42 years old, boatbuilder of Nigerian origin	Sudan, Suakin			DAA fieldwork Sudan 2004, interviewed on 23rd November 2004
Nabg	*Ziziphus spina-christi* L.	Planks	Muhammad Mahmoud, captain of a transport ship at Quft, 50 years old	Egypt, Quft			DAA fieldwork Egypt Quseir, interviewed on 18th March 2003
Nabq	*Ziziphus spina-christi* L.	Frames	Atef Matar, 50s, wood merchant, from Birket al sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It grows in Egypt and it was used for frames of boats. But it was weak so it stopped being used.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Nīm	*Azadirachta indica* A.Juss.	General	Muhammad Nour Saleh Othman, 42 years old, boatbuilder of Nigerian origin	Sudan, Suakin			DAA fieldwork Sudan 2004, interviewed on 23rd November 2004
Nīm	*Azadirachta indica* A.Juss.	Frames	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin	Local		DAA fieldwork Sudan 2004, interviewed on 29th November 2004
Nīm	*Azadirachta indica* A.Juss.	General	Mudassir Mousa Othman Mohammed aka Takroumi Fallati, 44 years old, of Nigerian origin, boatbuilder, assisted in the past Hussein Ibrahim Muahmmad in building *sanbūqs*	Sudan, Suakin		*Nīm* is better than Nabag because it is lighter and resistant (*yastahmal*), easy to make holes and saw.	DAA fieldwork Sudan 2004, interviewed on 6th December 2004
Nīm	*Azadirachta indica* A.Juss.	Frames, Stern, Prow	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu al-Bahr	Local	Also called Ṭarafa	DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007
Nīm	*Azadirachta indica* A.Juss.	Dooni (cargo or fishing boat)	Kamil Hassan, Director, Djibouti city, Ministry of Higher Education	Djibouti, Djibouti city		Dooni: Afari name: Cushitic term of the Afari tribe. In the old days they built it of jujube. In Yemen it is called *damas* (John). There is laurier du Yemen (?). It is not the same tree as Nem. The great tree *nīm* comes from Asia. *Nīm* is for construction, medicinal, fruit, dental bush. Cultivated in many countries such as Burkina Faso	DAA fieldwork, Djibouti 2009, interviewed on 10th October 2009

Nīm	*Azadirachta indica* A.Juss.	Frames	Hamid Suleiman Hamid, 50 years old, and Ali Suleiman Hamid, 48 years old, boatbuilders, from Tuwalet, Massawa	Eritrea, Massawa	Local		DAA fieldwork and JPC, Eritrea 2011, interviewed on 23rd February 2011
Nīm	*Azadirachta indica* A.Juss.	Frames	Bilal Muhammad Ge'der, fisherman, 45 years old, at Treter, north of Sikalat Lamba, Edaga behind the Salina	Eritrea, Treter		We were told the big trunk (picture) is *lim* and another red is *ʿarj*. They come from the wadi, both good for *shalamīn*	DAA fieldwork, Eritrea 2011, interviewed on 1st March 2011
Nīm	*Azadirachta indica* A.Juss.	Stempost	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*			DAA fieldwork, Saudi Arabia 2010, interviewed on 10th January 2010
Nīm	*Azadirachta indica* A.Juss.	Frames, Stern, Prow	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Local from plantations	Stronger than *ʿarg*. LS: is used for the frames and/or for the outer stempost. It is a local wood.	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Nīm or ʿaraj	*Azadirachta indica* A.Juss.	Rudder (*Sukkān*) of the Sanbūk	Hamid Suleiman Hamid, 50 years old, and Ali Suleiman Hamid, 48 years old, boatbuilders, from Tuwalet, Massawa	Eritrea, Massawa	Local	The *sukkān* of the *sanbūq* which was lying aside is from *nīm* or *ʿaraj*.	DAA fieldwork and JPC, Eritrea 2011, interviewed on 23rd February 2011
Romāni	*Pinus* sp.L.	Planks	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported	*Romāni* is less quality than *suweid*. It is similar to a wood called *bayaḍ*. It is very light. [I think he meant the wood made with compressed wood shavings]. *Bayaḍ* absorbs water a lot therefore it is not good for using in boats but it is used in on-land constructions	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012
Rūmanī	*Pinus* sp.L.	Planks, Deck	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Romania	*Abyaḍ*. LS: imported from Romania as pre-cut planks. More expensive than Sweydi [so it is rare to find]. Used for planking for the deck	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Sāg	*Tectona grandis* L.F.	Whole vessel (*Jalba*), Lower planks (*Sanbūk*)	Salim Hadi Shangi, Bir Fuqum village, Little Aden, 55 years old. Never used a sail in his life	Yemen, Fuqum		He said the vessel was made entirely of *sāg*, and was "very good quality". He said the vessel had been abandoned six years earlier, and had belonged originally to his grandfather. About the *sanbūq* [code: XXX] He said the lower planks were *sāg* because it lasted longer, and because corrosion of the iron nails did not cause the enlargement of the nail hole in the wood [it did not take rust from the nails]. The upper planks were *aḥmar* "Redwood", which were implicitly not as good.	JPC fieldwork, Yemen 2009, interviewed on 10th February 2009

Sāg	*Tectona grandis* L.F.	Keel, Stempost	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Bought from wood providers in Jeddah	DAA: He called *Sāj: dahab* (gold). they prefer teak it's the best. Can be recycled many times in different boats. LS: The *saj*/*sāg* is imported to the shipyard from India via Jeddah. It is worth gold. It is very expensive 12.000 or 14.000 SAR/m3. The *sāj* wood at the shipbuilding site is from recycled timbers since they do not imported anymore. They stopped the import around 25-30 years ago. It is very resistant and is suitable for building 'big' ships since 12m/14m planks of teak can be obtained. This increases its importance. It is used for the keel and/or the stempost. [The *sāj* keel found on site] was dismantled from a ship and was reused many times from ship to ship. [It is made from a single log measuring 13m70 x 0.28 x 0.22; it is rabbeted from both sides, took a very small sample of it].	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Sāg	*Tectona grandis* L.F.	General	Muhammad Isa Muhammad Aqili, 76 years old, pearl diver, his father was a pearl diver from Farasan Island	Saudi Arabia, Farasan			DAA fieldwork, Saudi Arabia 2010, observed on 18th May 2010
Sāg	*Tectona grandis* L.F.		Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Imported from Sudan	It is very tall so it serves as mast (*Ṣāri*) in sailing boats only. The saw cannot cut it because it is so strong. Reddish dark wood. No one uses it because no one can cut it. It naturally comes rounded. It was used in boats 30 to100 years ago.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Sāg	*Tectona grandis* L.F.		Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Imported	It is a very strong woods. It is not used in the small boats but in larger ones. It was used during my father's times perhaps. I have never used it. It was used for planking for large ships of about 13-14 metres. It resembles the *kafūr*, of red colour. It was imported.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012

Sāg	*Tectona grandis* L.F.		Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		We do not use it in boatbuilding. It is a very strong wood so it cannot be worked. It is very problematic to nail and cut. We used it in Libya for the infrastructure of a playground. It might be imported from Sweden.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Sāg	*Tectona grandis* L.F.	Planks	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden	Imported from India		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Sāg	*Tectona grandis* L.F.	Planks, Keel, Stempost (*Hinnām*), Sternpost (*Samaka*)	Ali Ibn Ali Salim, 36 years old, boatbuilder, from Khisa in Bureiqa (Aden), assisted his father since he was 17, built *galabas*, and planked *hūrīs*. He is now building fibreglass *galabas*	Yemen, Aden	Imported from India	Comes in 4 to 6 inches in thickness	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Sāg	*Tectona grandis* L.F.	Planks	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Imported from India		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Saj	*Tectona grandis* L.F.	Deck planks (*Kortāt*) and decoration in leisure boats	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir		But no one uses it nowadays.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Sāj	*Tectona grandis* L.F.	General	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu< al-Bahr	Imported from Malabar		DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007
Sāj	*Tectona grandis* L.F.	Caprail	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from India	This is a type of wood that used to come from India 30 to 40 years ago. It is a black (*aswad*) [dark] wood. It is very tall (5 to 6metres [this is not tall, I think he means width of the kutal]). It was used for the cap rails (*bawātīs*). Cannot be used for the keel because it is very heavy. It was not very used because it is very dry so it is difficult to work with. It used to be imported in sawn planks (*kutal*). It used to be imported by metal trading ships and they would unload it with pulleys and ropes on the old harbour in Quseir. These ships would take the phosphate from Quseir	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Samur	*Acacia tortilis* Forssk. (Hayne)	Frames, Stern, Prow	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu al-Bahr	Local	Was also used for charcoal, DAA: they brought it from the valleys. The charcoal is exported to Egypt and Suez	DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007
Sanabar	*Pine* sp. L	Stempost (*Hinnām*) and Sternpost, lower sternpost (*Samaka*)	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Imported from Yemen		DAA fieldwork, Djibouti 2009, interviewed on 22nd October 2009
Sanebār	*Pine* sp. L	Planks	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock	Imported from Sweden through Khokha	The 3 *mawalik* (garboard strakes) are *zangali* (bois rouge) and the one plank on top of these is *zangali*, the rest of the planks are of sanobar brought from Khokha. The planks that touch the sea are *zangali* (very strong)	DAA fieldwork, Djibouti 2009, interviewed on 21st October 2009
Sanṭ	*Acacia nilotica* L. Ex Delile.	Frames (*ʿAdem*), Stempost (*Muqaddima*, *bouz or badan*), Sternpost (*Muʾakhira*), lower part of sternpost (*Wesṭaniyya*, *baṭṭīkha*)	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Local	It is a solid wood. It can be cut as we please.	LS fieldwork, Egypt 2012, interviewed on 16th January 2011
Sanṭ	*Acacia nilotica* L. Ex Delile.	Frames (*ʿAdm*), Stempost (*Badan*), Lower stempost (*Ḥigra*), Lower sternpost (*Wesṭaniyya*), round stern (*Bibbeh*)	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Local from Upper Egypt	These are used in the interior of a boat. The local woods are also called *khashab akhdar* because they are planted, they come from the earth in Egypt. medicinal uses for gums of the bark of the *sanṭ*. It is a dry wood and is very solid. Stronger than *tūt*.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Sanṭ	*Acacia nilotica* L. Ex Delile.	Lower sternpost (*Wisṭaniyya*), stempost (*Badan*), frames	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		Brown wood. It is the strongest wood. But it is hard to work with this is why it is very not common. If you need to nail it again after 6 months, it would be impossible. It is like metal. for the *wistaniyya* to handle the pressure of the motor. It is not very tall so you cannot use it in the keel. The tree is rare so we cannot find it a lot	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Sanṭ	*Acacia nilotica* L. Ex Delile.	Stempost (*Badan*), Frames (*Duluʿ*, *ʿidān*), lower stempost (*ʾIgr*), Inner stempost (*Biṭān*), Sternpost (*Tirs*), lower sternpost (*Wisṭaniyyah*), planking of transom stern not a right angle (*Naqrafūs*)	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Local	It is hard to nail especially when it dries. If it is dry, you need to drill it before nailing it. It needs constant care with paint and varnish because it is prone to worms (*sūsa*) that attack it. It is difficult to use *sanṭ* for the stern (*Wisṭaniyyah*) because it is rare, but if you do use it, it never gets old. The boat might get old but not the *sanṭ* timber. It is also rare to find a *sanṭ* that fits the angle required	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Sanṭ	*Acacia nilotica* L. Ex Delile.	Frames (*ʿIdān*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	It is used for big boats of 20-25 metres long. It does not suit small boats such as these, 11 metres long 3 metres wide, because it might break since it is big and strong so it doesn't suit narrow curves. [the *falūkas* he was building].	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Sanṭ	*Acacia nilotica* L. Ex Delile.	Frames, Stempost	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It can be dark brown for old trees and light brown for young ones. It is used for frames and stempost in boats. It is strongest and more durable than the *tūt*. God created it this way. It is in demand. It is most in demand from other trees because of its availability. Can reach a height of 7 metres.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Ṣanṭ	*Acacia nilotica* L. Ex Delile.	Frames, Skeleton	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Local from Upper Egypt	It is rarer than the *tūt*. When it dries it becomes difficult to work with so it is better to work it when it is freshly cut. It takes double time of the *tūt* that it grows. It has the same use as the *tūt*. It is light brown. It is widespread in Upper Egypt.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Ṣant	*Acacia nilotica* L. Ex Delile.	Frames	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Local	Was used but it became rare because it became extinct. *Ṣant* is a strong wood, durable in the sea, more durable than *tūt* and *kafūr*. *Ṣant* was widespread, it was used more than 20 years ago for frames and some of the planking. It is local.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Ṣant	*Acacia nilotica* L. Ex Delile.	Frames	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Local		LS fieldwork, Egypt 2012, interviewed on 12th January 2012

Ṣant	*Acacia nilotica* L. Ex Delile.	Frames, Bow, Stern, Inner stempost (*Biṭāna*), Outer stempost	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Local	One of the woods that are the best types of local woods, are very efficient, long-lasting, is equally or more durable than the *aru*. The dusur of the Hatshepsut replica ship were made with *ṣant*, because it was the wood that we could most trust its durability and strength among the local woods. It is the strongest local wood (*baladī*). Outer stempost made of two pieces: *Muqaddima* or *badan* (the upper piece of the outer stempost) and *ḥigri* al-*badan* (the element between the *muqaddima* and the keel, joined to them on each side by a hook and butt planking). Frames called *ʿūd* (pl. *fremāt*). *Ṣant* is the strongest of woods. [Pointing to a semi-converted log]. It is destined to be a *muʾakhira* (sternpost) because it has a 'big' angle. God created it with that angle so it fits the purpose. When we see a piece curved/angled naturally this way we choose it for the stern.	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012
Ṣant	*Acacia nilotica* L. Ex Delile.	Stem, Frames	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Local	Frames, Stem (*badan*), durable in water. Light grey, not red and not yellow	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Ṣant	*Acacia nilotica* L. Ex Delile.	Stem (Badan), stern (Qūs el khalfi), frames	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local from Sharqiya, Alexandria, Kafr el Sheikh, Damietta, Damanur, el Mahallah	Reddish brown wood. It has knots and its tiring during work. If it dries, it can't be nailed anymore. It is not easily worked. These three woods are robust, the front of the ship hits a lot of things such as water, quays. So they are resistant against shocks. They are durable in water. They are naturally curved and it forms the shape that we need for our boat. So we just draw a forma on it and cut it.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Sant	*Acacia nilotica* L. Ex Delile.	Keel, Frames	Ali Hamza, sea captain, 65 years old, worked for some 35 years	Egypt, Quseir	Local to the Nile	*Hirāb*= keel, *Shilmān*= frames, *Jisūr*= cross-beam	DAA fieldwork Egypt Quseir, interviewed on 8th March 2003
Sant	*Acacia nilotica* L. Ex Delile.	frames (*Shalmān* or *Dalaᶜ pl. duluᶜ*), Stempost, (*Hinnām or Muqaddima*), Sternpost (*Samaka or Muʾakhkhira*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir			DAA fieldwork Egypt Quseir, interviewed on 31st March 2002
Sant	*Acacia nilotica* L. Ex Delile.	Frames (*ʿIdān*), Stempost (*Badan*), Lower sternpost (*Samaka* or *Wistaniyya*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	The trees of local woods are not very tall but they are curved therefore suitable for the shape of the frames.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Sarsu ᶜ	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.		Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It has three colours, from the inside out brown, then white and then yellow. The bark is smooth. Can reach a height of 7 metres	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Sarsū ᶜ	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Bow	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed		I don't know the scientific name of it but it has a strength that lies between the *tūt* and the *ṣant*: stronger than *tūt*, weaker than the *ṣant*.	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012
Sarsū ᶜ	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Frames and keel	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria			LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Say	*Tectona grandis* L.f.	Frames	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *zaʿīmas* and *sanbūqs*	Yemen, Aden		DAA: they used teak for the *shalmanāt*. Muhammed: *el khashab afkhar w aḥsan no* ᶜ *el say w baʿdein el bentek*. Teak imported as planks. Brought the wood from the traders.	DAA fieldwork, Yemen 2009, interviewed on 7th February 2009
Shām	*Pinus* sp. L	Planks	Muhammad Uthman Mahmud Hanas, in his 70s, from Sayer village on Segid Island, pearl, kukyan and sea cucumber diver. Father was a diver. His uncle used to make *hūrīs* close to the present house here were interviewing him (in the courtyard outside the house)	Saudi Arabia, Farasan		For the *hūrī* planks they used planks hanch (1 inch) which is called *shām*. LS: [Gave me a piece of *shām* wood plank, his late uncle used to build *hūrīs* for pearling in front of his house, nothing remains now. 6 people would carry the *hūrī* from the village to the coast].	LS fieldwork, Saudi Arabia 2010, observed on 24th May 2010
Shūm	*Pinus* sp. L	Not used	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeᶜ	Local	This type of wood is used in the handles of tools such as hammers. It is expensive but durable and of good quality	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Shūra	*Avicennia marina* Forssk.	Frames	Muhammad Uthman Mahmud Hanas, in his 70s, from Sayer village on Segid Island, pearl, kukyan and sea cucumber diver. Father was a diver. His uncle used to make *hūrīs* close to the present house here were interviewing him (in the courtyard outside the house)	Saudi Arabia, Farasan	Local	They brought the wood for the ribs from the islands of Zafzaf and Kira.	DAA fieldwork, Saudi Arabia 2010, observed on 24th May 2010

Sidir	*Ziziphus spina - christi* L.	Frames	Abbas Muhammed Ali Daud, Sea Captain; Head of the Fisherman cooperation, 81 years old, Quseir, father and grandfather experienced at sea	Egypt, Quseir	Local to the Nile		DAA fieldwork Egypt Quseir, interviewed on 10th February 2004
Sidir	*Ziziphus spina - christi* L.	Frames, Stern, Prow	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu al-Bahr	Local		DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007
Sidra	*Ziziphus spina - christi* L.	Mast	Ahmed Mohammed Shahhar, 56 years old, fisherman who knows a lot about sails	Saudi Arabia, *Jizan*		Mast sample at Khabs-Khotob (Farasan Islands)	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th,12th May 2010
Singafura aḥmar		Keel, Stempost (*Hinnām*)	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Imported from Singapore	Planks can be 2 inches thick, 1.5 foot, 20, 60, 80 feet long.	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Sinibar	*Pinus* sp. L.	Planks	Hussein Ahmad Faris (HAF)	Yemen, Salif		JC: I have heard that people use a specific wood, like *zengali*, for the planks that are low down, and when you come up here, they use another timber, like *snober*. HA: Ah, *Sinibaar* JC: Do you do the same thing? HA: No, *Sinibar* is that white one. [crowd talking, someone says "this is strong"] JC: When you are building a boat, do use the same wood [for planks] below as above. HA: You put this one above because it goes [rots] quickly under the sea. JC: So you mean you use two woods. HA: Yes, two woods.	
Sinibar/snobar	*Pinus* sp. L.	?	Abduh Balgayth, age (?), boatbuilder, worked 8 years as a carpenter	Yemen, Hudayda	Imported from Austria, Sweden and Malaysia		JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009

Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.		Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada		Is not used in boatbuilding but in the parquet of houses, it is very expensive. No one uses it.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Frames (<Idān), Stempost (Badan), Lower sternpost (Samaka or *Wistaniyya*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	Very rare. It got extinct. Beautiful wood, a mix of brown and yellow colours	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Skeleton	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Local	It is rarer than the two latter. It is available in 10%. It is a tall tree and has flowers. It grows in front of churches. Light brown in colour. It provides curves and is strong. It is used in the skeleton	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Stempost (*badan*), Frames (*Dulu* ^{c}, *ʿidān*), Lower stempost (*Ḥigr*), Inner stempost (*Biṭān*), Sternpost (*Tirs*), Lower sternpost (*Wistaniyyah*), Planking of transom stern not a right angle (*Naqrafūs*)	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Local	It resembles the *mogana* (*mogono*) but it is an 'arab'wood [he means local]. It is a beautiful wood, if you cut it from the inside you can see a mixture of colours, brown integrated with the white. It grows in Upper Egypt. It is used in the lower stern of a single motor lansh called *wistaniyya*. The tree that we used here was created bent by God so it is put to good use of the people to build this part of the boat	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Frames (*ʿIdan*), Stempost (*Badan*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	It is a white wood.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Sirsa ^{c}	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Frames	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Local	Usually is not used in boatbuilding. It is used in Aswan. It is problematic. It is used for the frames because it has curves (*dawaranāt*). Its smell is terrible. It is brown and white in colour.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012

Sirsa [c]	*Dalbergia* sp./ *Dalbergia sissoo* Roxb.ex DC.	Decoration elements of leisure boats.	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga		That is like the *labakh*. It is used in decoration, in leisure boats. It is not used in fishing boats.	LS fieldwork, Egypt 2012, interviewed on 21th January 2012
Snawbar/Sonyebar	*Pinus* sp. L.	Plate of oar	Ibrahim Muhammad Abduh al-Anbari, 60s, boatbuilder from Khokha, resides at Dokka, Aden, 40 years as a carpenter in Khokha, built *sanbūqs*, *ʿobrīs* and *galabas*	Yemen, Aden			DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Sumur	*Acacia tortilis* Forssk. (Hayne)	Frames	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Local		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Sumur	*Acacia tortilis* Forssk. (Hayne)	Frames	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Local from the mountains		JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Sunṭ	*Acacia nilotica* L. Ex Delile.	Frames (*Shalmān*), Stempost (*Muqaddima* or *Badan* or *Hinnām*), Inner stempost (*Biṭān*)	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Local	It is curved that correspond to the shapes required. It is used less than the *tūt* because it is very strong so it deserves to be used in big ships of 22-23 metres long and not in small faluka. It is water resistant and stronger than *tūt*. It is a reddish wood like the *kafūr*. It comes from Misr [he means Cairo], and Kafr el sheikh	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Sunṭ	*Acacia nilotica* L. Ex Delile.	Stempost (*Hinnām*), Sternpost (*Samaka*), Frame (*Shalmān*), Cross beam (*Garya*).	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local	It is the strongest wood. Red wood. It grows in Wadi el Nil and in the *rīf*. It has a thick trunk. If the boat is of a big size it is preferable to build the frames with *sunt* because it is strong.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Sunaybar	*Pinus* sp. L.	Mast, Yard	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Kenya		DAA fieldwork, Saudi Arabia 2010, observed on 12th May 2010
Sunaybar		General	Muhammad Isa Muhammad Aqili, 76 years old, pearl diver, his father was a pearl diver from Farasan Island	Saudi Arabia, Farasan			DAA fieldwork, Saudi Arabia 2010, observed on 18th May 2010
Sunt	*Acacia nilotica* L. Ex Delile.	Planks, Ribs	Muhammad Mahmoud, captain of a transport ship at Quft, 50 years old	Egypt, Quft			DAA fieldwork Egypt Quseir, interviewed on 18th March 2003
Sunt	*Acacia nilotica* L. Ex Delile.	Frames, Stempost	Saad Ali Hasan, sea captain, 63 years old, Mersa Alam	Egypt, Mersa Alam			DAA fieldwork Egypt Mersa Alam, interviewed on 31st March 2003
Sunt	*Acacia nilotica* L. Ex Delile.	Stringers	Kamil Muhammad Abu Lubb al-Burri, 68 years old, Boatswain, from Quseir, he started life at sea from the age of 9 years	Egypt, Quseir	Local to the Nile	The timber used [for the *buṭāna* = the planks across the ribs (stringers)] was *sunt* (*yitḥammal ma* ͨ *al-may*) which they got from the Nile.	DAA fieldwork Egypt Quseir, interviewed on 9th February 2004
Sunt	*Acacia nilotica* L. Ex Delile.	Frames	Abbas Muhammed Ali Daud, Sea Captain; Head of the Fisherman cooperation, 81 years old, Quseir, father and grandfather experienced at sea	Egypt, Quseir	Nile	*Dala* ͨ (pl. *adla*ͨ) = ribs	DAA fieldwork Egypt Quseir, interviewed on 10th February 2004
Sunt	*Acacia nilotica* L. Ex Delile.		Mahmud Saad Ibrahim: interviewed on 12 Feb 2004. Sea captain, 67 years old, Awayna of the Ababda tribe	Egypt, Quseir		They used sunt for timber to practically all parts of the ship.	DAA fieldwork Egypt Awayna interviewed on 12th February 2004
Sunt	*Acacia nilotica* L. Ex Delile.	Frame (*Dul* ͨ or *Shilmān*), Sidr (*Stempost*), *Hinnām*	Ali Hussein Ahmed Ibrahim (Abu Hibaya). Sea captain, 53 age, Quseir of Abu Hibaya tribe, father and grandfather experienced at sea	Egypt, Quseir			DAA fieldwork Egypt Awayna interviewed on 12th February 2004
Sunt	*Acacia nilotica* L. Ex Delile.	Frames (*Shilmān*)	Duwi Toufiq Mahmud, boatswain, 64 years old, from Quseir	Egypt, Quseir	Nile		DAA fieldwork Egypt Quseir interviewed on 21st February 2004
Sunt	*Acacia nilotica* L. Ex Delile.	Keel, Stempost (*Hinnām*)	Hussein Ibrahim Muhammad aka Hussein Baloum, 72 years old, master boatbuilder, originally from Port Sudan, 56 years of experience	Sudan, Suakin			DAA fieldwork Sudan 2004, interviewed on 29th November 2004

Suweidī	*Pinus* sp., window-like pits L.	Planks	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Sweden	*Abyaḍ*, cheap, 25-30 years started replacing Indian woods. LS: imported from Sweden as pre-cut planks in industrial quantities. Used for planking and for sheer strakes. Cheaper to use than *sāg*. It replaced all the other woods in shipbuilding since it is cheaper.	DAA fieldwork, Saudi Arabia 2010, interviewed on 11th May 2010
Suwweid	*Pinus* sp., window-like pits L.	Planks hull and deck, Paddle, Oar, Mast, Yard, Stern oar	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported from Russia, Finland, Sweden	It can be *finlandī* or *sweidī*, this is the wood found nowadays in the market. It is used for hull planks, and all the upper structures on the deck. There are quality degrees. The Russian is the less quality. Used by his father in his latest working days. *Suwweid* is more prone to the friction action from the rope against the hull, so people put a piece of leather around this area of the paddle to protect it, some other people rather have it made from *kafūr* which is less prone to friction. 99% *suwweid* is used nowadays and from 20-25 years ago. It is flexible; it can be curved following the curvatures of the boat's hull. Nowadays, if I have a sailing boat, I would use *suwweid* for the daffa, because the sailing boat would not be too big, since nowadays the sailing boats are used for leisure. *Qishra khārigiyya* made with *suwweid finlandī*. The planks thickness is proportionate with the size of the ships.	LS fieldwork, Egypt 2012, interviewed on 14th January 2012
Suwweid	*Pinus* sp., window-like pits L.	Hull, Stern, Stringers, Caprail	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daᵓahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Imported	Planks for the hull and sometimes the stern, stringers, caprail in case *kafūr* is not available. *Suwweid* is white *suwweid* are types: *Finlandi*, *Sweidi*, *Russi*. The best one is *finlandi*.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Suwweid	*Pinus* sp., window-like pits L.	Planking of the dongol and other boats. Fore deck planking (*Kawortāt*). Transom Stern (*Tirs, muᵓakhira*), Cabin (*Kabīna*).	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Imported from Turkey, Sweden	Does not last more than ten years. It cannot be used for the frames, because it is planted like the date palm [maybe here insinuating that it is tall and straight]. It is not as strong as the *tūt* or the *ṣant*. It grows in cold places	LS fieldwork, Egypt 2012, interviewed on 16th January 2011
Suwweid	*Pinus* sp., window-like pits L.	Planking	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported	There are different qualities of this wood. There is the *russi*, *finlandi*, *sweidi*. [He calls these woods *khashab abyaḍ*]. They are imported woods, imported as pre-cut planks. Your client might not understand this and it's up to one conscience [he means to use a good quality wood and not lure the client]	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Suwweid	*Pinus* sp., window-like pits L.	Planking, Mast (*Ṣāri*, *Dagal*), Yard (*Faramān*), Rudder (*Daffa*), Paddle or oar (*Migdāf*), Transom stern	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Imported	Also called *khashab abyaḍ*. It is a tall wood	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Suwweid	*Pinus* sp., window-like pits L.	Planking, Transom stern (*Tirs*), Caprail (*Baṭūs*) for a fibreglass boat, Mast (*Ṣāri*) and yard (*ʿErya*), Rudder (*Daffa*), Paddle (*Migdāf*), Deck and Upper structures	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir		If the keel is made in *suwweid* it might break easily [Because the *suwweid* is not as resistant as the *kafūr*]. But *suwweid* can be used in the keel for fibre-boats since the fibre protects the wood. The transom stern is made of *suwweid* so it can hold the fibre glass. The *suwweid* is used for the planking because the planks join together when the boat goes in the water because the planks get thicker [maybe because the wood absorbs a bit of water?]. It comes in tall planks. For the *daffa* and *migdaf*, the *suwweid* is good because it is light and easily manoeuvred.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Suwweid	*Pinus* sp., window-like pits L.	Planks, Stringers, Front upper deck (*Mashshaya*), Stern oar (*Daffa*), Mast.	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Imported	Should be changed every year, it depends on the degrees of it [meaning the different quality types]. It can be *Rūsī*, *Finlandī*, *Abyaḍ*. There are ten types of *Finlandi*: *farz awwal*, *tānī*, *tālet*, depending on its quality. *Abyaḍ* is very soft and does like a paste when it gets in contact with water. *Rusi* also is in several degrees, until you reach the *bayāḍ/abyaḍ*. The *bayāḍ* is used for fiberglass boats since the fiberglass is waterproof.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Suwweid	*Pinus* sp., window-like pits L.	Planking (*Loḥ*), Foredeck (*Kurti* or *Kawortāt*), Deck and all upper structures as the cabin of the captain and of the fishermen	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Imported	It is called *khashab abyaḍ*. The reason is that the *suwweid* is water resistant it keeps its consistency (Ar. *biḥāfiz ʿala khamto*) and does not taper (Ar. *ma bi khess*), whereas the local wood tapers under the sun and high temperature. The wood is light so it suits the upper-structure of a boat.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Suwweid or Moski	*Pinus* sp. L	Planking (*Talwiḥ*), Paddles, Yard (*Faramān*), Cross beam (*Qaʿda*), Caprail (*Baṭūs*), Rubbing strake (*Zunnār*)	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Imported	It's the best wood for hull planking. The *russi* is not good. The *finlandi* is the 'cleanest wood'. It is imported but I don't know from which country because I buy it here in Hurghada from the wood merchants. [He doesn't have a preference between the *suwweid*, *moski* or *finlandi*, he says they are all good woods]. The caprail in small boats is made with *suwweid*.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Suwweid/Sweedi	*Pinus* sp. L		Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Imported	*Suwweid*, and *qontar*, *quntar finlandi*, *suwweid* comes from Russia] L: *Swaydi*? S: *Sweedi*, *khashab Sweed* but it's not from Sweden, but comes from Russia and its neighbouring countries.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Sweidi	*Pinus* sp. L	Planking, Deck, Rudder (*Daffa* or *Sukkān*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from Russia, Sweden	It lasts for 10 to 15 years. It cannot be used in the skeleton because it is straight and cannot be curved.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Sweidi	*Pinus* sp. L	Planks	Muhammed Saeed al-Sabbagh, boatbuilder from Rashid, 30 years old, 15 years of experience in boatbuilding, learnt his trade from his uncle. He worked in Damietta, Hurghada, Sharm al-Sheikh, Luxor and Quseir. He worked also in Piraeus, Greece for a couple of years. He built boats for tourism and fishing	Egypt, Quseir	Sweden		DAA fieldwork Egypt Quseir, interviewed on 7th March 2003
Sweidi	*Pinus* sp. L	Planks	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Imported	The boards (*liḥān*) we bring from outside, whether from minayba (Malaysia?), Russia, Italy, Sweden, from any country of wood – the red, and the white [woods], *sweidi* .	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Sweydi	*Pinus* sp. L	General	Ali Hamid al-Zimi, boatbuilder, 48 years old, at Yanbu al-Bahr	Saudi Arabia, Yanbu al-Bahr			DAA fieldwork Saudi Arabia 2007, interviewed on 12th May 2007
Tek	*Tectona grandis* L.f.	Ceilings, Floors	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Imported	The most expensive wood. might be from Africa, because it is a dry wood, and Africa has dried woods. Dry wood means that God created it this way for these purposes [boatbuilding]. It is the best wood because it handles water, water makes it better at the opposite of the other woods that are destroyed by water. used for leisure boats.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Tek	*Tectona grandis* L.f.	Leisure boats	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Imported	*Tek* is used a lot nowadays especially in the leisure boats. Because it is resistant to weather conditions and water, and has a nice brown colour. It is painted with oil of the same colour. It is not Egyptian but from Africa, meaning far from Egypt, from the countries that cultivate *tek*, *aru* and *Mogono* and woods that has a high resistance to water and with nice colours. [shows us *mogono*, *aru*, *tek* in the boat where we were sitting for the interview]. *Tek* is used for the deck, benches and stairs on a leisure boats. *Mogono* and *aru* are used in the inside decoration. These three woods are used only in leisure boats. These were not used 60 years ago. These woods denote a bit of luxury.	LS fieldwork, Egypt 2012, interviewed on 14th,15th January 2012

Tek	*Tectona grandis* L.f.	Fore decks (*Kawortāt*)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Imported from Burma, India		LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Tek	*Tectona grandis* L.f.	Floor of the leisure boats	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Imported	It is water resistant.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Tek	*Tectona grandis* L.f.		Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Imported	There are other woods that are specialised for the sea such as the *tek*. L: where do u get the *tek* from? S: It comes from Africa.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Tek	*Tectona grandis* L.f.	Foredeck	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Imported		LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Tek	*Tectona grandis* L.f.	Floor panels	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported	Does not have a straight grain. It is imported, maybe from the USA.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Tūt	*Morus* sp. L.	Frames	Sarwat Ramzi, Maritime Engineer for metallic boats, 46 years old, spent most of his childhood in the Anfushi boatyard	Egypt, Anfushi-Alexandria	Local		LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Tūt	*Morus* sp. L.	Frames	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Local		LS fieldwork, Egypt 2012, interviewed on 12th January 2012

Tūt	*Morus* sp. L.	Stem, Frames	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daᵓahliyya. Worked for 9 years in Safaga	Egypt, Safaga	Local	Yellow wood for the frames, stem (badan), durable in water. Better than the *sanṭ* and the *Labakh*. It has curvatures. There are two types of *Tūt*: *Baladī* and *shāmī*. The *baladī* is yellow in colour, like the lentils. The *shāmī* is yellowish white and less resistant in the water. They are both local woods but the baladī lasts a long time in the water. The *shāmī* of lesser quality, if exposed for a long time under the sun warps and bends. The tree log comes ain its natural shape, and it passes under the saw and is cut depending on the thickness required. Its shape is adequate for the *forma* (the template) to cut the frames.	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Tūt	*Morus* sp. L.	Stem (*Badan*), Stern (Libyan dialect: *Qūs el khalfi*), Frames, Stern oar (*Daffa*), Mast	Ali Ahmad Sherdi, boatbuilder, 40 years old. Learnt the trade from his maternal uncles since he was 13 years old. Originally from Port Said. Came to Safaga 5 years ago. He used to build fishing boats in Port Said, he also worked in Damietta and Suez	Egypt, Safaga	Local from Sharqiya, Alexandria, Kafr el Sheikh, Damietta, Damanur, el Mahallah	Yellow wood. Large tree. It is the preferred wood naturally because it is easily worked. If you are cutting it with the *adūm* (adze), curving it is not tiring, also when you work the surface with the *fara*. These three woods are robust, the front of the ship hits a lot of things such as water, quays. So they are resistant against shocks. They are durable in water. They are naturally curved and it forms the shape that we need for our boat. So we just draw a forma on it and cut it	LS fieldwork, Egypt 2012, interviewed on 21st January 2012
Tūt	*Morus* sp. L.	Bow (*Būz*), Stern (*Dahr*), Frames (pl. *ᶜIdān*)	Mohammad Metwalli, 40 years old, boatbuilder and repairing work, from Suez, he came to Hurghada in 1984 for work, to be a "maritime carpenter". He learnt the trade at the age of 14 years old from a master boatbuilder called Abdo Shata	Egypt, Hurghada	Local	It is not very tall. It provides curves. Durable in water, strong, resistant. It is yellowish and gets darker with time. It is widespread because people grow it more than the *sanṭ*. I prefer it to the *sanṭ* because it is good to work with. It is not grown more than the *sanṭ* because it is more in demand from the boatbuilders but because they grow it because of the shadow it provides. It grows fast so they can cut it and plant another one in its place.	LS fieldwork, Egypt 2012, interviewed on 22nd January 2012
Tūt	*Morus* sp. L.	Frames (*Shalmān*), Stempost (*Muqaddima* or *Badan*), Paddles (*Ḥaddafa*).	Khalil Mohammad Khalil, Boatbuilder, 60 years old. He learnt the trade from his father, hereditary craftsmanship. From Sina, where he learnt the trade at the age of 17-18 years old, came to Safaga 35 years ago, escaping the conflict with Israel. He only builds fishing boats	Egypt, Hurghada	Local	Yellow wood. It is curved that correspond to the shapes required. It is used more than the *sunt*. It comes from Misr [he means Cairo], and Kafr el sheikh. It can be used in both big and small boats. Easily worked	LS fieldwork, Egypt 2012, interviewed on 2nd January 2012

Tūt	*Morus* sp. L.	Frames (*ʿAdem*), Stempost (*Muqaddima*, *Bouz* or *Badan*), Sternpost (*Muʾakhira*), Lower part of sternpost (*Wistaniyya*, *Baṭṭīkha*)	Mahmoud Abdel Maguid al-Qassas, boatbuilder, 49 years old, hereditary craftsmanship, 30 years of experience	Egypt, Buhayrat al Burullus	Local from Upper Egypt	It is durable. It comes the Saʿīd (Upper Egypt) through a land road, it gets cut as logs by Egyptian workers with electrical tools and we put it on the saw depending on the form we need. It can be cut as we please.	LS fieldwork, Egypt 2012, interviewed on 16th January 2011
Tūt	*Morus* sp. L.	Frames (*ʿAdm*), Stempost (*Badan*), Round stern (*Bibbeh*)	Hajj Ali Abd el Rahman al-Qassas, 66 years old, boatbuilder, hereditary craftsmanship	Egypt, Buhayrat al Burullus	Local	These are used in the interior of a boat. The local woods are also called *khashab akhdar* because they are planted, they come from the earth in Egypt. *Tūt* is better that the *sanṭ* for work, because the *sanṭ* dries very quickly when working under the sun whereas the *tūt* takes a long time to dry. It is easily nailed whereas the *sanṭ* when it becomes dry it cracks when nailed. *Tūt* is supple.	LS fieldwork, Egypt 2012, interviewed on 16th January 2012
Tūt	*Morus* sp. L.	Stempost (*Badan*), Frames (*Duluʿ*, *ʿidān*), Lower stempost (*Ḥigr*), Inner stempost (*Biṭān*), Sternpost (*Tirs*), Lower sternpost (*Wistaniyyah*), Planking of transom stern not a right angle (*Naqrafūs*).	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Local	It is a yellow wood, not very tall usually and the trunk presents some curves. It is easier to work with than the *sanṭ*. It is a 'cleaner wood'. It lasts longer because the *sanṭ* might get attacked by worms much easier than the *tūt*. God created this wood with curves, so we use our templates to draw on the piece that fits the angle we need for the boat part. It can lasts up to 35-40 years in a boat.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Tūt	*Morus* sp. L.	Frames (*ʿIdān*), Stempost (*Badan*), Lower sternpost (*Samaka* or *Wistaniyya*), Transom stern (*Tirs*), Rounded stern (Bobba)	Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez	Local	The trees of local woods are not very tall but they are curved therefore suitable for the shape of the frames.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Tūt	*Morus* sp. L.	Frames (*Shalmān*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local	Second strongest after the *sunt*. Yellow wood.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Tūt	*Morus* sp. L.	Frames, Stempost (*Badan*), Inner sternpost (*Naqrafūs*)	Abdo Shata, 58 years old, from Suez, boatbuilder. Hereditary craftsmanship. Came to Quseir 20-25 years ago to work in boatbuilding	Egypt, Quseir	Local	This type of wood corresponds to the shape of a stempost since the tree is curved. I prefer to use this type of wood because it is a good wood and is easily worked. It is a big tree that can provide shapes that I need.	LS fieldwork, Egypt 2012, interviewed on 24th January 2012

Tūt	*Morus* sp. L.	Frames (*Shilmān*), Stempost (*Badan*), Stern (*Tirs*), Caprail (*Baṭūs*), *Shamʿa* (A piece of wood in the front deck where the fisherman ties the rope to drop anchor)	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Local from Sharqiyyah	Yellow colour. The tree has curvatures and it is wide so we can make the shape of the posts and frames out of it. It can lasts up to 20 years. The stern is made of *tūt* in a boat that is not with fibreglass. The *tūt* is used for the caprail because it resists the rubbing action of the fishing nets and threads, and for the *wistaniyya* to handle the pressure of the motor.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Tūt	*Morus* sp. L.	Frames and stempost	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeh	Local	It is a yellow wood, depending on the age of the tree it might be light or dark yellow. The dark yellow wood means that the tree has matured. If the tree is still young, the colour would be light yellow. It is used for frames and stempost in boats. It is stronger and more durable than the *labakh*. It is most in demand from other trees because of its availability. Can reach a height of 7 metres.	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Tūt	*Morus* sp. L.	Frames and Internal stempost (*Buṭāna*)	Atiya Saad Sikiyan Guta, 59 years old, from Quseir	Egypt, Quseir			DAA fieldwork Egypt, Quseir, interviewed on the 26th and 27th February 2004
Tūt	*Morus* sp. L.	Frame (*Dilaʿ*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Local from the Nile Valley		DAA fieldwork Egypt Quseir, interviewed on 31st March 2002
Tūt	*Morus* sp. L.	Frames	Muhammed Saeed al-Sabbagh, boatbuilder from Rashid, 30 years old, 15 years of experience in boatbuilding, learnt his trade from his uncle. He worked in Damietta, Hurghada, Sharm al-Sheikh, Luxor and Quseir. He worked also in Piraeus, Greece for a couple of years. He built boats for tourism and fishing	Egypt, Quseir			DAA fieldwork Egypt Quseir, interviewed on 7th March 2003
Tūt	*Morus* sp. L.	Frames	Ali Hamza, sea captain, 65 years old, worked for some 35 years	Egypt, Quseir		*Hirāb*= keel, *Shilmān*= frames, *Jisūr*= cross-beam	DAA fieldwork Egypt Quseir, interviewed on 8th March 2003
Tūt	*Morus* sp. L.	Frames	Ibrahim Ahmed Bilghaith, 55 years old, boatbuilder, builds shrimp trawlers and racing *hūrīs*	Saudi Arabia, *Jizan*	Imported from Egypt	Expensive	DAA fieldwork, Saudi Arabia 2010, interviewed on 10th January 2010

Tūt	*Morus* sp. L.	Frames, Bow, Stern, Inner (*Biṭāna*), Outer stempost	Hamdi Hasan Lahma, 48 years old, started when he was 12. He learnt the trade from his father. His three other brothers are working in the same boatyard. Great knowledge	Egypt, Rasheed	Local	One of the woods that are the best types of local woods, are very efficient, long-lasting, is equally or more durable than the *Aru*. Outer stempost made of two pieces: *muqaddima* or *badan* (the upper piece of the outer stempost) and *ḥigri al-badan* (the element between the *muqaddima* and the keel, joined to them on each side by a hook and butt planking). Frames called *ʿūd* (pl. *Fremāt*). Yellowish to orange brown wood .	LS fieldwork, Egypt 2012, interviewed on 14th January 2012
Tūt, sunṭ, atal	*Morus* sp. L. , *Acacia nilotica* L ex Delile, *Tamarix aphylla* L.	Frames (*Shilmān*)	Hasan Mohammed Hamd Allah, Boatswain, 55 years old, Mersa Alam of the Ababda tribe, started life at sea from the age of 12	Egypt, Mersa Alam			DAA fieldwork Egypt Mersa Alam, interviewed on the 22nd February 2004
White wood	*Pinus* sp. L.	Inner stempost (*Buṭāna*)	Ali Hussein Ahmed Ibrahim (Abu Hibaya). Sea captain, 53 age, Quseir of Abu Hibaya tribe, father and grandfather experienced at sea	Egypt, Quseir			DAA fieldwork Egypt Awayna interviewed on 12th February 2004
Zān	*Fagus* sp. L.	Mast	Saad Ali Hasan, sea captain, 63 years old, Mersa Alam	Egypt, Mersa Alam		Red wood.	DAA fieldwork Egypt Mersa Alam, interviewed on 31st March 2003
Zān	*Fagus* sp. L.	Cabin divisions	Yusif Ahmad Maaruf, 57 years old, boatbuilder from Alexandria. Worked most of his life as a boatbuilder. Learnt it from his father	Egypt, Anfushi-Alexandria	Imported	Used for leisure boats.	LS fieldwork, Egypt 2012, interviewed on 12th January 2012
Zān	*Fagus* sp. L.	Paddles	Amm Hassun, 60 years old, boatbuilder, learnt after primary school from his father. From Matariya el Daʾahliyya. Worked for 9 years in Safaga	Egypt, Safaga			LS fieldwork, Egypt 2012, interviewed on 21th January 2012
Zān	*Fagus* sp. L.	Paddles or oars (*Migdāf*)	Ibrahim Ali Musa al-Najjar, 72 years old, Master boatbuilder, from Quseir. Very old family tradition of boatbuilders	Egypt, Quseir	Imported from India	It is a dry wood, it is imported from India. Yellow colour [did not have a sample].	LS fieldwork, Egypt 2012, interviewed on 24th January 2012
Zan	*Fagus* sp. L.	Frames	Ibrahim al Sayyid, 30s, boatbuilder, hereditary craftsmanship from Upper Egypt, Grew up in Suez and leant boatbuilding there	Egypt, Suez	Imported	Straight planks for frames	LS fieldwork, Egypt 2012, interviewed on 19th January 2012

Zangali	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.		Abduh Balgayth, age (?), boatbuilder, worked 8 years as a carpenter	Yemen, Hudayda	Imported from Malaysia and Singapore		JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
Zangali	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Keel	Umar Said Bahaydar 60 years old, from Khokha, worked all his life in this profession (making ships). Boatbuilder in Khokha (southern boatbuilding area). Born in Khokha, 55-60 years old. Has not built a new boat in 8 years	Yemen, Khokha	Imported from India, Pakistan	This wood is *zangali ʿain*, *zangali ḥadīdi*, *zangali suwaydi aḥmar*, *zangali būnnah*, *sult abyaḍ*. *Zangali Gaawah* [jeem] is the best for sea ships, from Indonesia and Malaysia. LS: he is enumerating how many types of *zangali* there are. Ūmar: the keel wood dimensions: . 20ft by 6inches by 6 inches.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009
Zangali	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Planks, Keel	Hamid Suleiman Hamid, 50 years old, and Ali Suleiman Hamid, 48 years old, boatbuilders, from Tuwalet, Massawa	Eritrea, Massawa		The planks are 5 inch wide, 30c, width and 6m long from *zangali* (red wood). There are no local planks.	DAA fieldwork and JPC, Eritrea 2011, interviewed on 23rd February 2011
Zangali (aḥmar)	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Frames	Ziyad Ahmed Khizari (aka Tar*zan*), 48 years old, a navigator	Djibouti, Djibouti city	From Africa, Europe	JPC said to discard this as the use is not correct.	DAA and JPC fieldwork, Djibouti 2009, interviewed on 12th,13thOctober 2009
Zangali (aḥmar)	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Garboard strakes, Planks	Ahmed Jaber Ali, 45 years old, boatbuilder and fisherman, Obock, learnt the trade from Abd al-Ali	Djibouti, Obock		The 3 *mawalīḥ* (garboard strakes) are *zangali* (bois rouge) and the one plank on top of these is *zangali*, the rest of the planks are of sanobar brought from Khokha. The planks that touch the sea are *zangali* (very strong).	DAA fieldwork, Djibouti 2009, interviewed on 21st October 2009

Zangali ʿayn	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Planks	Mohammed Ali Abdallah al-Najjar, 90 years old, boatbuilder from Fuqum, started at the age of 12. ancestors boatbuilders, built *zaʿīmas*, *sanbūqs* and *galabas*	Yemen, Aden	Singapore		DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
Zangali (aḥmar)	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Planks	Abdo Umar Bilghaith, 46 years old, boatbuilder, Ancestors carpenters, built *sanbūqs*, today does maintenance	Yemen, Khor al-Ghoreira	Imported		DAA fieldwork, Yemen 2009, interviewed on 13th February 2009
Zanzlakht, Baʾs or also Sarū		Not used	Atef Matar, 50s, wood merchant, from Birket al Sabeᶜ, Munufiya. Inherited the business from his father	Egypt, Birket al Sabeᶜ	Local	Mobilia	LS fieldwork, Egypt 2012, interviewed on 28th January 2012
Zen	*Fagus* sp. L.	Keel, Stempost	Al-Arabi Mohamad al-Shuwwa, 29 years, boatbuilder, From Matariya Daʾahliyya, Port Said where he learnt the trade at the age of 10 [Did not say from whom]	Egypt, Quseir	Imported from Italy, France and Germany	Planks glued together with *ḥabu* (?) and oil.	LS fieldwork, Egypt 2012, interviewed on 24th, 25th January 2012
Zengali	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Planks	Hussein Ahmad Faris (HAF)	Yemen, Salif	Imported from Singapore	JC: The wood here [points to planking of the 'ubri] is *suwaydi*? *zingali*? HA: *Zengali*, that is. JC: Where does it come from? HA: Outside (abroad). JC: It's imported, then? HA: Yes. JC: From where? HA: From Singapore, some of them… JC: From Asia, then… Voice: From China, from other places, from Indonesia, for example.	JPC fieldwork, Yemen 2009, interviewed on ? February 2009

Zengili	*Shorea* sp. Roxb.ex C.F.G aertn. *Terminalia alata* Roth. *Quercus* sp., ever green L./*Lithocarpus* sp. Blume.	Stern, Stempost	Muhammed al-Ghaili, boatbuilder, 65 years old, from Hadramaut residing in Aden, worked 30 years as a carpenter in Hadhramaut and Dokka, Aden, building *za'īmas* and *sanbūqs*	Yemen, Aden	Imported from East Africa		DAA fieldwork, Yemen 2009, interviewed on 7th February 2009
Zenn	*Fagus* sp. L.		Mohammad Abu el-Sayyid Shata, 53 years old, boatbuilder, from Damietta. Came to Suez at age 6	Egypt, Suez		It is not used in boatbuilding because it absorbs sea water and becomes like a sponge.	LS fieldwork, Egypt 2012, interviewed on 19th January 2012
Zingīr	*Dryobalanops* sp. Gaertn.	Planks	Abduh Balgayth, age (?), boatbuilder, worked 8 years as a carpenter	Yemen, Hudayda			JPC fieldwork, Yemen 2009, interviewed on 22nd February 2009
Zūr or Zann	*Fagus* sp. L.	Kirda	Ali Ibn Ali Salim, 36 years old, boatbuilder, from Khisa in Bureiqa (Aden), assisted his father since he was 17, built *galabas*, and planked *hūrīs.* He is now building fibreglass *galabas*	Yemen, Aden	Imported from East Asia	*Zann* is the scientific name and *zur* is the local name. [Resistant that's why used in Kirda; LS interpretation from listening to the recording 18.28mn)	DAA fieldwork, Yemen 2009, interviewed on 10th February 2009
?		Mast	Duwi Toufiq Mahmud, boatswain, 64 years old, from Quseir	Egypt, Quseir	Imported from Sudan	For the *dagal* they brought the timber from Sudan. You go there and choose the wood. They always carried an extra *dagal* in case of emergency. The big *dagal* was 10+m and the small one 6 to 6.5 m. The *faramān* (yard) was 16-17m.	DAA fieldwork Egypt Quseir interviewed on 21st February 2004
?	*Acacia*	Planks	Abd el-Rahman Khalifa, guide	Sudan, Omdurman		[Two cargo river boats. DAA didn't note the name for acacia in Arabic]	DAA fieldwork Sudan 2004, informed on 19th November 2004
?		Planks	Idris Daud Ali, 50 years old, fisherman, deputy to Hasan Madani, Head of fisheries	Eritrea, Zula	Imported from India	[Conversation bit confusing]	DAA and JPC fieldwork, Eritrea 2011, interviewed on 22nd February 2011
?		Planks	Muhammed Nour, 40s, employee and guide, department of fisheries, ministry of Mariner Resources, Massawa Branch	Eritrea, Massawa	Imported from Europe	[No wood ID]	DAA fieldwork, Eritrea 2011, interviewed on 24th February 2011

?		Mast	Muhammad Uthman Mahmud Hanas, in his 70s, from Sayer village on Segid Island, pearl, kukyan and sea cucumber diver. Father was a diver. His uncle used to make *hūrīs* close to the present house here were interviewing him (in the courtyard outside the house)	Saudi Arabia, Farasan	Brought from Jeddah		DAA fieldwork, Saudi Arabia 2010, observed on 24th May2010

12.3.6 Table 6: Red Sea wood samples identification by R. Gerisch

Tree species identified by Rainer Gerisch	Vernacular name (when provided by an informant about the related sample)	English name	Country	Structural boat component	Origin of sample	Uses (from corresponding ethnographic interview)	Comment	Date of taking the sample
Acacia nilotica (L.) Willd. ex Delile	*Sanṭ*		Egypt		1 sample of *sanṭ*, Lahma shipyard, Rasheed, Egypt.			15 January 2012
Acacia nilotica (L.) Willd. ex Delile	*Sanṭ*		Egypt		1 sample of sanṭ, Qassas shipyard, Lake Burullus, Egypt.			16 January 2012
Albizia sp. Benth.			Saudi Arabia	Knee	1 sample grown knee attached to S4 and held by S15-5 (Ship 1-S5)			
Albizia sp. Benth.			Saudi Arabia	Frame	1 sample top of frame piece (Ship 1-S9)			
Albizia sp. Benth.			Saudi Arabia	Frame	J-S1-25 frame piece connected by nails with plan of position on hull .			
Artocarpus sp. J.R.Forster & G.Forster			Oman	Hūrī	*Hūrī* H3 from *hūrīs* beached on the mainland just opposite Mahawt Island, taken by Tom Vosmer		"Mahawt is an amazing place, low-lying, economically poor, the locals still eat turtle. And most incredible – they were using large amphora up to a millennium old for water storage. Now gradually switching to plastic drums" (Vosmer Pers. com. by email on 30 August 2014).	
Avicennia marina (Forssk.) Vierh.			Eritrea	Frame	1 sample from framing timber, natural crook, on a saddāfa, Massawa, Eritrea			27 February 2011
Azadirachta indica A. Juss.	*Nīm*	Neem	Saudi Arabia	Log	Nīm sample from tree log (from Al-Hafa Shipbuilding site at Jizan)	Frames/outer stempost	Might be the same *Muraymirah* of Yemen	11 May 2010
Bambusa sp. Schreb.	*Bashkīr*	Bamboo	Saudi Arabia	Yard	Bamboo sample from hūrī sail yard imported from Egypt (from Al-Hafa Shipbuilding site at Jizan)		Imported from Egypt, India, Kenya	11 May 2010
Calophyllum sp. L.			Djibouti	Stringer	1 sample *za'īma* internal stringer (Broad plank) starboard side, Ras Ali			16 October 2009
Calophyllum sp. L.			Yemen	Mast	DG mast 1 (from a masts dump at Dakkat al Ghaz, Aden)			February 12
Calophyllum sp. L.			Yemen	Mast	DG mast 2 (from a masts dump at Dakkat al Ghaz, Aden)			February 12
Calophyllum sp. L.			Yemen	Mast	DG mast 3 (from a masts dump at Dakkat al Ghaz, Aden)			February 12
Calophyllum sp. L.			Yemen	Mast	DG mast 4 (from a masts dump at Dakkat al Ghaz, Aden)			February 12
Calophyllum sp. L.			Yemen	Mast	DG mast 5 (from a masts dump at Dakkat al Ghaz, Aden)			February 12

Calophyllum sp. L.			Oman	Keel	The Keel timber were from cargo badans beached and abandoned on Mahawt Island. These boats were regularly used in the East Africa trade until the middle of the last century, Taken by Tom Vosmer			
Conocarpus lancifolius Engl.			Yemen	Tree	*Damas* sample from a tree in Maᶜalla		From Rainer: Conocarpus has two species, C. lancifolius and C. erectus. C. latifolius is occurring in Somalia and Yemen. C. erectus is native to the tropical coasts of America and the western coast of Africa and is planted in Kuwait, Pakistan and grown in some timber plantations in India. There are only small anatomical differences (narrow parenchyma bands in wood of C. erectus and sometimes one row of marginal cells in rays). From the distribution, it is most likely C. lancifolius. I think you can write C. lancifolius.	
Conocarpus lancifolius Engl.			Djibouti	Floor timber	Shia, Obock			23 October 2009
Conocarpus lancifolius Engl.	*Abiaḍ*		Djibouti	?	1 sample 'White', Ras Ali lagoon			
Conocarpus lancifolius Engl.			Djibouti	Log	1 sample ‘medium red wood’ from pile used on boats, Ras Ali lagoon			October 2010
Conocarpus lancifolius Engl.			Djibouti	Deck beam	1 sample *zarūq* deck beam, Ras Ali			16 October 2009
Conocarpus lancifolius Engl.			Djibouti	Futtock	1 sample *zarūq* upper futtock starboard side, Ras Ali			16 October 2009
Conocarpus lancifolius Engl.	*Damas*		Djibouti	Tree	1 sample, *damas* or oreil du Yemen, Port de Pêche			
Conocarpus lancifolius Engl.			Djibouti	Mast	1 sample mast (main pole) *hūri* 007, Port de Pêche.			
Conocarpus sp. L.	*ᶜordj*	?	Saudi Arabia	Log	2 ordj samples from tree log (from Al- Hafa Shipbuilding site at Jizan)	Frames, Jafla and ᶜamud el jafla	Local found around Jizan and particularly Sabia, reported to be very resistant by Ibrahim Bilgaith at al-Hafa. Jizan shipbuilding yard. From Rainer: Also checked Sample Ordj, Jizan from the same bag again, wood anatomy looks also like Conocarpus. Then and now I could not find the term ordj in connection with timbers on the internet	11 May 2010

Conocarpus sp. L.	*Tamer Hindi/Homar*	?	Saudi Arabia	Log	Tamer hindi/homar sample (from Al- Hafa Shipbuilding site at Jizan)		Bilgaith: it's not a good quality wood because it splits easily and not resistant under the heat and the sun. From Rainer: Tamarindus: I have looked at the sample again *(Tamr hindi*, *homar*, Jizan from Bag: Al Hafa, May 2010, 10 samples) and have seen that the axial parenchyma shows unfortunately not much anatomical similarity with the mentioned genus. The identification remains Conocarpus.	11 May 2010
Conocarpus sp. L. *and Melia sp.*	*Barzūma*	?	Saudi Arabia		3 Barzūma wood samples (from Al-Hafa Shipbuilding site at Jizan)		Conocarpus sp. (two pale pieces), Melia sp. (light reddish-brown piece)	January 2010
Dalbergia sp. L.f.			Djibouti	Sternpost	1 sample lower stern post with prop shaft pole, Ras Ali			16 October 2009
Dalbergia sp. L.f.			Djibouti	Rudder	1 sample rudder on the beach (abandoned), Ras Ali			16 October 2009
Dalbergia sp. L.f.			Djibouti	Floor timber	2 samples floor timber, Hulk Ras Ali			16 October 2009
Dalbergia sp. L.f.	*Sirsa* [c]		Egypt		1 sample of *sirsa* [c] Suez shipyard, Egypt.		Sirsa, name for Dalbergia latifolia	16 January 2012
Dalbergia sp. L.f.			Oman	Keel	The Keel timber were from cargo badans beached and abandoned on Mahawt Island. These boats were regularly used in the East Africa trade until the middle of the last century, Taken by Tom Vosmer			
Entandrophragma sp.(Figure 12.54)	*Mogono*		Egypt		1 sample mogono (mahogany?), Anfushi shipyard, Alexandria, Egypt.			12 January 2012
Eucalyptus sp. L'Hér./Corymbia sp. (Corymbia citriodora (Hook.) K.D. Hill & L.A.S.Johnson)	*Kafūr*		Egypt		1 sample of *kafūr-lamūni*, Lahma shipyard, Rasheed, Egypt.		*Kafūr lamūni,* name for Eucalyptus citriodora	15 January 2012
Eucalyptus sp. L'Hér.	*Kafūr*		Egypt		1 sample of *kafūr*, Lahma shipyard, Rasheed, Egypt.			15 January 2012
Eucalyptus sp. L'Hér.	*Kafūr*		Egypt		1 sample of kafūr, Qassas shipyard, Lake Burullus, Egypt.		Eucalyptus camaldulensis and E. citriodora are the main species in Egypt	16 January 2012
Fagus sp. L.	*Zan*		Egypt		1 sample *zan*, Anfushi shipyard, Alexandria, Egypt.			12 January 2012
Ficus sycomorus L.	*Jummayz*		Egypt		1 sample of *jummayz,* Lahma shipyard, Rasheed, Egypt.			15 January 2012
Hopea sp. Roxb	*Mantīk*	?	Saudi Arabia	Hull plank	2 mantīk samples from planks dismantled from a ship (from Al-Hafa Shipbuilding site at Jizan) (two samples: 1 from workers and 1 I took from planks).	Keel Yard	Imported from India, used for keel or yard	11 May 2010
Undetermined			Djibouti	Garboard	Shia, Obock			23 October 2009
Undetermined			Djibouti	Log	1 sample from local wood with smooth grey bark among wood piles on shore for boat work, Ras Ali			October 2010

					lagoon			
Undetermined			Djibouti	Cross beam	1 sample *zaʿīma*, cross beam midship (by mast gouge), Ras Ali			16 October 2009
Undetermined			Djibouti	Engine mount	1 sample *zaʿīma,* engine mount block, Ras Ali			16 October 2009
Undetermined			Djibouti	Rudder	1sample from unattached rudder timber, 3m long, broken, Ras Ali			16 October 2009
Undetermined			Djibouti	Futtock	1 sample futtock, Godoriya Wreck south			
Undetermined			Djibouti	Futtock	1 sample futtock *hūrī* 007, Port de Pêche.			12 October 2009
Undetermined			Djibouti	Log	1 sample of piece of wood used to build *sanbūq* 006. Port de Pêche.			12 October 2009
Undetermined			Saudi Arabia	?	J-S1-22 main x beam (That carried mast).			
Undetermined			Qatar	Frame	1 sample, frame Shini, Doha, Qatar, 04/12/2010 (fair colour)		Sheikh Faisal, Al Thani Workshop (Museum)	4 December 2010
Undetermined			Eritrea	Keel	1 sample of worm-eaten keel from 40 year old *sanbūq* under repair, given by owner, Tuwalet, Massawa, Eritrea			24 February 2011.
Undetermined			Yemen	Hull plank	DG1 planking starboard (from 'obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012
Undetermined			Yemen	Mast	DG top of the mast 5 (from a masts dump at Dakkat al Ghaz, Aden)			February 2012
Undetermined			Yemen	Hull plank	M3 upper plank – port side (from *hūrī sanbūq* in Mocha)			February 2012
Undetermined	*Damas*	?	Saudi Arabia	Tree	Fruits of Damas			January 2010
Undetermined			Oman	Hull	Hull of small *hūrī* taken by Weismann, complete sample number (Soton 003)			
Undetermined			Oman	Hull	Hull of large *hūrī* taken by Weismann, end of sample, sample number (Soton 0043)			
Juniperus sp. L.			Saudi Arabia	Sternpost	1 sample top of false sternpost (Ship 1-S6)			
Khaya sp.	*Aḥmar*		Djibouti	?	1 sample Aḥmar from Europe, Port de Pêche		1 sample *aḥmar* from Europe, Port de Pêche	October 2010
Lagerstroemia sp. L.			Djibouti	Stringer	1 sample String, Godoriya Wreck north			
Lagerstroemia sp. L.			Djibouti	Stringer	1 sample Stringer, Godoriya Wreck south			
Lagerstroemia sp. L.			Yemen	Hull plank	Sample taken from a sewn plank at Aden Yemen, By Lucy Blue and John P. Cooper, small end sample, number (Soton 010)			
Mangifera indica L.			Djibouti	Frame	Shia, Obock			23 October 2009
Mangifera indica L.			Djibouti	Log hūrī	1 sample log *hūrī,* Tadjoura beach.			

Mangifera indica L.			Djibouti	Log hūrī	1 sample log *hūrī* 007, Port de Pêche.			
Mangifera indica L.		Mango	Saudi Arabia	Log hūrī	Log *hūrī* at Saddayn-Farasan			January 2010
Mangifera indica L.		Mango	Saudi Arabia	Log hūrī	Log *hūrī* sample from Qumah island (Farsan islands)		Log *hūrī* sheer line sample, taken by DA. Dug out *hūrī* with built-in frames: 5.61 x 2.80x 0.30	23 May 2010
Mangifera indica L.		Mango	Suakin	Log hūrī	Log *hūrī* sample, Port Suakin, Sudan			September 2009
Mangifera indica L.		Mango	Eritrea	Log hūrī	1 sample from log *hūrī,* part of vessel with log *hūrī* ends but body planked, Massawa, Edaga area			1 March 2011
Mangifera indica L.		Mango	Oman	Stem	Stem of *hūrī,* taken by Weismann, complete sample. Sample number (Soton 001)			
Mangifera indica L.		Mango	Oman	Rib	Piece of rib of *hūrī,* taken by Weismann, half sample. Sample number (Soton 002)			
Mangifera indica L.		Mango	Oman	Hūrī	*Hūrī* H1 from *hūrīs* beached on the mainland just opposite Mahawt Island, taken by Tom Vosmer			
Mangifera indica L.		Mango	Oman	Hūrī	*Hūrī* H4 from *hūrīs* beached on the mainland just opposite Mahawt Island, taken by Tom Vosmer			
Mangifera indica L.		Mango	Oman	Hūrī	Sample taken from a *hūrī* at As-Suwaih by Tom Vosmer			
Mangifera indica L.		Mango	Yemen	N/A	Sample taken by Lucy Blue and John P. Cooper at al-Mayfar, half sample, number (Soton 005).			
Mangifera indica L.		Mango	Yemen	N/A	Sample taken by Lucy Blue and John P. Cooper south-west of al-Mayfar, complete sample, number (Soton 006).			
Mangifera indica L.		Mango	Yemen	N/A	Sample taken by Lucy Blue and John P. Cooper west of al-Mayfar, half sample, number (Soton 007).			18 March 2007
Mangifera indica L.		Mango	Yemen	N/A	Sample taken by Lucy Blue and John P. Cooper at Qalat sira, Aden , half sample, number (Soton 008).			18 March 2007
Mangifera indica L.		Mango	Yemen	False frame	Sample taken from a false frame by Lucy Blue and John P. Cooper at Fuqum, complete sample, number (Soton 009).			18 March 2007
Mangifera indica L.		Mango	Eritrea	N/A	Sample taken by Lucy Blue and Julian Whitewright at "Museum" (?), complete sample, number (Soton 012).			
Mangifera indica L.		Mango	Eritrea	N/A	Sample taken by Lucy Blue and Julian Whitewright at "Museum" (?), complete sample, number (Soton 013).			

Mangifera indica L.		Mango	Eritrea	N/A	Sample taken by Lucy Blue and Julian Whitewright at Massawa complete sample, number (Soton 014).			
Mangifera indica L.		Mango	Eritrea	N/A	Sample taken by Lucy Blue and Julian Whitewright at Massawa from a buried boat on the beach, small end sample, number (Soton 015).			
Melia azedarach L.			Yemen	Sternpost	U1 upper timber - transom stern (from *hūrī sanbūq* at al-Qudbah)			February 2012
Melia azedarach L.			Djibouti	Knee	1 sample *zarūq* deck knee, Ras Ali			16 October 2009
Melia azedarach L.			Saudi Arabia	Floor timber	Obri (?) floor timber sample at Khutub (Farasan islands)			22 May 2010
Melia azedarach L.			Saudi Arabia	Bollard	1 sample bollard starboard bow (Ship 1-S1), taken by Edward Cordell			
Melia azedarach L.			Saudi Arabia	Knee	1 sample end of grown knee securing forward cross beam to starboard hull frame (Ship 1-S14), taken by Edward Cordell			
Melia azedarach L.			Saudi Arabia	Mast step	J-S1-24 Mast step, taken by Edward Cordell			
Melia azedarach L.			Saudi Arabia	Frame	J-S1-26 Lower frame forward of mast step giving bolt diameter of 1.5cm with a 7.50cm square flat washer, taken by Edward Cordell			
Melia azedarach L.			Saudi Arabia	?	J-S1-27 Point at which the bottom of an inner frame is connected to keel adjacent to a main frame with clenched nail intact, taken by Edward Cordell.			
Melia azedarach L.			Yemen	Tree	*"Miraymira"* sample from a tree in Ma^{c}alla			February 2012
Melia azedarach L.			Saudi Arabia	Log	Raw timber sample (from Al- Hafa Shipbuilding site at Jizan)			January 2010
Melia azedarach L.			Djibouti	Futtock	1 sample *zarūq* V shaped stern futtock (first frame), Ras Ali			16 October 2009
Melia azedarach L.			Yemen	Knee	DG1 knee (from 'obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012
Melia azedarach L.			Yemen	Futtock	DG1 upper futtock (from 'obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012
Melia azedarach L.			Yemen	Mast step	DG1 mast step (from 'obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012
Melia azedarach L.			Yemen	Keel	DG1 keel (from 'obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012
Morus sp. L.	*Tūt masri*	Mulberry	Saudi Arabia	Log	*Tūt masri* sample from tree log (from Al- Hafa Shipbuilding site at Jizan)		Imported from Egypt	11 May 2010
Morus sp. L.	*Tūt*		Egypt		1 sample of *tūt* , Lahma shipyard, Rasheed, Egypt.			15 January 2012

Morus sp. L.	*Tūt*		Egypt		1 sample of tūt, Qassas shipyard, Lake Burullus, Egypt.		Morus alba is the main species in Egypt (M. nigra less common cultivated)	16 January 2012
Pinus nigra J.F.Arnold /*P. Sylvestris* L.			Yemen	Hull plank	U1 upper planking – starboard hull (from *hūrī* at al-Qudbah)			February 2012
Pinus sp. (pinoid cross-field pits)			Eritrea	Stempost	1 sample of outer stempost of saddāfa, Massawa			27 February 2011
Pinus sp. (pinoid cross-field pits)	*Abiaḍ*		Djibouti	?	Port de Pêche			October 2010
Pinus sp. (pinoid cross-field pits)			Djibouti	Hull plank	1 sample extension strake starboard side *hūrī* 007, Port de Pêche.			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	Hull plank	Obri (?) planking sample at Khutub (Farasan islands)		Abandoned obri (?) behind the coral terrace	22 May 2010
Pinus sp. (pinoid cross-field pits)	*Shām*		Saudi Arabia	Plank	Sham wood plank sample (Mohamed Uthman Mahmud house in Farasan)		Given to us by Mohamed, remained from the old shipyard his uncle used to have in front of the house. Nothing remains nowadays of it.	24 May 2010
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	Cross beam	1 sample cross support beam FWD (Ship 1-S4), taken by Edward Cordell			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	Deck plank	1 sample deck stern port (Ship 1-S12), taken by Edward Cordell			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	?	J-S1-19 Stern quarter x beam port side, taken by Edward Cordell			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	?	J-S1-20 Stern quarter rider piece, taken by Edward Cordell.			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	?	J-S1-23 Forward x beam, taken by Edward Cordell			
Pinus sp. (pinoid cross-field pits)			Saudi Arabia	Hull timber	1 sample hull timber with caulking midship (Ship 2), taken by Edward Cordell			
Pinus sp. (pinoid cross-field pits)			Qatar	Frame	1 sample, frame (?), Doha, Qatar.			December 2010
Pinus sp. (pinoid cross-field pits)			Eritrea	Hull plank	1 sample from side planking of a saddāfa, Massawa, Eritrea			27 February 2011
Pinus sp. (window-like cross-field pits)			Djibouti	Cross beam	1 sample *zarūq* cross beam, Ras Ali			16 October 2009
Pinus sp. (window-like cross-field pits)			Djibouti	Deck plank	1 sample *zaʿīma,* deck planking (rear deck port), Ras Ali			16 October 2009

Pinus sp. (window-like cross-field pits)		Pine	Saudi Arabia	Hull plank	*Hūrī* A at Saddayn-Farasan		From Rainer: There are many pine species worldwide, using the species level based on wood anatomical characters is not possible. The two categories that I am using for charcoal are the one that have pinoid tracheid to ray pitting in the radial section or window-like. In the Near East, pinoid crossfield pits have *Pinus brutia, P. halepensis, P. pinea*, window-like crossfield pits in Europe and the Near East have *P. nigra and P. sylvestris*	January 2010
Pinus sp. (window-like cross-field pits)	*Soneybar*	Pine	Saudi Arabia	Mast	Pine sample bottom of mast (from Al- Hafa Shipbuilding site at Jizan)		Sample bottom of mast (sample size h=0.95, D of top= 0.97, D of bottom = 0.97 x 0.75)	11 May 2010
Pinus sp. (window-like cross-field pits)	*Romani*	Pine	Saudi Arabia	Plank	Romani sample from imported ready-made planks from Romania (from Al- Hafa Shipbuilding site at Jizan)	Deck planking	pre-cut planks imported from Romania	11 May 2010
Pinus sp. (window-like cross-field pits)	*Sweydi*	Pine	Saudi Arabia	Plank	Suweydi sample from imported ready-made planks from Romania (from Al- Hafa Shipbuilding site at Jizan	Hull planking		11 May 2010
Pinus sp. (window-like cross-field pits)			Saudi Arabia	Mast	Mast sample at Abu el Toog (Farasan islands)		Imported from Jizan (?), Abdallah Ibrahim Muftah mentioned the mast comes from Jizan	25 May 2010
Pinus sp. (window-like cross-field pits)			Saudi Arabia	Hull plank	Sample of planking from shipwreck on Tibta beach (Farasan islands)			20 May 2010
Pinus sp. (window-like cross-field pits)			Saudi Arabia	Rudder	2 samples rudder (Ship 1-S7a-b), taken by Edward Cordell			
Pinus sp. (window-like cross-field pits)			Saudi Arabia	Garboard	1 sample last plank before keel (garboard strake (?)) (Ship 1-S10), taken by Edward Cordell			
Pinus sp. (window-like cross-field pits)			Saudi Arabia	Hull plank	J-S1-17 The 9th plank up from the sheer strake, taken by Edward Cordell			
Pinus sp., window-like pits	*Suwweid*		Egypt		1 sample of *suwweid-finlandi*, Lahma shipyard, Rasheed, Egypt.			15 January 2012
Pinus sp., window-like pits	*Suwweid*		Egypt		1 sample of suwweid, Qassas shipyard, Lake Burullus, Egypt.			16 January 2012

Pinus sp.L.	*Bichpine*		Egypt		1 sample of beech pine (?) Qassas shipyard, Lake Burullus, Egypt.		From Rainer: in Europe and Near East: *Pinus nigra*, *P. sylvestris*. For America, it is difficult to find literature about a complete documentation. There are worldwideabout 120 pine species, in the USA for example *P. Radiate*, *P. clausa* (Florida), *P. contorta* (N-America), *P. monophylla* (California), *P. jeffreyi* (California), etc. For ship building, *P. strobus* is of importance (the wood has window-like pits), also the Southern yellow pine *P. palustris* (which has no window-like pits). Have read the generic term pitch pine. It is not a specific botanical species, but a name for heavy pine woods	16 January 2012
Platanus sp. L.			Saudi Arabia	Stringer	J-S1- 30 Two samples of stringer abutting one another, taken by Edward Cordell.			
Populus sp. L.			Saudi Arabia	Deck plank	J-S1-18 Deck plank aft, taken by Edward Cordell.			
Quercus sp. L., *deciduous*	*Arū*		Egypt		1 sample of *arū,* Lahma shipyard, Rasheed, Egypt.		*Arū,* Afrikaans common name for *Albizia anthelmintica*, in India name for *Prunus persica*	15 January 2012
Quercus sp. L., *evergreen/Lithocarpus* sp. Blume	*Zangali*		Eritrea	Garboard	1 sample of *zangali* plank about to be attached to *sanbūq* as new garboard stake, Tuwalet, Massawa, Eritrea			24 February 2011.
Quercus sp. L., *evergreen/Lithocarpus* sp. Blume			Djibouti	Hull plank	1 sample *zarūq* port strake, Ras Ali		From Rainer: Quercus sp., evergreen/Lithocarpus sp. question: All Quercus sp., evergreen samples need to be changed to Quercus sp., evergreen/Lithocarpus sp. because of the wood anatomical similarity of evergreen oaks with the Lithocarpus genus, of which representatives can be found in India.	16 October 2009
Quercus sp. L., *evergreen/Lithocarpus* sp. Blume			Djibouti	Deck plank	1 sample *zarūq* deck plank, Ras Ali			16 October 2009
Quercus sp. L., *evergreen/Lithocarpus* sp. Blume			Djibouti	Futtock	1 sample *zaʿīma*, upper futtock port side, Ras Ali			16 October 2009
Shorea sp. Roxb. ex C.F.Gaertn.	*Aḥmar*		Djibouti	Log (?)	1 sample, *aḥmar zangali*, Port de Pêche			

Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Keel	*Hūrī* A Saddayn-Farasan			January 2010
Shorea sp. Roxb. ex C.F.Gaertn.	*Maranti*		Saudi Arabia	Hull plank	Maranti sample from planks dismantled from a ship (from Al-Hafa boatbuilding site at Jizan)	Top cabin	Used for top of deck cabin	11 May 2010
Shorea sp. Roxb. ex C.F.Gaertn.	*Khashab aḥmar*		Saudi Arabia	Hull plank	Khashab a+mar sample from random plank (from Al- Hafa Shipbuilding site at Jizan)			11 May 2010
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Stringer	ᶜobri (?) stringer sample at Khutub (Farasan islands)			22 May 2010
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Sternpost	1 sample scantling end-port bow (Ship 1-S2), taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	?	2 samples bow plank end starboard bow (Ship 1-S3a-b), taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Sternpost	1 sample Sternpost (Ship 1-S8), taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Keel	1 sample keel (Ship 1-S11), taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Stringer	J-S1-29 Two samples of stringer abutting one another, taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Rubbing strake	J-S1-31 Rubbing strake bow starboard.			
Shorea sp. Roxb. ex C.F.Gaertn.			Saudi Arabia	Sheer strake	J-S1-28 Sample of sheer strake with both antifouling and inner waterproof pitch intact, taken by Edward Cordell			
Shorea sp. Roxb. ex C.F.Gaertn.			Yemen	Keel	M3 Keel (from *hūrī sanbūq* in Mocha)			
Shorea sp. Roxb. ex C.F.Gaertn.	*Jangali*		Abu Dhabi	Hūrī	Sample from *hūrī,* said to be Jangali			May 2011
Swietenia sp. Jacq. (Figure 12.63)	*Mogono*		Egypt		1 sample of mogono (mahogany?), Lahma shipyard, Rasheed, Egypt.			15 January 2012
Tamarix aphylla L. Karst.	*Atl*		Egypt		1 sample athl (tamarisk?), Qassas shipyard, Quseir, Egypt.			16 January 2012
Tamarix sp. L.			Djibouti	Futtock	1 sample futtock, Godoriya Wreck north			
Tectona grandis L.f.	*Tek*		Egypt		1 sample of teak (Tectona sp.?), Lahma shipyard, Rasheed, Egypt.			15 January 2012
Tectona grandis L.f.		Teak	Yemen	Hull plank	KGS4 hull plank (from *zārūq sanbūq* at Khor al-Ghurayrah south)			February 2012
Tectona grandis L.f.			Yemen	Keel	DG1 keel (from obri *sanbūq* at Dakkat al Ghaz, Aden)			February 2012

Tectona grandis L.f.		Teak	Yemen	Keel	M3 keel (from *hūrī sanbūq* in Mocha)		From Rainer: Mocha, keel sample question: Attached a picture. There were originally three little pieces of wood in the brown envelope, which were of different colour. Two looked weathered from the outside, were middle and dark brown and showed little remains of red paint. One piece is reddish brown (identical colour to Sample 16, sternpost, maybe it needs to be counted to this sample).	February 2012
Tectona grandis L.f.		Teak	Yemen	Sternpost	M3 sternpost – lowest timber of 3 (from *hūrī sanbūq* in Mocha)			February 2012
Tectona grandis L.f.			Djibouti	Deck plank	Shia, Obock			23 October 2009
Tectona grandis L.f.			Djibouti	Keel	1 sample keel plank, Hulk Ras Ali			16 October 2009
Tectona grandis L.f.			Djibouti	Hull plank	1 sample hull plank, Hulk Ras Ali			16 October 2009
Tectona grandis L.f.			Djibouti	Hull plank	1 sample outer plank, Godoriya Wreck north			
Tectona grandis L.f.			Djibouti	Keel	1 sample Keel (?), Godoriya Wreck north			
Tectona grandis L.f.	*Sāg*	Teak	Saudi Arabia	Hull plank	Sāg sample from plank imported from India (from Al- Hafa boatbuilding site at Jizan)	keel stempost	Imported from India, considered as gold by Ibrahim Bilgaith	11 May 2010
Tectona grandis L.f.	*Sāg*	Teak	Saudi Arabia	Keel	Sāg sample from keel reused many times (from Al- Hafa boatbuilding site at Jizan)	keel stempost	Imported from India, considered as gold by Ibrahim Bilgaith	11 May 2010
Tectona grandis L.f.			Qatar	Frame	1 sample, frame Shīnī, Doha, Qatar, 04/12/2010 (reddish colour)		Sheikh Faisal, Al Thani Workshop (Museum)	4 December 2010
Tectona grandis L.f.		Teak	Eritrea	N/A	Sample taken by Lucy Blue and Julian Whitewright at "Museum twisted B" complete sample, number (Soton 011).			
Ziziphus spina-christi(L.) Willd.			Yemen	Frame	KGS4 frame (from *zarūq sanbūq* at Khor al-Ghurayrah south)			February 2012
Ziziphus spina-christi(L.) Willd.			Yemen	Futtock	M3 upper futtock - port side (from *hūrī sanbūq* in Mocha)			February 2012
Ziziphus spina-christi(L.) Willd.			Yemen	Frame	U1 upper frame – starboard (from *hūrī sanbūq* at al-Qudbah)			February 2012
Ziziphus spina-christi(L.) Willd.			Djibouti	Log	1 sample from very red wood among piles of wood on shore for boat work, this wood also seen as knees in *zaʿīma*, Ras Ali Lagoon			October 2010
Ziziphus spina-christi(L.) Willd.			Djibouti	Futtock	1 sample *zaʿīma*, lower futtock starboard side, Ras Ali			16 October 2009
Ziziphus spina-christi(L.) Willd.			Djibouti	Floor timber	1 sample *zaʿīma*, floor midship, Ras Ali			16 October 2009
Ziziphus spina-christi(L.) Willd.			Djibouti	Samaka	1 sample *zaʿīma*, samaka timber, Ras Ali			16 October 2009
Ziziphus spina-			Djibouti	Sternpost	1 sample *zaʿīma*, inner stempost,			16 October 2009

christi(L.) Willd.					Ras Ali			
Ziziphus spina-christi(L.) Willd.			Saudi Arabia	Mast	Mast sample at Khabs-Khotob (Farasan islands)		Location: mast lying behind the small wooden sheds along with other planks. From Rainer: Ziziphus spina-christi: Have studied the two samples in the bag: Farasan May 2010 for an hour again (Obri sample, Futtock, Khutub, 22.5.2010; Samples from mast, Khutub). The identifications are correct. Have seen on the labelling that one letter was not written clearly, it might not mean mast but must (attached picture).	
Ziziphus spina-christi(L.) Willd.			Saudi Arabia	Futtock	Obri (?) futtock sample at Khutub (Farasan islands)			22 May 2010
Ziziphus spina-christi(L.) Willd.			Saudi Arabia	?	J-S1-16 The prop shaft gland upright that rises vertical from the keel, taken by Edward Cordell			
Ziziphus spina-christi(L.) Willd.			Saudi Arabia	?	J-S1-21 Aft main x beam.			
Ziziphus spina-christi(L.) Willd.			Eritrea	Samaka	1 sample of *ʿurj* taken from v. large crook at Tuwalet, Massawa. Crook was about to be used to replace worm-eaten *samaka*			23 February 2011
Ziziphus spina-christi(L.) Willd.			Yemen	Knee	KGS4 knee (from *zarūq sanbūq* at Khor al-Ghurayrah south)			February 2012
Ziziphus spina-christi(L.) Willd.			Oman	Tree	"The timber from Wadi Bani Kharus is from a tree growing there, which we wanted to confirm was *Z. spina-christi*" (Vosmer Pers. com. by email on 30 August 2014).			

12.3.7 Table 7: Summary table

Tree species used in boatbuilding	**Vernacular names**	**Arabic names from medieval Islamic sources**	**Greek/Latin names from classical antiquity sources**	**In the Archaeological record**	**Wood samples identification**
Abies spp. Mill.			Ἐλάτης		
Abies alba Mill.			Ἐλάτης		
Abies cilicica Ant. & Kotschy Carriére		*Shūh*			
Abies pectinata Lmk.			Abies		
Acacia sp. Mill.		*Sanṭ*	ἀκάνθα	x	
Acacia mellifera (Vahl) Benth.	Samur/ Smūr/Sumur				
Acacia nilotica (L.) Willd. ex Delile	Sanṭ/Ṣant/Sunt/Sunṭ		ἀκάνθα μέλαινα		x
Acacia tortilis (Forssk.) Hayne	Samur/ Smūr/Sumur			x	
Afzelia sp. Sm.				x	
Albizia sp. Benth.					x
Albizia lebbeck L. Benth.	Labakh	*Al-libakh*			x
Alnus sp. Mill.				x	
Artocarpus hirsuta	ᶜayn/ Zengili ᶜayn				
Avicennia marina (Forssk.) Vierh.	Dangala, Shūra				x
Azadirachta indica A. Juss.	Nīm				x
Balanites aegyptiaca	Ḥajlīj/Ḥajlīt/Halīj/Ḥagrīt (?)				
Bambusa sp.	Bashkīl/Bomba/Bamboo				x
Calophyllum sp. L.	Finnī				x
Calophyllum inophyllum L.	Finnī				

Casuarina sp.	Gazwarīn/Gazwarina/ Gazwarina Sudāni				
Cedrus sp. Trew/ *Cedrus libani* A. Rich.			Κέδρος Cedrus	x	
Cocos nucifera L.		*Narjīl*			
Conocarpus sp. L.	ᶜarj				x
Conocarpus lancifolius Engl.	ᶜarj , barzūma, damas				x
Cupressus spp. L.			Κυπάρισσος		
Dalbergia sp. L.f.	Sarsūᶜ/ Sirsaᶜ				x
Dalbergia sissoo Roxb.			Σασαμίνων	x	
Diospyros spp.			Έβενίνων		
Dryobalanops sp.	Zingīr (?)				
Entandrophragma sp.					x
Eucalyptus sp. L'Hér.	Baharzāf (?), Kafūr/Kāfūr/Kafūr rukhāmi or Kafūr lamūni				x
Fagus sp. L.	Zān/ Zenn/ Zūr or Zann				x
Fagus sylvatica L.			Οξύα Fagus		
Ficus sp. L.				x	
Ficus sycomorus L.		*Jummayz*			x
Fraxinus ornus L.			Μελία		
Hopea sp.	Mantīk				x
Juniperus sp. L.					x
Juniperus procera Hochst. ex Endl.				x	

Khaya sp.	Al-aḥmar/Khashab aḥmar				x
Lagerstroemia sp. L.	Bantek				x
Larix spp.Mill.			Larix		
Luehea divaricate Mart.				x	
Mangifera indica L.	ᶜanba				x
Melia azedarach L.	Barzūma (?), Muraymara / Muraymira / Mraymara / Maraymirah / Miraymira				x
Moringa peregrina Forssk.			Βάλανος Balanus		
Morus sp. L.	Tūt				x
Morus nigra L.			Συκάμινος		
Olea sp. L.			Olea	x	
Pinus sp. L.	Abyaḍ, Bichbine/ Bachbay/ Bachbayn, Muskī/Moski/Mosku	Sanawbar Snūbar	Πεύκης	x	x
Pinus sp., pinoid					x
Pinus window-like cross-field pits	Rūmāni/ Romāni, Shām (?), Snawbar/Suneybar/Soneybar/ Sinibar/Snobar/Sanebār, Suwweid/Sweydi/Suweydi				x
Pinus brutia Ten.			Πίτυς		
Pinus nigra J.F.Arnold			Πίτυς		x
Pinus silvestris L.			Tibulus		x
Pithecellobium dulce (Roxb.) Benth.	Daymān/Duyman				
Platanus sp. L.					x
Platanus orientalis L.			Πλάτανος		

Pomoideae Juss.				x	
Populus sp. L.		*Ḥawr*		x	x
Pseudotsuga taxifolia/P. menziesii Mirb	Duglas/Doblesfir				
Pterocarpus sp.					x
Rhizophora mucronata Lam.	Gandal (?), Kandala (?)				
Salvadora persica L.				x	
Quercus sp. L.	Aru, Ballūt		Δρῦς	x	x
Quercus sp. L., *evergreen/Lithocarpus* sp. Blume	Zangali/Zangali ᶜayn/ Zangali aḥmar/Zangili aḥmar/Zengili/Zengali/Jangal				x
Saccharum officinarum L. (Figure 12.44)	Ghāb				
Salix spp. L.			Ἰτέης	x	
Shorea sp. Roxb. ex C.F.Gaertn.	Al-aḥmar / Khashab aḥmar, Jāwī/Jāwa, Marantī, Zangali / Zangali ᶜayn / Zangali aḥmar / Zangili aḥmar / Zengili / Zengali / Jangal				x
Swietenia sp. Jacq.					x
Tamarix sp. L.	Atl /Atal/Atel/Athal		Μυρίκη	x	x
Tamarix aphylla L. Karst.	Atl /Atal/Atel/Athal	Athl			x
Tectona grandis L.f.	Sāg/Saj/Sāj/Sag/Say/Tek	*Sāj*	Σαγαλίνων	x	x
Terminalia sp.				x	x
Terminalia alata Roth.	Zangali/Zangali ᶜayn/ Zangali aḥmar/Zangili aḥmar/Zengili/Zengali/Jangal				x
Tilia spp. L.			Φίλυρα		
Ulmus sp. L.			Πτελέα		

Ziziphus ziziphus (L.) H. Karst./ Z. jujube Mill.	Hardī/Hardo Jujube				
Wrightia sp. R. Br.					
Ziziphus spina-christi L. Willd	Alob (?), ᶜarj, ᶜilb/ᶜelb, Nabq/Nabg/Nabag/Nabaq, Sidir/Sidr/Sidra	*Sidr*		x	x

12.4 Appendix 4: Pictures of trees mentioned in the text.

Figure 12.1: ***Abies alba*** **Mill. (http://eol.org/data_objects/26864882 [Accessed on 15th July 2015]).**

Figure 12.2: ***Abies cilicica*** **Ant. & Kotschy Carriére (http://www.hgtvgardens.com/flowers-and-plants/cilicican-fir-abies-cilicica [Accessed on 15th July 2015])**

Figure 12.3: ***Abies pectinata*** **Lmk. (http://www.fitoetica.org/abies-pectinata/ [Accessed on 15th July 2015]).**

Figure 12.4: ***Acacia mellifera*** **(Vahl) Benth. (http://eol.org/data_objects/16900455 [Accessed on 15th July 2015]).**

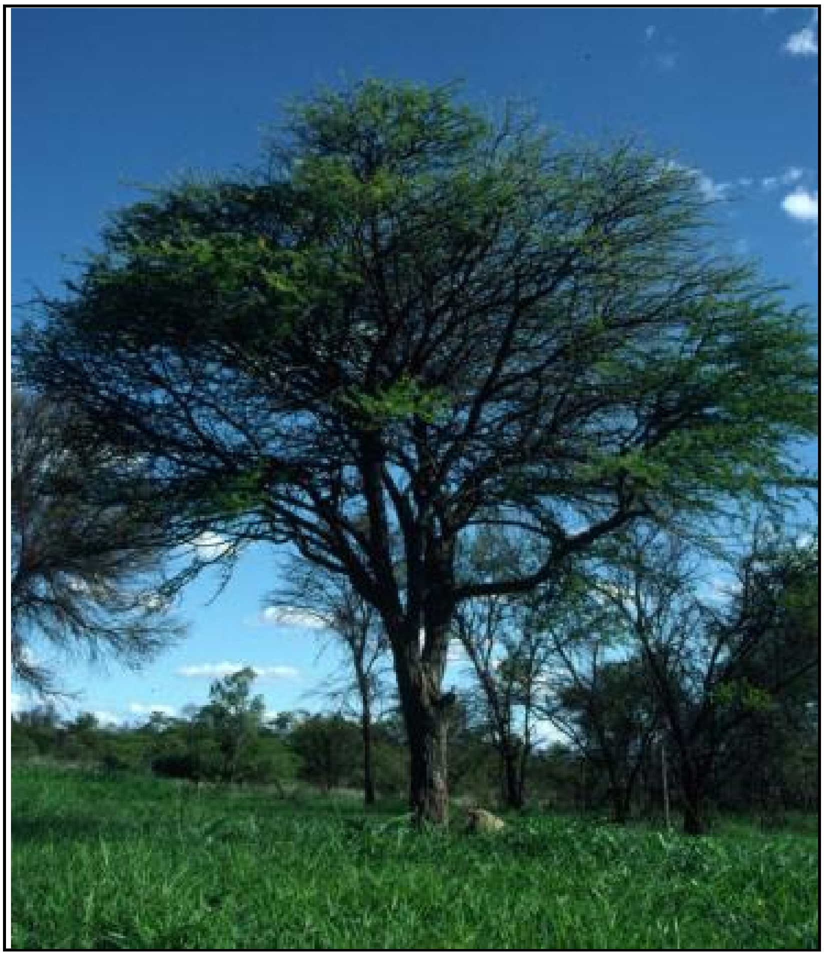


Figure 12.5: ***Acacia nilotica*** **(L.) Willd. ex Delile (http://www.kew.org/science-conservation/plants-fungi/acacia-nilotica-acacia [Accessed on 15th July 2015]).**

Figure 12.6: ***Acacia tortilis*** **(Forssk.) Hayne (http://www.krugerpark.co.za/africa_umbrella_thorn.html [Accessed on 15th July 2015]).**

Figure 12.7: ***Azelia africana*** **Sm. (http://www.arkive.org/afzelia/afzelia-africana/image-G115033.html [Accessed on 14th August 2015]).**

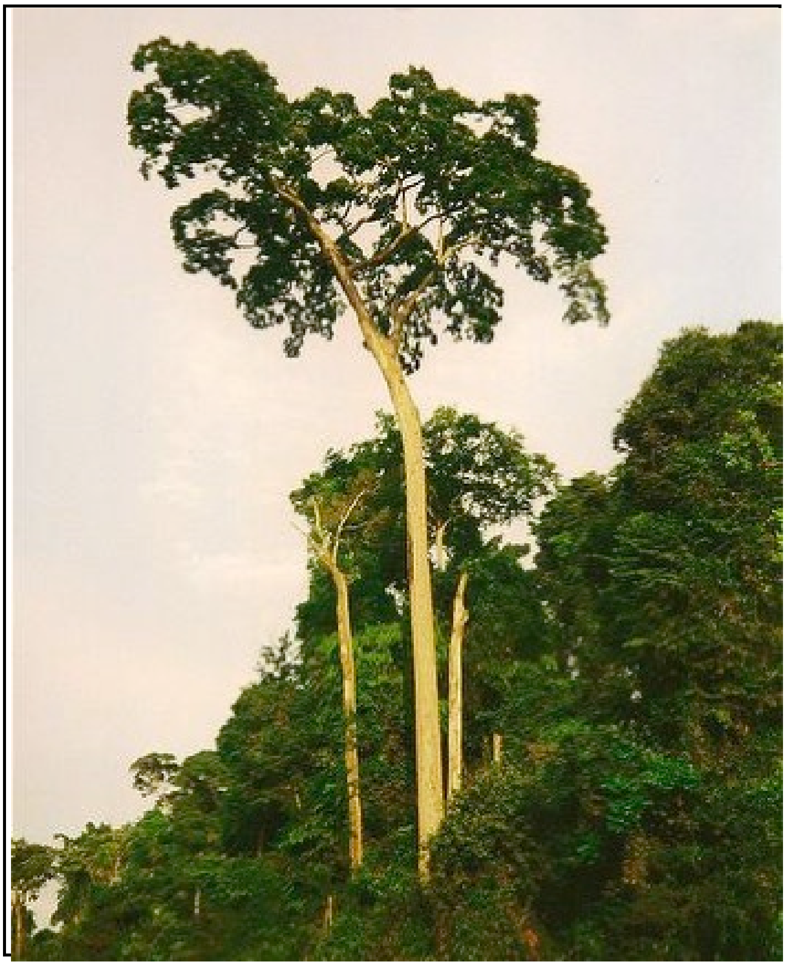


Figure 12.8: ***Afzelia bipindensis*** **Sm. (http://www.arkive.org/afzelia/afzelia-bipindensis/image-G113798.html [Accessed on 14th August 2015])**

Figure 12.9: ***Albizia*** **sp. Benth.**

(http://www.natureloveyou.sg/Plant%20Story/Plant%20Story%20-%20Albizia%20Trees.html [Accessed on 15th July 2015]).

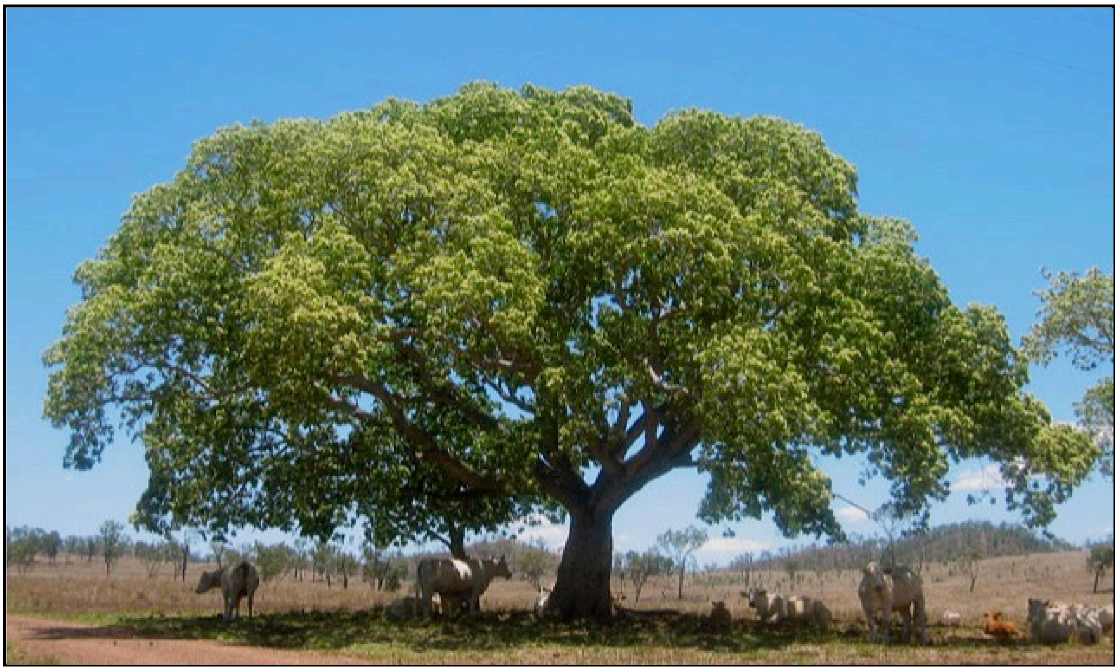


Figure 12.10: ***Albizia lebbeck*** **L. Benth. (http://www.tropicalforages.info/key/Forages/Media/Html/Albizia_lebbeck.htm [Accessed on 15th July 2015])**

Figure 12.11: ***Alnus*** **sp. Mill. (http://www.woodlandtrust.org.uk/visiting-woods/trees-woods-and-wildlife/british-trees/native-trees/alder/ [Accessed on 15th July 2015]).**

Figure 12.12: ***Artocarpus hirsuta*** **(http://eol.org/data_objects/31476159 [Accessed on 14th August 2015]).**

Figure 12.13: ***Avicennia marina*** **(Forssk.) Vierh. (http://www.arkive.org/gray-mangrove/avicennia-marina/ [Accessed on 16th July 2015]).**

Figure 12.14: ***Azadirachta indica*** **A. Juss.**
(http://www.oramsnurseries.com.au/product/azadirachta-indica-neem-tree-2/ [Accessed on 14th August 2015]).

Figure 12.15: ***Balanites aegyptiaca***
(http://www.researchgate.net/publication/259921775_Balanites_Aegyptiaca_(L.)_A_Multipurpose_Fruit_Tree_in_Savanna_Zone_Of_Western_Sudan [Accessed on 16th July 2015]).

Figure 12.16: ***Bambusa*** **sp. (http://www.abc.net.au/gardening/stories/s1866569.htm [Accessed on 16th July 2015]).**

Figure 12.17: ***Calophyllum inophyllum*** **L. (http://www.ntbg.org/plants/plant_details.php?rid=179&plantid=2196 [Accessed on 16th July 2015]).**

Figure 12.18: ***Casuarina*** **sp. (http://www.thehindu.com/sci-tech/energy-and-environment/they-tailor-trees/article5120138.ece [Accessed on 14th August 2015]).**

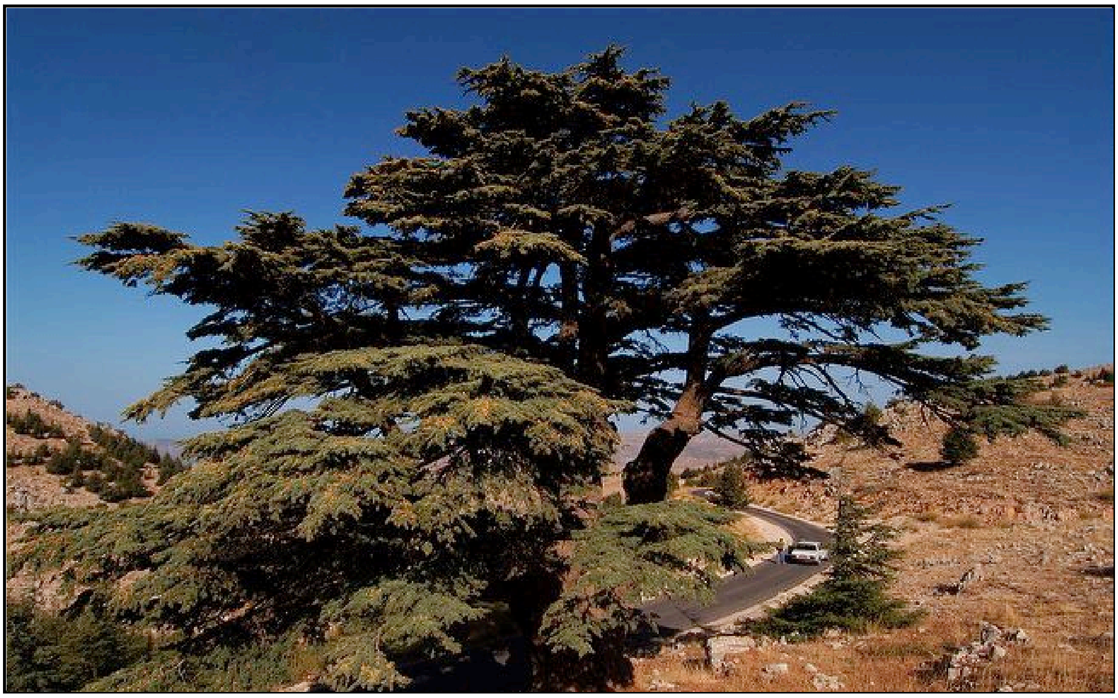


Figure 12.19: ***Cedrus libani*** **A. Rich. (http://www.arkive.org/cedar-of-lebanon/cedrus-libani/ [Accessed on 16th July 2015]).**

Figure 12.20: ***Cocos nucifera*** **L. (http://www.ntbg.org/plants/plant_details.php?plantid=3054 [Accessed on 16th July 2015]).**

Figure 12.21: ***Conocarpus lancifolius*** **Engl. (http://www.canadaplants.ca/display.php?id=3712 [Accessed on 16th July 2015]).**

Figure 12.22: ***Cupresus sempervirens*** **(https://selectree.calpoly.edu/tree-detail/cupressus-sempervirens [Accessed on 14th August 2015]).**

Figure 12.23: ***Dalbergia sissoo*** **Roxb. (http://davesgarden.com/guides/pf/showimage/278006/ [Accessed on 16th July 2015]).**

Figure 12.24: ***Diospyros ebenum*** **(http://thepearl.lk/conserving-the-ceylon-ebony-tree/ [Accessed on 17th August 2015]).**

Figure 12.25: ***Dryobalanops aromatica***
(http://www.aquaticquotient.com/forum/showthread.php/31301-Trees-of-Singapore-Botanical-Gardens [Accessed on 17th August 2015]).

Figure 12.26: ***Entandrophragma cylindricum*** **(http://eol.org/pages/5617843/overview [Accessed on 17th August 2015]).**

Figure 12.27: ***EucalyptuS* sp. L'Hér. (http://www.apstas.org.au/flora-2.html [Accessed on 14th August 2015]).**

Figure 12.28: ***Fagus sylvatica* L. (https://www.rhs.org.uk/plants/details?plantid=779 [Accessed on 16th July 2015]).**

Figure 12.29: ***Ficus sycomorus*** **L.**
(http://www.figweb.org/Ficus/Subgenus_Sycomorus/Section_Sycomorus/Subsection_Sycomorus/Ficus_sycomorus_sycomorus.htm [Accessed on 16th July 2015]).

Figure 12.30: ***Fraxinus ornus*** **L. (http://plants.usda.gov/core/profile?symbol=FROR2# [Accessed on 16th July 2015]).**

Figure 12.31: ***Juniperus procera*** **Hochst. ex Endl. (http://www.arkive.org/african-pencil-cedar/juniperus-procera/ [Accessed on 16th July 2015]).**

Figure 12.32: ***Khaya senegalensis***
(http://www.africanplants.senckenberg.de/root/index.php?page_id=78&id=951# [Accessed on 17th August 2015]).

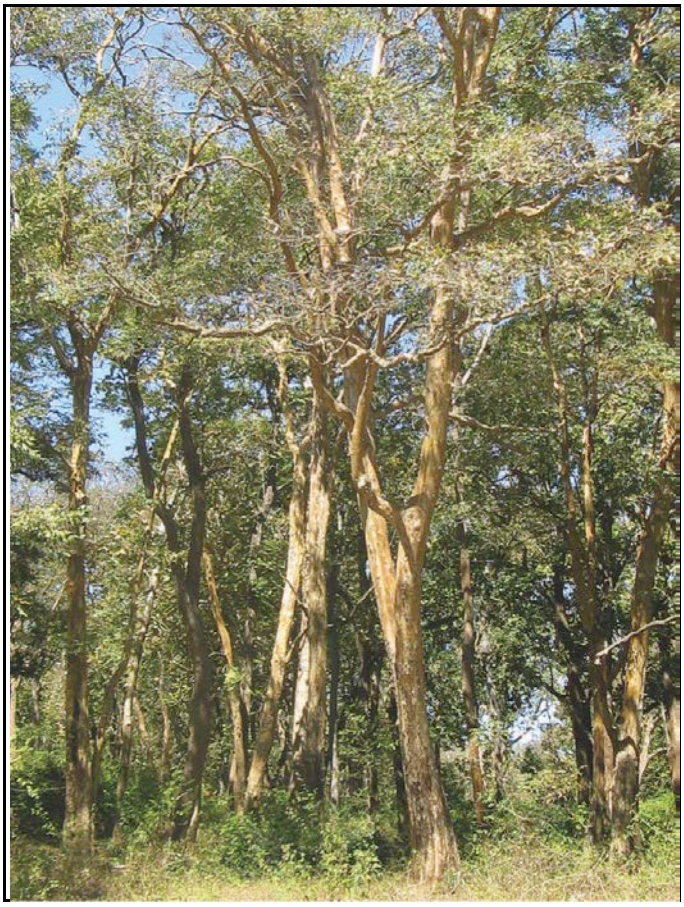


Figure 12.33: ***Lagerstroemia lanceolata*** **(http://eol.org/pages/5429594/overview [Accessed on 17th August 2015]).**

Figure 12.34: ***Larix*** **spp. Mill. (https://davisla.wordpress.com/2011/12/05/plant-of-the-week-larix-gmelinii/ [Accessed on 14th August 2015]).**

Figure 12.35: ***Luehea divaricata*** **Mart. (http://davesgarden.com/guides/pf/showimage/58354/#b [Accessed on 14th August 2015]).**

Figure 12.36: ***Mangifera indica*** **L. (http://eol.org/pages/582270/overview [Accessed on 16th July 2015])**

Figure 12.37: ***Melia azedarach*** **L. (https://www.anbg.gov.au/gnp/interns-2008/melia-azedarach.html [Accessed on 16th July 2015]).**

Figure 12.38: ***Moringa peregrina*** **Forssk. (http://www.explorelifeonearth.org/peregrina.html [Accessed on 16th July 2015]).**

Figure 12.39: ***Morus nigra*** **L. (http://plants.usda.gov/core/profile?symbol=moni [Accessed on 16th July 2015]).**

Figure 12.40: ***Olea europaea*** **(http://davesgarden.com/guides/pf/showimage/176896/ [Accessed on 17th August 2015]).**

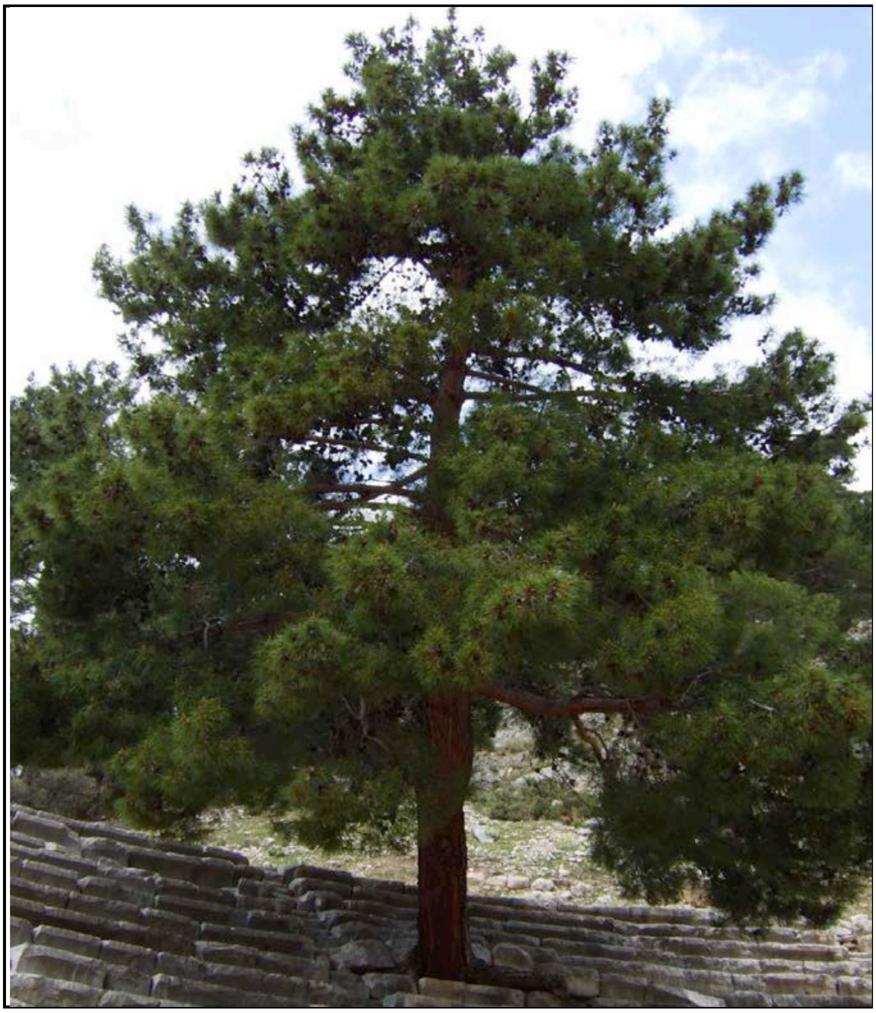


Figure 12.41: ***Pinus brutia*** **Ten. (http://eol.org/data_objects/27743703 [Accessed on 16th July 2015]).**

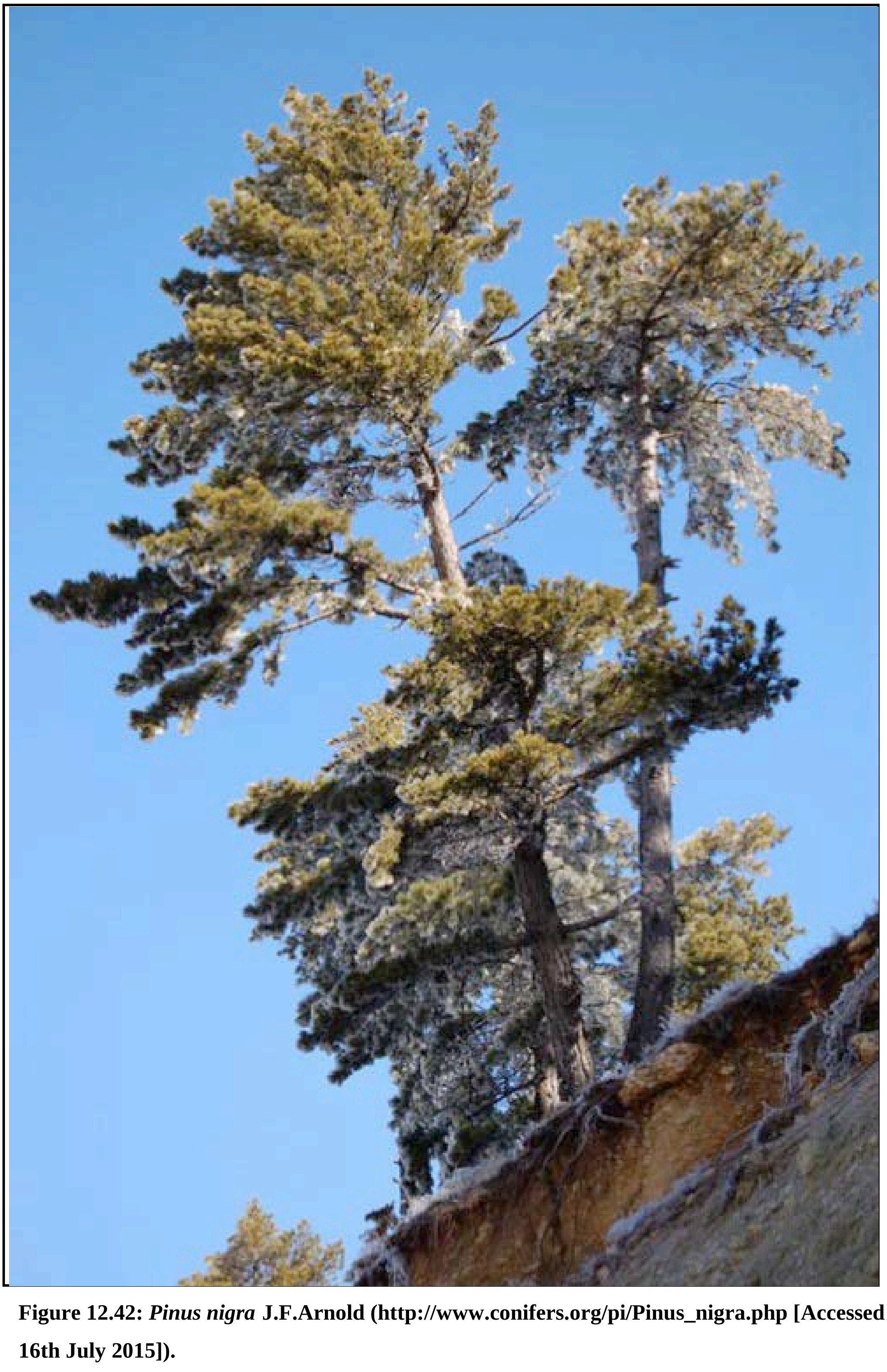


Figure 12.42: ***Pinus nigra*** **J.F.Arnold (http://www.conifers.org/pi/Pinus_nigra.php [Accessed on 16th July 2015]).**

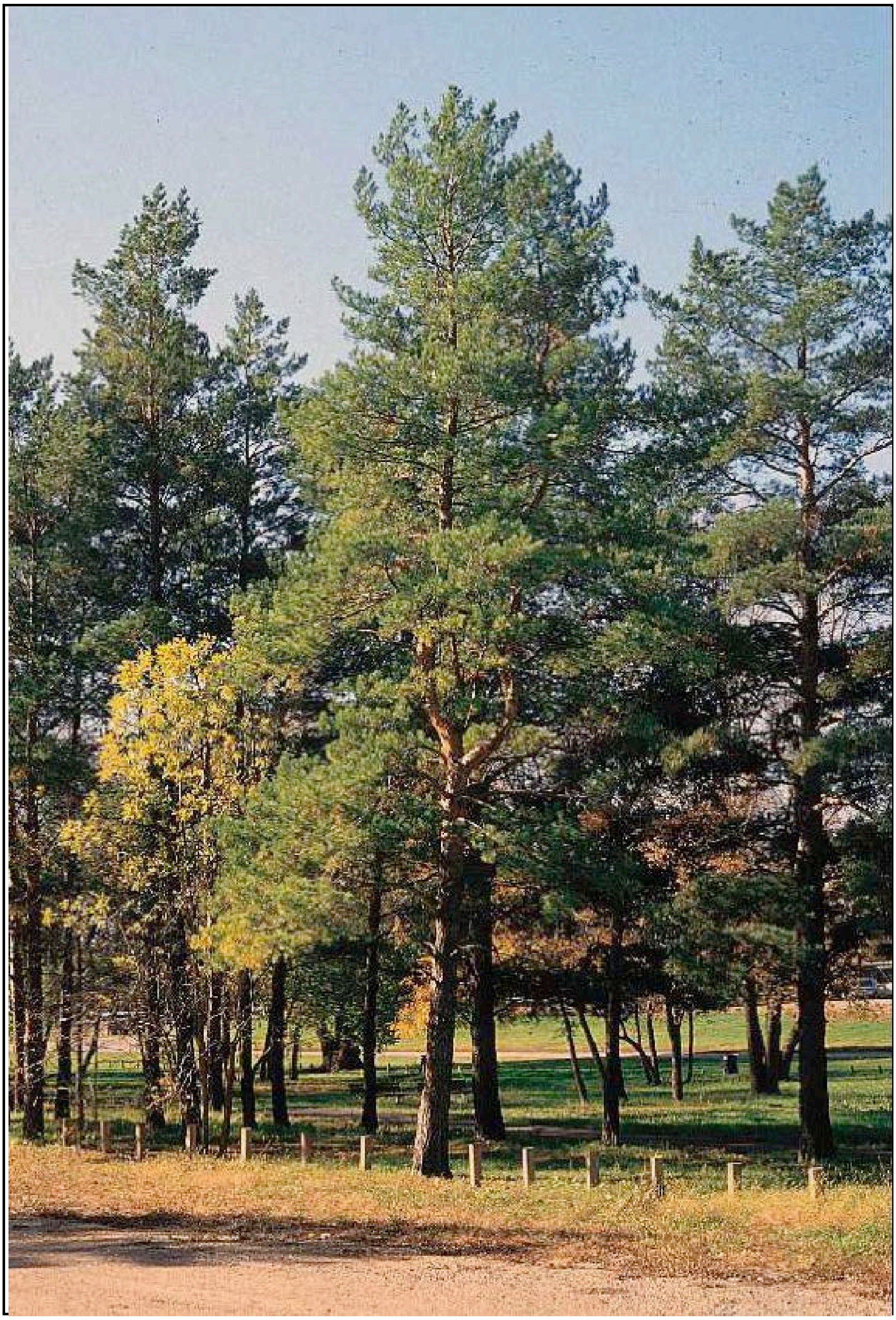


Figure 12.43: ***Pinus sylvestris*** **L. (http://plants.usda.gov/core/profile?symbol=PISY [Accessed on 17th July 2015]).**

Figure 12.44: ***Pithecellobium dulce*** **(Roxb.) Benth. (http://www.cabi.org/isc/datasheet/41187 [Accessed on 17th July 2015]).**

Figure 12.45: ***Platanus orientalis*** **L. (http://www.kew.org/science-conservation/plants-fungi/platanus-orientalis-oriental-plane [Accessed on 17th July 2015]).**

Figure 12.46: ***Populus euphratica*** **Oliv. (http://botany.cz/cs/populus-euphratica/ [Accessed on 17th August 2015]).**

Figure 12.47: ***Pseudotsuga taxifolia*** **P. menziesii Mirb (http://science.halleyhosting.com/nature/gorge/tree/conifer/pseudo/dougfir.htm [Accessed on 18th July 2015]).**

Figure 12.48: ***Pterocarpus lucens*** **Guill & Perr. (http://www.westafricanplants.senckenberg.de/root/index.php?page_id=14&id=1320# [Accessed on 17th August 2015]).**

Figure 12.49: ***Quercus*** **sp. L. (http://www.gardenaction.co.uk/trees/quercus/oak-trees-1.asp [Accessed on 18th July 2015]).**

Figure 12.50: ***Quercus*** **sp. L.,** ***evergreen/Lithocarpus*** **sp. Blume (http://www.wellgrowhorti.com/Page/LandscapePlants/Trees/Tree%20Images%20L.htm [Accessed on 14th August 2015]).**

Figure 12.51: ***Rhizophora mucronata*** **Lam. (http://eol.org/pages/482514/overview [Accessed on 18th July 2015]).**

Figure 12.52: ***Saccharum officinarum*** **L. (http://www.kew.org/science-conservation/plants-fungi/saccharum-officinarum-sugar-cane [Accessed on 1st August 2015]).**

Figure 12.53: *Salix mucronata* Thunb. (http://eol.org/data_objects/22633520 [Accessed on 17th August 2015]).

Figure 12.54: *Salix tetrasperma* Roxb. (http://indiabiodiversity.org/species/show/261494 [Accessed on 17th August 2015]).

Figure 12.55: ***Salvadora persica*** **L. (http://www.westafricanplants.senckenberg.de/root/index.php?page_id=14&id=2446# [Accessed on 18th July 2015]).**

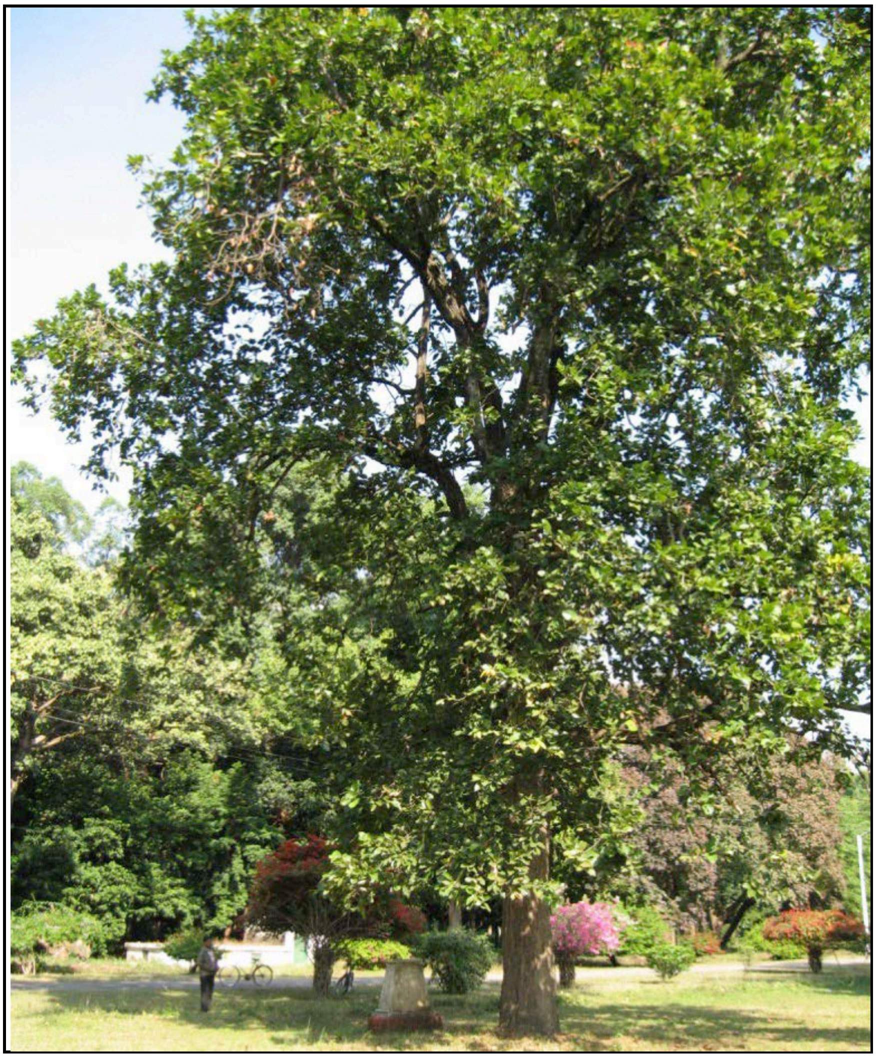


Figure 12.56: ***Shorea robusta*** **(http://indiaflora.blogspot.com/2013/08/state-trees-of-india.html [Accessed on 17th August 2015]).**

Figure 12.57: ***Swietenia macrophylla*** **(http://www.tree-nation.com/trees/tree-product-details/25/shop [Accessed on 17th August 2015]).**

Figure 12.58: ***Tamarix aphylla*** **L. Karst. (http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Tamarix_aphylla.htm [Accessed on 1st August 2015]).**

Figure 12.59: ***Tectona grandis*** **L.f.**

(https://commons.wikimedia.org/wiki/File:KANNIMARA_TEAK_TREE.JPG [Accessed on 14th August 2015]).

Figure 12.60: ***Terminalia alata*** **Roth.**
(http://www.discoverlife.org/mp/20p?see=I_PAO1059&res=640 [Accessed on 17th August 2015]).

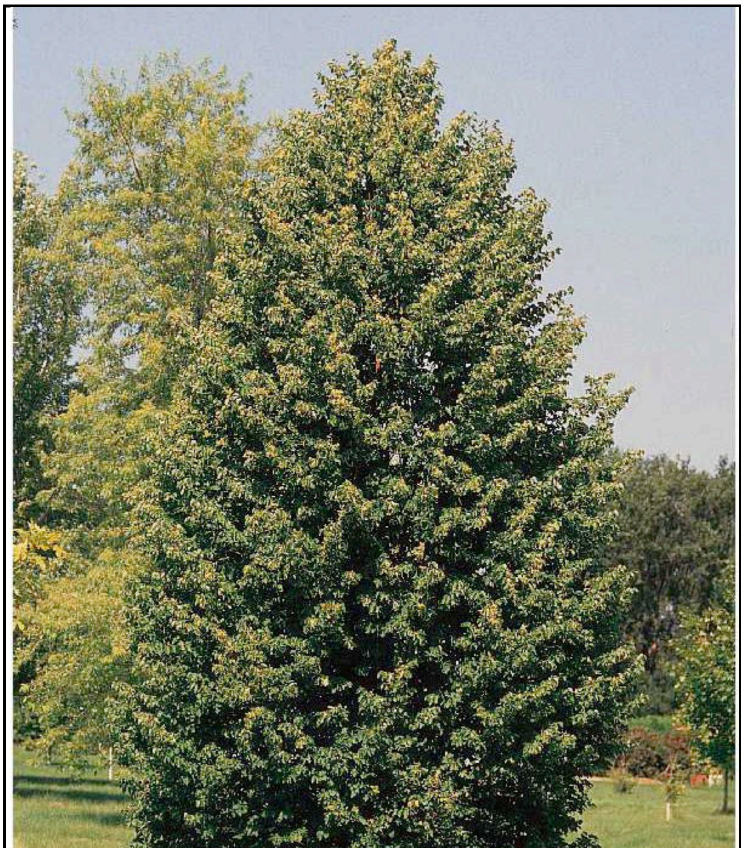


Figure 12.61: ***Tilia cordata*** **Mill. (http://plants.usda.gov/core/profile?symbol=TICO2# [Accessed on 17th August 2015]).**

Figure 12.62: ***Tilia rubra*** **(http://mbpollen.com/en/woody-plants-2/ [Accessed on 17th August 2015]).**

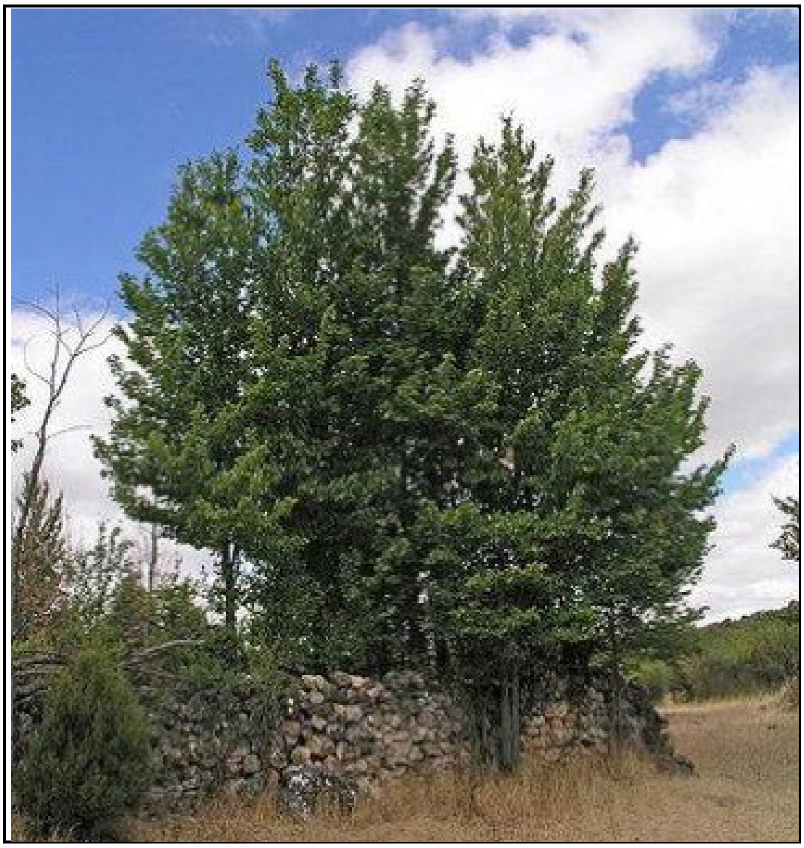


Figure 12.63: ***Ulmus campestris*** **L. (http://bonnier.flora-electronica.com/menus/112-Ulmacees/Ulmus%20campestris%201.html [Accessed on 17th August 2015]).**

Figure 12.64: ***Wrightia tinctoria*** **Rottler (http://opendata.keystone-foundation.org/wrightia-tinctoria-roxb-r-br/th_wrightia-tinctoria [Accessed on 17th August 2015]).**

Figure 12.65: ***Ziziphus ziziphus*** **(L.) H. Karst./** ***Z. jujube*** **Mill. (http://www.fungoceva.it/erbe_ceb/Zizyphus_vulgaris%20.htm [Accessed on 17th August 2015]).**

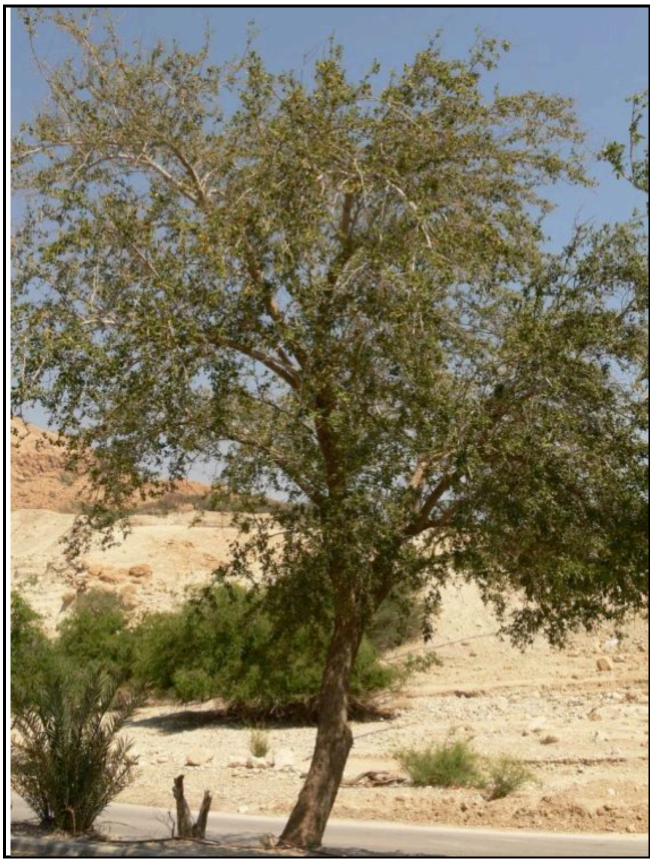


Figure 12.66: ***Ziziphus spina-christi*** **L. Willd (http://eol.org/pages/2885426/overview [Accessed on 17th August 2015]).**

12.5 Appendix 5: Anatomical examination of the wood samples (R. Gerisch).

12.5.1 Introduction

During the ethnographic study of traditional maritime vessels from places along the coast of the western Indian Ocean and from northern Egypt conducted by the MARES Project, Institute for Arab and Islamic Studies, University of Exeter, several sets with samples from boats and ships and their dismantled parts, from sawn wood of shipyards, material used in buildings and those taken from trees were collected by a group of maritime archaeologists and provided for examinations of the wood structure. Countries of North Africa, the northern part of East Africa and the Arabian Peninsula were included and interviews with local people carried out to study the use of the resource wood in boat and shipbuilding. The samples were mediated by C. Zazzaro, Naples, through work on ship timbers during the Mersa/Wadi Gawasis excavations at the ancient port of *Saww* on the Egyptian Red Sea coast, Universities of Boston, Naples and Rome. The microscopic analysis was carried out with breaks in the years 2011-14 accompanied by a study of tree species and their wood anatomy, of wood for construction (TROTTER 1960: 198-200, LOUPPE et al. 2008, LEMMENS et al. 2012, etc.) and anatomical identifications of shipwreck timbers.

Wood represents a multipurpose natural raw material which was used since earliest times. The examination of samples from archaeological and historical contexts gained increasingly importance as an interdisciplinary field contributing to the aspects of wood fuel and timber gathering, craftsmanship, trade as well as vegetation and climate history. They comprise generally fossil wood as remains from fireplaces and from burnt timber, desiccated wood from twigs and branches, remnants from woodworking and wooden objects, waterlogged wood from sunken boats and ships, subfossil in preservation, and modern wood. Associated with the excavation of ship wrecks, the anatomical examination of the timbers forms an important part to reconstruct the building of the vessels. From the included countries, wood anatomical research was mainly carried out on material from Egypt, on settlement sites with cemeteries, quarry and harbour sites, on riverine and seagoing vessels and museum collections.

Wood used for crafting is available domestically and by intra- and extra-regional trade. In modern times, deliveries are shipped from more distant countries, among them pine timber from Sweden, although much timber comes from the countries bordering the

Indian Ocean. Several countries are less or sparsely wooded and dependent on the trade with sawn timber. Large quantities are exported from South and Southeast Asian countries. Timber is obtained from trees growing naturally, in mangrove belts, wadi courses, in mountain forests, savannas, rainforests, etc., and cultivated in gardens and plantations (e.g. RICKS 1992). The extensive demand for wood in the course of the millennia had led to a large-scale degradation and destruction of naturally grown forests. The types of wood used in construction of boats and ships are chosen against the background of tradition, also considering the rot and insect resistance, financial means and personal taste of the customer as well as the availability of the timber species for the shipyard and determine the workability, colour, weight, durability and costs. The vessels can be seen under the aspects of functionality and prestige. Old ship timbers are reused in harbour installations, buildings, furniture and as fire wood.

The hull and superstructure are affected by decay and activities by termites, beetles and marine borers after having been exposed to the weather, shoreland and saltwater for some time. Through the choice of timber and its treatment, the damage to the vessel can be reduced. In ancient Egypt and Mesopotamia, the highly valued durable wood of *Cedrus libani* was used for temples and ships. Shipworm burrows in planks of seagoing ships excavated in Egypt showed that also cedar wood was infested. The wood of *Tectona grandis*, members of the Dipterocarpaceae and Meliaceae, *Conocarpus lancifolius*, *Lagerstroemia* spp., *Terminalia* spp., *Mangifera indica* and of many other tree species is durable and very to moderately resistant towards decay and wood eating organisms (NAGABHUSHANAM 1997: 7-8, APPANAH and TURNBULL 1998: 118-119). Teak wood, which was extensively used in the shipbuilding industry for its high qualities, is resistant to termites and moderately resistant to marine borers.

The countries with a coastline on the western Indian Ocean belong almost entirely to the floral kingdom of the Palaeotropis, which comprises the tropical and partly subtropical regions of the Old World with Africa, India and Southeast Asia (African, Madagascan and Indo-Malaysian subkingdoms), to a small part to the kingdom of the Capensis, the islands from Madagascar to the Laccadives to the Palaeotropis. Countries neighbouring the eastern Indian Ocean and the islands within belong to the Palaeotropis and Australia. The countries bordering the north-western part of the western Indian Ocean belong to the Mediterranean-Sahara regional transition zone, the Saharo-Sindian regional zone, the Sahelian regional transition zone, the Somalia-Masai regional centre of endemism and the Afromontane archipelago-like regional centre of endemism after LEONARD (1989) and WHITE and LEONARD (1991). The palaeotropical flora is characterized by a high diversity of plants and includes a large number of commercially important hardwood species. The floras of the southern hemisphere countries have a common ancestor in the flora of the southern supercontinent of Gondwana.

Many of the tropical woods are known to have a higher raw density, which relates to the volume of the wood including that of the pores at a certain moisture content, for tropical regions 15%. As an indicator for the strength properties, hardness and wear resistance, but also difficulties in the processing increase with ascending raw density. Advantages of their hardness are durability and resistance against weathering, pests and fungi. Besides the hardness, the occurrence of toxical acting contents in the cell walls protect the woods. Most of the frequent raw densities lie between 0.4 and 0.8 g/cm^3. Wood of *Terminalia* spp. has a density of 0.4-0.7 g/cm^3, *Mangifera indica* of 0.5-0.7 g/cm^3, *Shorea* spp. 0.5-0.8 g/cm^3 and *Tectona grandis* of 0.4-0.8 g/cm^3. The raw density can reach values of up to 1.3 g/cm^3. Woods with density values above 1 g/cm^3, reached in air-dried or wet condition, sink in water. A group of woods from different plant genera with exceptional hardness and density is called ironwood, among them that of *Dalbergia melanoxylon*, which has a raw density of 0.9-1.2 g/cm^3.

Some of the tropical and subtropical woods distinguish through a special growth pattern, an irregular twist, in which stratifications of cells are spirally arranged around the stem axis in alternating sense of direction. This results in alternating reflections of light with matt and shiny stripes giving the wood a decorative appearance. In woodworking it can cause tear outs. Wood with irregular twists occurs e.g. in *Afzelia* spp., *Albizia procera*, *Artocarpus* spp., *Dalbergia* spp., *Entandrophragma cylindricum*, *Toona* spp., *Shorea laevis*, *Swietenia macrophyla* and *Terminalia superba*.

For the work with wood and charcoal, a range of anatomical atlases and sets of plates has been published describing taxa from Europe, Israel (FAHN et al. 1986), Syria (FREY et al. 1991), the eastern Mediterranean region (AKKEMIK and YAMAN 2012), North Africa / Egypt (NEUMANN 1989, NEUMANN et al. 2000, GERISCH 2004), East Africa (FASOLO et al. 1939-1971), Saudi Arabia (JAGIELLA und KÜRSCHNER 1987), Iran (PARSA PAJOUH et SCHWEINGRUBER 1993), India, Sri Lanka (HAYASHI and NOMURA 1986), Southeast Asia / Malaysia (HAYASHI et al. 1973, NAIR 1998, OGATA et al. 2008), for commercial tropical woods, woods from Australia and the northern temperate region (DADSWELL and ECKERSLEY 1935, ILIC 1991), the mahogany timbers (WHITE and GASSON 2008), etc. An atlas with the main timber trees growing in the countries bordering the far-reaching territory of the western Indian Ocean and the islands within has not yet been compiled. Research facilities include the Forest Research Institute, Wood Anatomy Branch in Dehra Dun, the Institute of Wood Science and Technology, Wood Properties and Uses Division in Bangalore and the CSIRO Division of Forestry and Forest Products in Australia. For the Pacific Ocean region, conferences were hosted by a group of organizations under the title *Pacific Regional Wood Anatomy Conferences* (PRWAC).

The wealth of trees in India found entrance to literature with wood anatomical remarks and on wood anatomy published since colonial times. The English botanist J.S. Gamble, Imperial Forest Department, India, wrote *A manual of Indian timbers* (GAMBLE 1881), R.S. Pearson published together with H.P. Brown the two volumes of *Commercial timbers of India* (PEARSON and BROWN 1932). Six volumes were written under the title *Indian woods* at the Institute in Dehra Dun (CHOWDHURY et al. 1958-2001). Other publications include: *A handbook for field identification of fifty important timbers of India* (RAO and JUNEJA 1971), *Wood anatomy of legumes of India* (CHAUHAN and RAO 2003) and *Timber identification manual* (ANOOP and PASHA undated). Wood samples were collected from different types of forest and woodland vegetation to establish a South Indian wood reference collection conducted by the University of Liverpool; the samples were thin-sectioned and micro-photographs taken (ASOUTI and FULLER 2007).

A number of identifications was carried out on traditional vessels and on shipwreck timbers in the frame of reef explorations and excavation projects. *The Omani Dhow Recording Project* was led by T.A. Vosmer, Department of Maritime Archaeology of the Western Australian Maritime Museum, Fremantle, including the examination of wood and resin. 39 wood samples were taken for species identification (VOSMER et al. 1992: 69-73). Timbers of a 9th century AD shipwreck of an Arabian dhow excavated off the coast of Belitung Island, Indonesia, were examined by the Forestry and Forest Products Division of the CSIRO in Australia and by N. Liphschitz, Institute of Archaeology, Botanical Laboratories, Tel Aviv University (*Afzelia africana*, *A. bipindensis*, *Tectona grandis*, cf. *Juniperus procera*) (FLECKER 2008, 2011: 117). From wreck sites of colonial and later times, several ships of Iberian-Atlantic tradition were studied. Wood samples of a 17th century AD Portuguese shipwreck, of a century-old wreck and from a wooden stock of an iron anchor found off the coast of Goa, India, were examined at the Institute of Wood Science and Technology, Bangalore (*Lagerstroemia microcarpa*, *Lagerstroemia* sp., *Tectona grandis*) (TRIPATI et al. 2005). Archival records from the excavated 16th century frigate *Santo António de Tanna,* wrecked off Mombasa and from the 19th century frigate *Dom Fernando II e Glória* partially destroyed by fire in the mouth of Tagus river, Portugal, mention that the timber used for construction was teak (JORDAN 2001, DUARTE 2012).

12.5.2 Methods and aims

The pieces of wood, small to large, weathered to very well preserved, some with remains of paint, wood treatment and shipworm burrows, were analysed with the use of a Euromex stereo microscope at magnifications of ×40 and ×80 and a high power Euromex reflected light microscope (×60-×500) by cutting in the three sections transversal, tangential longitudinal and radial longitudinal [Figure 1]. For the cuts, double-sided razor blades and single-sided Apollo-Herkenrath Ever-sharp-blades were used. Anatomical characteristics to identify the different types of hard- and softwood are the presence of growth ring boundaries, the pattern of vessel arrangement, wall structures (vessel perforations, vessel pits, helical thickenings, tyloses), wall thickness of fibres, distribution and arrangement of axial parenchyma, ray size and composition, secretory elements (the presence of resin canals or traumatic canals and laticifers) and mineral inclusions (crystals). For each sample, the properties of colour, hardness, strength, odour and anatomical characters were recorded in a working list.

The taxa were determined by excluding timbers with similar anatomy known in the region. They were mainly assigned on the genus level due to wood anatomical similarities, in several cases on the species level considering plant distributions and further diagnostic characters as well as beyond the genus level. Identifications were carried out with wood anatomical literature and databases (GOTTWALD and PARAMESWARAN 1966, VAN VLIET 1979, CHAUHAN and DAYAL 1985, FAHN et al. 1986, JAGIELLA und KÜRSCHNER 1987, ILIC 1991, HÖHN 1999, GALE and CUTLER 2000, NEUMANN et al. 2000, RICHTER and DALLWITZ 2000 onwards, BENKOVA and SCHWEINGRUBER 2004, INSIDE WOOD 2004 onwards, ASOUTI and FULLER 2007, PANDE et al. 2007, WHITE and GASSON 2008, OGATA et al. 2008, etc.) and a reference collection. The photographic documentation was undertaken with a ScopeTek DCM310 microscope camera. The magnification of the pictures was determined with help of a Bresser Slide with micrometric scale (0.1 mm).

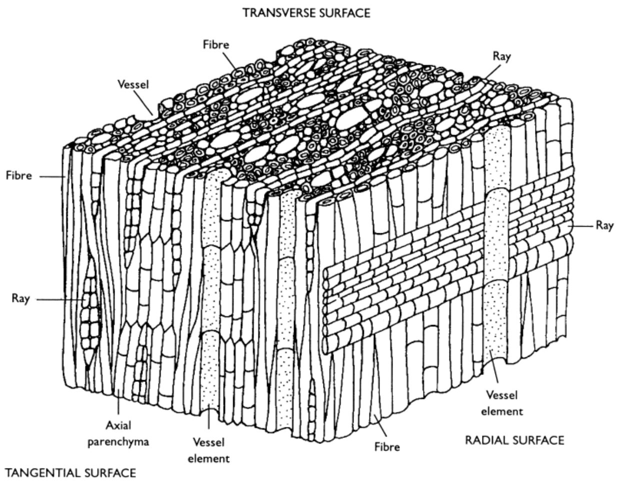


Figure 1: Wood block with the anatomical sections (GALE and CUTLER 2000: 6: Figure 1)

Aims of the studies were to identify the woods used in boat and shipbuilding, for which parts they were used in construction and to document them in descriptions and a selection of illustrations. The results should contribute to identifications and interviews of other fieldwork projects.

*12.5.3 **Results***

The spectrum of taxa obtained from the samples shows a wide range of local and foreign woody plants which are native to different geographical regions. It is dominated by strong and durable tropical and subtropical hardwoods, some taxa are of Holarctic origin. Sample labelling indicate that wood was obtained from Europe, North and East Africa and from India.

Among the 39 taxa are six from conifers, six which belong to the Meliaceae mahoganies, one which belongs to the meranti group and one to the mangroves. Represented are members of the gymnosperm plant families Cupressaceae and Pinaceae, the angiosperm plant families Anacardiaceae, Combretaceae, Dipterocarpaceae, Fabaceae, Meliaceae, Moraceae and others. More commonly found woods in the collected samples are those from *Pinus* sp., *Conocarpus lancifolius*, *Dipterocarpus* sp., *Mangifera indica*, *Melia* sp., *Tectona grandis* and *Ziziphus* sp., less frequently those from *Picea* sp., *Calophyllum* sp., *Dalbergia* sp. and *Shorea* sp., in single pieces e.g. from *Artocarpus* sp. and *Lagerstroemia* sp. No stem or leaf pieces of palms like from *Cocos nucifera* or *Phoenix dactylifera* have been found. One sample was collected from a mast made of bamboo cane. Bamboo belongs to the family of the Poaceae, subfamily Bambusoideae.

12.5.4 ***Wood anatomical atlas***

12.5.4.1 Identification key

Included in the dichotomous key are taxa identified from the samples and additional taxa of trees and palms used for boat and shipbuilding in the observed region in past and modern times comprising 69 taxa. The characters are chosen in the way that it is also suitable for charred wood. Page numbers are given for the anatomical descriptions of the identified taxa, for those of the other taxa it is referred to the above mentioned literature and databases. The key provides an overview for the examination of wood samples and cannot replace the use of anatomical descriptions, illustrations and modern reference material. It is not complete and therefore cannot provide reliable identifications. Information on the stem anatomy of *Cocos nucifera* was obtained from TOMLINSON (1961: 189, 197). Results of identifications on Middle Kingdom and Roman period boat and ship timbers excavated at Mersa/Wadi Gawasis (GERISCH 2007: 185-188 and others) and at Berenike (VERMEEREN 2000/2003 and others), of wood identifications from ship wrecks and the compilation of local and foreign woods as resources for boat and shipbuilding in ancient Egypt by WARD (2000: 15-24) were also considered.

1. Vessels absent . . . . (Gymnospermae) **2**
- Vessels present . . . . (Angiospermae) **9**

2. Resin canals or sometimes traumatic canals present, cross-field pits pinoid, window-like, piceoid or taxodioid in the earlywood . . . . (Pinaceae) **3**

- Resin canals or traumatic canals absent, cross-field pits cupressoid . . . .
(Cupressaceae, Taxodiaceae) **7**

3. Resin canals present, rays up to 15(25) cells high **4**
- Traumatic canals sometimes present, rays up to 25(40) cells high **6**

4. Cross-field pits pinoid or window-like . . . . **Pinus sp.,** p.599
- Cross-field pits piceoid **5**

5. Transition from early- to latewood gradual, longitudinal tracheids generally with one row of bordered pits . . . . **Picea sp.,** p. 599
- Transition from early- to latewood abrupt, longitudinal tracheids generally with two rows of bordered pits . . . . **Larix sp.,** p. 599

6. Transverse tracheids absent, bordered pits without scalloped tori . . . . . **Abies sp.***
- Transverse tracheids present, bordered pits with scalloped tori . . . **Cedrus libani***

7. Tracheids with distinct helical thickenings . . . . **Taxus baccata***
- Tracheids without helical thickenings **8**

8. Rays up to 8(12) cells high . . . . **Juniperus sp.,** p. 598
- Rays up to 20(40) cells high . . . . **Cupressus sp.***

9. (2-). Vessels in discrete vascular bundles accompanied by fibre caps scattered in parenchymatous ground tissue . . . . (Liliopsida) **66**
- Vessels not in discrete vascular bundles . . . . (Rosopsida) **10**

10. Wood ring- to diffuse-porous, axial parenchyma in bands, paratracheal aliform and confluent, sometimes winged-aliform, rays uniseriate or 1-2-seriate, homocellular, not storied . . . . **Lagerstroemia sp.,** p. 607
- Wood not as above **11**

11. Initial bands in association with the earlywood vessels, axial parenchyma paratracheal scanty and vasicentric, heterocellular, tyloses absent, helical thickenings in vessel elements absent . . . . **Toona sp.***

- Wood not as above **12**

12. Vessels mainly solitary, sometimes in small clusters, axial parenchyma mainly paratracheal vasicentric, rays wide, heterocellular **13**

- Wood not as above **14**

13. Rays up to 23 cells wide . . . . **Tamarix aphylla,** p. 611

- Rays less wide . . . .**Tamarix sp.***

14. Rays storied, uniseriate or 1-3-seriate, ray height low, axial parenchyma not in broad bands **15**

- Parenchyma different **17**

15. Rays mainly uniseriate . . . .**Pterocarpus sp.***

- Rays mainly 1-3-seriate **16**

16. Heartwood of black colour . . . . **Dalbergia melanoxylon,** p. 603

- Heartwood of other colour . . . . **Dalbergia sp.,** p. 603

17. Helical thickenings in vessel elements present, latewood vessels or latewood vessels and axial parenchyma not forming tangential or loose tangential bands **18**

- Wood not as above **22**

18. Radial resin canals present . . . .**Pistacia sp.***

- Radial resin canals absent **19**

19. Intervessel pits vestured . . . . **Prosopis juliflora***

- Intervessel pits not vestured **20**

20. Axial parenchyma in marginal bands, mainly up to 4 cells wide **21**

- Banded axial parenchyma more abundant, 3-6(10) cells wide **Azadirachta indica,** p. 601

21. Wood ring- to semi-ring-porous, prismatic crystals abundant in chambered axial parenchyma cells . . . . **Melia azedarach,** p. 608

- Wood diffuse-porous, prismatic crystals occasionally present in ray cells and in axial parenchyma . . . .**Melia composita***

22. (18-). Wood ring-porous, ring- to semi-ring-porous **23**
- Wood semi-ring- to diffuse-porous, diffuse-porous **27**

23. Earlywood vessels in one row included in a band of axial parenchyma . . . . **Tectona grandis,** p. 612
- Earlywood vessels not included in a band of axial parenchyma **24**

24. Rays of two distinct sizes, uniseriates and less frequent wide multiseriates . . . . **Quercus sp., deciduous,** p. 610
- Rays not of two distinct sizes **25**

25. Rays 1-3-seriate, helical thickenings in vessels elements absent . . . **Fraxinus sp.***
- Rays up to 8-seriate, helical thickenings present in narrow vessels **26**

26. Latewood vessels in diagonal or tangential bands, sometimes undulating (ulmiform) .. . . **Ulmus sp.***
- Latewood vessels together with axial parenchyma in loose dendritic or tangential bands . . . . **Morus sp.,** p. 608

27. (22-). Included phloem present, sclereid bands divide the conjunctive parenchyma in an inner region that includes the phloem groups and an outer region . . . . **Avicennia marina,** p. 601
- Included phloem absent **28**

28. Axial parenchyma scalariform **29**
- Axial parenchyma not scalariform **30**

29. Rays 9-20(35) cells wide . . . . **Balanites aegyptiaca***
- Rays less wide . . . .**Bombax sp.***

30. Rays regularly or irregularly storied, horizontal or in echelon, axial or radial resin canals absent **31**

- Wood not as above **33**

31. Rays uniseriate . . . . **Faidherbia albida***

- Rays up to 5(6)-seriate **32**

32. Marginal and non-marginal bands common, fibres mostly non-septate . . . .
Entandrophragma sp., p. 604

- Marginal and non-marginal bands less common, septate fibres in varying abundance . . . . **Swietenia sp.,** p.611

33. Vessels usually solitary, not arranged in diagonal/radial pattern, axial parenchyma in more than 3 cells wide bands . . . . **Celastraceae,** p. 602-603

- Wood not as above **34**

34. Axial parenchyma bands common, 2-4 cells wide, rays not in two distinct sizes, intervessel pits not vestured . . . . **Dysoxylum sp.***

- Wood not as above **35**

35. Vessels arranged in diagonal/radial pattern, axial parenchyma bands usually not prominent . . . . **Eucalyptus/Corymbia sp.,** p. 605

- Wood not as above **36**

36. Axial parenchyma vasicentric, aliform, confluent, often heterocellular rays present, growth ring boundaries can be marked by thick-walled fibres or darker tint in latewood, axial canals absent, intervessel pits vestured **37**

- Wood not as above **39**

37. Vessels mainly larger and not numerous . . . . **Terminalia sp.,** p. 612

- Vessels smaller and more numerous **38**

38. Rays with procumbent, square and upright cells mixed throughout the ray . . . .
Anogeissus sp.*

- Heterocellular rays with one row of square/upright marginal cells **39**

39. (30-). Rays uniseriate or predominantly uniseriate **40**

- Rays multiseriates **45**

40. Large vessel-ray pits present **41**
- Large vessel-ray pits absent **42**

41. Rays composed of procumbent cells . . . . **Populus sp.,** p. 609
- Rays composed of procumbent cells and 1-2 rows of square/upright marginal cells . . . . **Salix sp.***

42. Intervessel pits vestured **43**
- Intervessel pits not vestured **44**

43. Prismatic crystals in axial parenchyma cells, in square/upright marginal and procumbent ray cells present . . . . **Conocarpus lancifolius,** p. 610
- Prismatic crystals not in axial parenchyma cells and in ray cells present . . . . **Lumnitzera sp.***

44. Vessels solitary, arranged in diagonal/radial pattern . . . . **Calophyllum sp.,** p. 602
- Vessels not solitary and arranged in diagonal/radial pattern . . . . **Ziziphus sp.,** p. 613

45. (40-). Scalariform vessel perforations present **46**
- Scalariform vessel perforations absent **50**

46. Intervessel pits scalariform **47**
- Intervessel pits not scalariform **48**

47. Winged-aliform and confluent parenchyma present . . . . **Ceriops tagal***
- Winged-aliform and confluent parenchyma absent . . **Rhizophora/Bruguiera sp.***

48. Narrow axial parenchyma bands common . . . . **Casuarina sp.***
- Narrow axial parenchyma bands not common **49**

49. Rays of two distinct sizes, broader rays up to 20-seriate . . . .**Fagus sp.,** p. 605
- Rays not of two distinct sizes, up to 12-seriate . . . .**Platanus sp.,** p.609

50. (47-). Rays homocellular **51**

- Rays heterocellular **56**

51. Uniseriate and less frequent wide multiseriates rays present . . . .
Quercus sp., evergreen/Lithocarpus sp., p. 610

- Uniseriate and wide multiseriates rays absent **52**

52. Rays tangentially higher (separation below for species in North Africa and the Near East) **53**

- Rays tangentially lower **54**

53. Axial parenchyma paratracheal vasicentric, aliform, less frequently confluent, rays 1-4(5)-seriate . . . . **Acacia nilotica,** p. 600

- Axial parenchyma paratracheal aliform, confluent and in bands, rays 1-10(14)-seriate . . . . **Acacia sp.***

54. Prismatic crystals in fibres present . . . .**Tamarindus indica***

- Prismatic crystals in most species absent **55**

55. Paratracheal vasicentric parenchyma in many species present, rays 1-4(5)-seriate .
Albizia sp., p. 600
Prosopis sp.*

- Paratracheal vasicentric parenchyma in many species absent, lozenge-aliform parenchyma prominent, rays 1-3-seriate . . . .**Afzelia sp.***

56. (50-). Axial parenchyma absent or extremely rare . .**Burseraceae/Anacardiaceae,** p.602

- Axial parenchyma not absent or extremely rare **57**

57. Axial resin canals present **58**

- Axial resin canals absent **61**

58. Axial resin canals diffuse and in short tangential lines . . . .**Dipterocarpus sp.,** p.604

Axial resin canals in short and long tangential lines **59**

59. In rays in tangential section large cells interspersed among small cells

Hopea sp., p. 606

Large cells not interspersed among small cells **60**

60. Vessels predominantly solitary . . . . **Dryobalanops sp.***

Vessels solitary and in radial multiples . . . . **Shorea sp.,** p. 610

61. (58-). Laticifers present in rays **62**

- Laticifers absent in rays **64**

62. Axial parenchyma in tangential bands alternating with fibre bands **63**

- Axial parenchyma not in bands alternating with fibre bands . . . . . **Artocarpus sp.,** p.601

63. Axial parenchyma bands 6-20 cells wide, rays up to 14-seriate . **Ficus sycomorus,** p.606

- Axial parenchyma bands and rays less wide . . . . **Ficus sp.***

64. Rays of two distinct sizes, short uniseriate and biseriate rays and multiseriate rays up to 6 cells wide . . . . **Khaya sp.,** p.607

- Rays not of two distinct sizes **65**

65. Rays with one row of square/upright marginal cells . . . . **Mangifera indica,** p.607

- Rays with 2-4 or more rows of square/upright marginal cells . . . . **Mimusops sp.***

66. (61-). Stem with nodal and internodal regions, internodal regions hollow forming cavities, vascular bundles surrounded by lignified fibre cells . . . . **Bambusoideae***

- Stem with a wide central cylinder and a narrow cortex, vascular bundles accompanied by a cap of fibres on the phloem side . . . .(Arecaceae) **67**

67. End walls of metaxylem vessels in the stem with simple perforations . . . .

Cocos nucifera*

Hyphaene thebaica*

- End walls of metaxylem vessels in the stem with scalariform perforations . . . .

Phoenix dactylifera*

***** taxon not contained in the anatomical descriptions, except of the bamboo not identified from the samples.

12.5.4.2 Descriptions

Scheme: Running number. Wood taxon, species name with author abbreviation(s) (plant family-subfamily), assigned to the genus level: possible species referred to the sample material, author abbreviation(s), English vernacular name(s), assigned to the species level: syn.: synonym, English vernacular name: category(ies) of wood, trade name, species or representatives of the genus protected by CITES (Convention on International Trade of Endangered Species of Wild Fauna and Flora) and IUCN (International Union for Conservation of Nature). - Wood properties. - Wood anatomical description (abbreviations: TS: transverse section, TLS: longitudinal tangential section, RLS: longitudinal radial section) [reference to the relevant plate]. Diagnostic remarks. Reference to anatomical literature. Examined samples: country(ies) (places). The wood properties were obtained from the samples and BEGEMANN (1981-1994). The descriptions of the anatomical characters follow the list for hardwood identification established by the IAWA COMMITTEE (1989).

1. ***Cupressus* sp.** (Cupressaceae), *C. sempervirens* L., Italian cypress, Mediterranean cypress, pencil pine: coniferous softwood.
Heartwood yellowish brown or reddish brown, sapwood light brown, wood hard, strong and durable, aromatic.
TS: growth ring boundaries distinct, transition from early- to latewood gradual, axial parenchyma diffuse and in tangential bands, resin canals absent, TLS and RLS: rays uniseriate, rarely biseriate, (1)3-20(40) cells high, homocellular, ray cells thick-walled, with smooth to faintly nodular end walls, cross-field pits cupressoid, with elliptic to slit-like included apertures, horizontal end walls of axial parenchyma smooth to faintly nodular. Diagnostic remarks: The wood is recognizable by the absence of resin canals and transverse tracheids, by rays up to 20(40) cells high and cupressoid cross-field pits. Literature: FAHN et al. (1986: 55, Plate 1A-D). Sample: Saudi Arabia (Jeddah / Ship 1).

2. ***Juniperus* sp.** (Cupressaceae), *J. procera* HOCHST. ex ENDL., African juniper, African pencil cedar, East African cedar: coniferous softwood.
Heartwood reddish brown, sapwood yellowish white, wood moderately heavy, durable and aromatic.

TS: growth ring boundaries distinct, transition from early- to latewood gradual, axial parenchyma diffuse and in loose tangential bands throughout the growth ring, resin canals absent, TLS and RLS: rays uniseriate, rarely biseriate, 1-8(14) cells high, homocellular, ray cells thick-walled, with nodular end walls, cross-field pits cupressoid, with elliptic to slit-like included apertures, horizontal end walls of axial parenchyma pitted to smooth [Plate 1]. Diagnostic remarks: *Juniperus* can be differentiated from *Cupressus* by its low ray height and a higher ray frequency. Literature: FAHN et al. (1986: 55-56, Plate 2A-D). Sample: Saudi Arabia (Jeddah / Ship 1).

3, 4. ***Picea* sp.**, ***Picea*/*Larix* sp.** (Pinaceae), *P. abies* (L.) KARST., common spruce, European spruce: coniferous softwood.
Wood pale, light, soft, moderately durable, *Larix*: reddish brown, harder, strong and durable, aromatic.
TS: growth ring boundaries distinct, transition from early- to latewood gradual in *Picea*, abrupt in *Larix*, axial parenchyma absent, resin canals in latewood, with thick-walled epithelial cells, TLS and RLS: rays uniseriate, rarely biseriate, 10-15(25) cells high, heterocellular, with one marginal row of ray tracheids, walls smooth, horizontal walls of ray cells pitted, with nodular end walls and indentures, cross-field pits piceoid, sometimes cupressoid in earlywood, radial resin canals in fusiform rays. Diagnostic remarks: The wood of *Pinus* can be separated by resin canals with thin-walled epithelial cells and by pinoid or window-like cross-field pits. Literature: HATHER (2000: 40-43). Sample: Eritrea (Massawa), Djibouti (Port de Pêche), Saudi Arabia (Farasan Islands / Khutub, Sayer; Jeddah / Ships 1 and 2, Jizan / Al Hafa), Qatar (Doha).

5. ***Pinus* sp., window-like cross-field pits** (Pinaceae), *P. nigra* J.F. ARN., black pine, *P. sylvestris* L., Scots pine: coniferous softwood.
Heartwood pale yellow to light reddish brown, sapwood pale yellow to nearly white, wood moderately heavy to heavy, moderately hard to hard and less durable, resinous.
TS: growth ring boundaries distinct, transition from early- to latewood usually abrupt, sometimes gradual, axial resin canals in transition zone and in latewood, with thin-walled epithelial cells, TLS and RLS: rays uniseriate, rarely biseriate, 3-15(22) cells high, heterocellular, with one or more marginal rows of ray tracheids, ray cells thick-walled, in some species with nodular end walls, ray tracheid walls dentate, cross-field pits window-like, resin canals in fusiform rays [Plate 2]. Literature: HATHER (2000: 34-35). Samples: Egypt (Lake Burullus / Qassas Shipyard, Rasheed / Lahma Shipyard),

Djibouti (Ras Ali), Saudi Arabia (Farasan Islands / Abou el Toog, Ali Kibani Workshop, Saddayn, Tibta; Jeddah / Ship 1, Jizan / Al Hafa), Yemen (Al-Qudbah).

6. **Pinaceae –** resin canals observed, not further identified due to wood treatment, etc. Samples: Djibouti (Port de Pêche), Saudi Arabia (Farasan Islands / Sayer).

7. ***Acacia nilotica*** (L.) WILLD. ex DEL. (Fabaceae-Mimosoideae), syn.: *A. arabica* (LAM.) WILLD., Nile acacia: tropical and subtropical hardwood.
Heartwood reddish brown, sapwood pale brown, wood heavy, hard, strong and durable.
TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows and clusters of 2-4, fibres medium thick- to thick-walled, axial parenchyma paratracheal vasicentric, aliform, lozenge-aliform, less frequently confluent and apotracheal diffuse, TLS and RLS: rays 1-4(5)-seriate, up to 40 cells high, homocellular, composed of procumbent cells, intervessel pits vestured, prismatic crystals in chambered axial parenchyma cells [Plate 3]. Diagnostic remarks: *A. nilotica* can be separated from other North African acacia species mainly by its vasicentric parenchyma. In *Prosopis africana* (GUILL. & PERR.) TAUB. (Fabaceae-Mimosoideae), lower rays occur and septate fibres are present. Literature: NEUMANN et al. (2000: 300-301). Samples: Egypt (Lake Burullus / Qassas Shipyard, Rasheed / Lahma Shipyard).

8. ***Albizia* sp.** (Fabaceae-Mimosoideae): tropical and subtropical hardwood.
Heartwood brown, often with blackish brown to purplish brown streaks, sapwood yellowish white, wood heavy, hard, strong and durable, several threatened IUCN Red List species.
TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, fibres thin- to thick-walled, axial parenchyma in marginal bands, up to 3 cells wide, paratracheal vasicentric, sheath broad, aliform, lozenge-aliform and confluent, TLS and RLS: rays 1-3-seriate, up to 22 cells high, homocellular, composed of procumbent cells, intervessel pits vestured, septate fibres present, prismatic crystals in chambered axial parenchyma cells. Diagnostic remarks: In *Afzelia* and *Tamarindus indica* L. (Fabaceae-Caesalpinioideae), lozenge-aliform parenchyma occurs more prominently. Literature: CHAUHAN and DAYAL (1985). Samples: Saudi Arabia (Jeddah / Ship 1).

9. ***Artocarpus* sp.** (Moraceae), *A. heterophyllus* LAM., jackfruit tree, *A. hirsutus* LAM., wild jack: tropical and subtropical hardwood.

Heartwood yellowish brown, sapwood greyish or yellowish white, wood light to moderately heavy, moderately hard, strong and durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres thin- to medium thick-walled, arranged in radial rows, axial parenchyma sparse, paratracheal vasicentric, aliform, lozenge-aliform and confluent, TLS and RLS: rays 1-4-seriate, up to 30 cells high, heterocellular, with 1-4 rows of square and/or upright marginal cells, sheath cells sometimes present, laticifers occasionally in rays [Plate 4]. Literature: OGATA et al. (2008: 250-251, Figures 228, 229). Sample: Oman (Film).

10. ***Avicennia marina*** (FORSSK.) VIERH. (Avicenniaceae), grey or white mangrove: tropical and subtropical hardwood, mangrove wood.

Heartwood yellowish grey to reddish brown, sapwood more pale, wood moderately heavy, hard and strong, not durable.

TS: growth ring boundaries distinct, wood diffuse-porous, vessels mostly in radial rows of 2-9, occasionally solitary and in clusters, fibres thick- to very thick-walled, included phloem of the concentric type, embedded in broad bands of lignified conjunctive parenchyma, with sclereids in 1-2(3) cells wide bands dividing the parenchyma into an inner and outer region, axial parenchyma also paratracheal scanty, TLS and RLS: rays 1-6-seriate, up to 30 cells high, heterocellular, composed of mixed procumbent, square and upright cells, small crystals in most ray cells, also druses [Plate 5]. Diagnostic remarks: The wood of *Avicennia* is easily distinguishable from that of other mangrove genera. Literature: FAHN et al. (1986: 73-74, Plate 14A-C). Sample: Eritrea (Massawa).

11. ***Azadirachta indica*** A. JUSS. (Meliaceae), syn.: *Melia azadirachta* L., neem tree: tropical hardwood, mahogany.

Heartwood pale to dark reddish brown, sapwood yellowish white, similar to that of *Melia*, wood heavy, hard, strong and durable.

TS: growth ring boundaries distinct, wood diffuse-porous, vessels solitary and in radial rows and clusters of 2-6, fibres medium thick- to thick-walled, axial parenchyma in marginal and non-marginal bands, 3-6(10) cells wide, paratracheal scanty and vasicentric, intercellular axial canals of traumatic origin occasionally present, TLS and RLS: rays (1)2-3(4)-seriate, up to 20 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, helical thickenings in vessel elements, fibres rarely septate, prismatic crystals in chambered axial parenchyma cells. Diagnostic remarks: *A. indica* can be differentiated from *Melia azedarach* by its diffuse-porous wood and more abundant banded axial parenchyma. It is similar to *A. excelsa* (JACK) JACOBS, which grows naturally in Thailand, Malaysia, Indonesia and the Philippines. *M. azedarach* is distinctive by its ring- to semi-ring-porous wood and diagonal pattern of vessels. In *Khaya*, prismatic crystals occur mainly in square/upright ray cells, rarely in axial parenchyma cells. Literature: NEUMANN et al. (2000: 342-343). Sample: Saudi Arabia (Jizan / Al Hafa).

12. **Burseraceae/Anacardiaceae**: tropical hardwood.
Heartwood reddish brown, wood hard and strong, moderately durable.
TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses absent, fibres thin- to very thick-walled, axial parenchyma very rare, paratracheal scanty, radial canals present, TLS and RLS: rays mainly biseriate, some uniseriate, up to 22 cells high, heterocellular with 1-2 rows of square and/or upright marginal cells, prismatic crystals rarely present, in procumbent and square/upright ray cells and in fibres. Literature: INSIDE WOOD (2004 onwards). Sample: Djibouti (Ras Ali).

13. ***Calophyllum* sp.** (Clusiaceae), *C. angustifolium* ROXB., poon spar, *C. inophyllum* L., Alexandrian laurel: tropical hardwood, several threatened IUCN Red List species.
Heartwood reddish brown, sapwood yellowish brown to orange, wood moderately heavy, hard and strong, not durable.
TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels solitary, arranged in a diagonal/radial pattern, tyloses present, fibres thin- to thick-walled, axial parenchyma in marginal and non-marginal bands, 1-3 cells wide, paratracheal vasicentric, confluent, apotracheal diffuse and diffuse-in-aggregates, TLS and RLS: rays 1(2)-seriate, up to 23 cells high, heterocellular, with 1-4 rows of square and/or upright marginal cells, prismatic crystals in chambered axial parenchyma cells [Plate 6]. Diagnostic remarks: The wood is easily recognizable by its vessel pattern and uniseriate rays. Literature: ILIC (1991: 14-15, 137-138). Samples: Yemen (Aden / Dakkat al Ghaz), Oman (Mahoot Island).

14. **Celastraceae**: tropical hardwood.

Heartwood reddish brown, wood hard and strong, moderately durable.

TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels solitary, in other species also in multiples of 2-3(5), tyloses absent, fibres thin- to very thick-walled, axial parenchyma in marginal and non-marginal bands, up to 7 cells wide, TLS and RLS: rays 1-2-seriate, up to 30 cells high, homocellular, composed of procumbent cells, in other species also heterocellular, vessel perforations simple, in other species also scalariform. Literature: INSIDE WOOD (2004 onwards). Sample: Saudi Arabia (Jeddah / Ship 1).

15. ***Conocarpus lancifolius*** ENGL. (Combretaceae), axlewood: tropical hardwood.

Wood greyish white to olive brown, moderately heavy, hard, strong and durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, fibres thin- to thick-walled, axial parenchyma paratracheal scanty, vasicentric, aliform and apotracheal diffuse, TLS and RLS: rays 1(2)-seriate, up to 15 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, intervessel pits vestured, prismatic crystals in procumbent and square/upright ray cells and in non-chambered axial parenchyma cells [Plate 7]. Diagnostic remarks: The other representative of the genus, *C. erectus* L., has a similar wood anatomy. It differs through the presence of narrow bands and winged-aliform parenchyma. In *Anogeissus leiocarpus* (DC.) GUILL. & PERR. (Combretaceae), prismatic crystals are not observed in axial parenchyma cells and rays are composed of mixed procumbent, square and upright cells. Literature: INSIDE WOOD (2004 onwards). Samples: Djibouti (Obock Shia, Port de Pêche, Ras Ali), Yemen (Ma'alla), Saudi Arabia (Jizan / Al Hafa).

16, 17. ***Dalbergia melanoxylon*** GUILL. & PERR. (Fabaceae-Papilionoideae), African blackwood, grenadilla, ***Dalbergia* sp.**, (*D. latifolia* ROXB., East Indian rosewood, Bombay blackwood, and another species): tropical and subtropical hardwood, rosewood, several CITES species, Appendix II and threatened IUCN Red List species.

Heartwood golden brown to darker reddish brown or dark brown to black (in *D. melanoxylon* almost black), sapwood pale yellow, wood hard, strong and durable.

TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, fibres thick-walled, axial parenchyma in irregular marginal and non-marginal bands, 1-3 cells wide or more than 3 cells wide, in some species reticulate, paratracheal scanty, vasicentric, aliform, lozenge-aliform, winged-aliform and apotracheal diffuse-in-aggregates, TLS and RLS: rays 1-3-seriate, up to 14 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, rays, axial parenchyma and vessel elements storied, intervessel pits vestured, prismatic crystals in procumbent ray cells and in chambered axial parenchyma cells [Plate 8]. Diagnostic remarks: *Dalbergia* can be confused with *Pterocarpus*, but the latter genus has predominantly uniseriate rays. Literature: NEUMANN et al. (2000: 330-331). Samples: Egypt (Suez Shipyard), Djibouti (Ras Ali), Oman (Mahoot Island).

18. ***Dipterocarpus* sp.** (Dipterocarpaceae): tropical hardwood, keruing, threatened IUCN Red List species.

Heartwood orange/reddish to dark brown, sapwood from a light to medium yellowish brown to a pale greyish brown, wood moderately heavy, moderately hard and less durable, moderate to poor insect resistant.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels predominantly solitary, occasionally in pairs, tyloses present, fibres medium-thick- to very thick-walled, axial parenchyma scanty paratracheal to vasicentric and irregularly diffuse, axial resin canals diffuse and in short tangential lines, TLS and RLS: rays 1-3- to 1-7-seriate, with a tendency of two sizes, up to 84 cells high, heterocellular, with 2-4 rows of square and/or upright marginal cells, intervessel pits vestured, silica bodies in ray cells. Diagnostic remarks: The wood is recognizable by its solitary vessels and diffuse axial resin canals. Literature: OGATA et al. (2008: 82-83, Figures 71, 72). Samples: Saudi Arabia (Farasan Islands / Khola, Khutub, Jeddah / Ship 1), Yemen (Khor al-Ghurayrah).

19. ***Entandrophragma* sp.** (Meliaceae), tropical hardwood, mahogany, threatened IUCN Red List species.

Heartwood reddish brown, sapwood reddish grey, wood heavy, moderately hard to hard, moderately strong and durable.

TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels commonly solitary and in pairs, fibres thin- to very thick-walled, axial parenchyma in irregular marginal and non-marginal bands, 2-5 cells wide, paratracheal scanty and vasicentric, sometimes extending to lozenge-aliform, intercellular axial canals of traumatic origin sometimes present, TLS and RLS: rays (1)3-4(5)-seriate, up to 24 cells high, heterocellular, with one row of square and/or upright marginal cells, irregularly storied, often in echelon, fibres septate and non-septate, prismatic crystals in square/upright ray cells and in chambered and non-chambered axial parenchyma cells [Plate 9]. Diagnostic remarks: Easily distinguished from other mahogany woods by its parenchyma bands and rays storied in echelon. The partly weavy parenchyma bands are similar to those of *Dysoxylum* (Meliaceae), but in the latter genus, the bands are more numerous, the rays are narrower and not storied. Literature: WHITE and GASSON (2008: 42-45). Samples: Egypt (Alex Anfushi), Saudi Arabia (Farasan Islands / Ali Kibani Workshop).

20. ***Eucalyptus*/C*orymbia* sp.** (Myrtaceae), *E. camaldulensis* DEHNH., river red gum, *C. citriodora* (HOOK.) K.D. HILL & L.A.S. JOHNSON, lemon scented gum: tropical and subtropical hardwood.

Heartwood reddish brown to deep red, sapwood distinctly paler / heartwood pale brown to greyish brown, sapwood white to cream, heavy, hard, strong and durable.

TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels predominantly solitary (*E. camaldulensis*), also in multiples of 2-4 (*C. citriodora*), arranged in a diagonal/radial pattern, tyloses present, fibres thin- to thick-walled, axial parenchyma paratracheal scanty, vasicentric, apotracheal diffuse and diffuse-in-aggregates (*E. camaldulensis*), vasicentric, aliform, winged-aliform, confluent, in bands and diffuse (*C. citriodora*), TLS and RLS: rays 1-2(3)-seriate, up to 15 cells high, numerous, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, intervessel pits vestured, sometimes prismatic crystals in chambered axial parenchyma cells [Plate 10]. Literature: ILIC (1991: 45-50, 338-364). Samples: Egypt (Lake Burullus / Qassas Shipyard, Rasheed / Lahma Shipyard).

21. ***Fagus* sp.** (Fagaceae), *F. orientalis* LIPSKY, Oriental beech, *F. sylvatica* L., European beech: temperate hardwood.

Wood reddish white to pale grey, heavy, hard and strong, less durable.

TS: growth ring boundaries distinct, wood semi-ring- to diffuse-porous, vessels numerous, small, decreasing in latewood, solitary, in short radial rows and clusters, tyloses present, fibres medium thick- to thick-walled, axial parenchyma sometimes in incomplete uniseriate bands, apotracheal diffuse and diffuse-in-aggregates, TLS and RLS: rays of two distinct sizes, narrower rays up to 4-seriate, wider rays up to 20-seriate, heterocellular, with 1-4 rows of square and/or upright marginal cells, vessel perforations both simple and scalariform, prismatic crystals in procumbent ray cells and in non-chambered axial parenchyma cells. Diagnostic remarks: The genus *Platanus* has a similar wood anatomy, but can be differentiated by less broad rays and prismatic crystals in procumbent ray cells. Literature: GALE and CUTLER (2000: 110-112). Sample: Egypt (Alexandria/Anfushi).

22. ***Ficus sycomorus*** L. (Moraceae), sycomore fig, mulberry fig: tropical and subtropical hardwood.

Wood dark yellow with numerous brown dots, fibrous, light, moderately hard, strong and durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in radial rows and clusters of 2-5, tyloses present, fibres thin- to medium thick-walled, axial parenchyma in bands, up to 20 cells wide, also paratracheal vasicentric, TLS and RLS: rays 1-14-seriate, up to 65 cells high, heterocellular, with one row of square and/or upright marginal cells, fibres septate and non-septate, laticifers occasionally in rays, prismatic crystals in procumbent ray cells and in non-chambered axial parenchyma cells [Plate 11]. Diagnostic remarks: The wood is separable from that of other fig species due to its broad parenchyma bands and rays. Literature: NEUMANN et al. (2000: 356-357). Sample: Egypt (Rasheed / Lahma Shipyard).

23. ***Hopea* sp.** (Dipterocarpaceae): tropical hardwood, threatened IUCN Red List species.

Heartwood yellowish to dark brown, sapwood pale yellow, wood heavy, hard, strong and durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres thin- to very thick-walled, axial parenchyma in marginal bands, up to 3 cells wide, paratracheal vasicentric, aliform, lozenge-aliform, confluent, apotracheal diffuse and diffuse-in-aggregates, axial resin canals in short and long tangential lines, included in axial parenchyma bands, TLS and RLS: rays 1-4-seriate, up to 28 cells high, heterocellular, with 1-4 rows of square and/or upright marginal cells, large cells interspersed among small cells, rays and fibres irregularly storied, intervessel pits vestured, prismatic crystals in square/upright and procumbent ray cells, in procumbent cells in radial alignment. Diagnostic remarks: see *Shorea* sp. Literature: OGATA et al. (2008: 86-87, Figures 75, 76). Samples: Saudi Arabia (Jizan / Al Hafa).

24. ***Khaya* sp.** (Meliaceae): tropical hardwood, mahogany, threatened IUCN Red List species.

Heartwood reddish brown, sapwood yellowish white, wood moderately heavy and hard, durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, fibres thin- to very thick-walled, axial parenchyma rarely in bands, paratracheal scanty and vasicentric, intercellular axial canals of traumatic origin occasionally present, TLS and RLS: rays of two distinct sizes, 1-2-seriates and up to 6-seriates, up to 28 cells high, heterocellular, with 1-4 or more rows of square and/or upright marginal cells, fibres septate and non-septate, prismatic crystals in square/upright ray cells. Diagnostic remarks: The wood is similar to that of *Swietenia*, but can be separated by the absence or rare occurrence of banded parenchyma, the absence of storied rays and the presence of rays of two distinct sizes. Literature: NEUMANN et al. (2000: 344-345). Sample: Djibouti (Port de Pêche).

25. ***Lagerstroemia* sp.** (Lythraceae), *L. parviflora* ROXB., small flowered crape myrtle, and others: tropical and subtropical hardwood, some threatened Red List species.

Heartwood golden brown to reddish brown, sapwood paler grey or pink, wood moderately heavy and hard, strong and durable.

TS: growth ring boundaries distinct, wood semi-ring- to diffuse-porous, vessels solitary and in multiples, commonly in short radial rows of 2-3, tyloses present, fibres thin- to thick-walled, axial parenchyma in more than 3 cells wide bands, paratracheal aliform, winged-aliform and confluent, TLS and RLS: rays uniseriate, up to 23 cells high, homocellular, composed of procumbent cells, intervessel pits vestured, fibres septate, prismatic crystals in chambered axial parenchyma cells and in fibres [Plate 12]. Diagnostic remarks: The wood is recognizable by the arrangement of axial parenchyma, the presence of tyloses and uniseriate homocellular rays. Literature: ILIC (1991: 37, 294-295). Sample: Yemen (Aden).

26. ***Mangifera indica*** L. (Anacardiaceae), mango, mango tree: tropical hardwood.

Wood yellowish brown with streaks of pink or black, moderately heavy and hard, less strong and durable.

TS: growth ring boundaries distinct to indistinct, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres medium thick-walled, arranged in radial rows, axial parenchyma in marginal bands, 3-10 cells wide, paratracheal vasicentric, aliform, lozenge-aliform, winged-aliform and confluent, TLS and RLS: rays 1-2(3)-seriate, up to 18 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, prismatic crystals in procumbent and square/upright ray cells and in non-chambered axial parenchyma cells [Plate 13]. Literature: NEUMANN et al. (2000: 118-119). Samples: Sudan (Port of Suakin), Eritrea (Museum, Massawa), Djibouti (Obock Shia, Port de Pêche, Tadjoura Beach), Saudi Arabia (Farasan Islands /Ali Kibani Workshop, Qumah Island, Saddayn), Yemen (Al-Mayfar, Aden, Fuqum), Oman (Oman/ As-Suwaih, Film).

27, 28. ***Melia azedarach*** **L.** (Meliaceae), white cedar, Chinaberry, Persian lilac, ***Melia*** **sp./*Azadirachta indica***: tropical hardwood, mahogany.

Heartwood golden brown to pinkish/reddish brown, darker brown streaks, sapwood yellowish white, wood hard and moderately durable.

TS: growth ring boundaries distinct, growth rings in wood from plantations often wide, up to 2 cm, wood ring- to semi-ring-porous, vessels solitary and in radial rows or clusters of 2-4, in a diagonal/radial pattern, fibres thin- to thick-walled, axial parenchyma in marginal bands, up to 4 cells wide, paratracheal vasicentric, confluent and apotracheal diffuse, intercellular axial canals of traumatic origin occasionally present, TLS and RLS: rays (1)3-4(6)-seriate, up to 22 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, helical thickenings in small vessel elements, prismatic crystals in chambered axial parenchyma cells [Plate 14]. *Melia* sp./*Azadirachta indica*: wood observed more diffuse-porous or diffuse-porous on the available TS. Diagnostic remarks: *M. azedarach* can be distinguished from *M. composita* WILLD. due to its ring- to semi-ring-porous wood, diagonal/radial pattern of vessels and the abundance of prismatic crystals, only occasionally present in *M. composita*. Literature: WHITE and GASSON (2008: 58-61). Samples: Djibouti (Ras Ali), Saudi Arabia (Farasan Islands / Khutub, Jeddah / Ship 1, Jizan / Al Hafa), Yemen (Aden / Dakkat al Ghaz; Al-Qudbah, Ma'alla).

29. ***Morus*** **sp.** (Moraceae), *M. alba* L., white mulberry, *M. nigra* L., black mulberry: temperate hardwood.

Heartwood yellowish brown to reddish brown, sapwood white to yellowish white, wood light to moderately heavy, hard and strong, and moderately durable.

TS: growth ring boundaries distinct, wood ring-porous, vessels in earlywood solitary and in pairs, in latewood generally in small groups, often forming loose tangential or dendritic bands together with vascular tracheids and paratracheal parenchyma, tyloses present, fibres medium thick- to very thick-walled, axial parenchyma paratracheal vasicentric and confluent, TLS and RLS: rays up to 9-seriate, up to 60 cells high or more, heterocellular, with 1-4 rows of square and/or upright marginal cells, rarely with sheath cells, helical thickenings in small vessel elements, prismatic crystals in square/upright ray cells and in non-chambered axial parenchyma cells [Plate 15]. Literature: GALE and CUTLER (2000: 162-164). Samples: Egypt (Lake Burullus / Qassas Shipyard, Rasheed / Lahma Shipyard), Saudi Arabia (Jizan / Al Hafa).

30. ***Platanus* sp.** (Platanaceae), *P. orientalis* L., Oriental plane: temperate hardwood.
Heartwood reddish brown, sapwood slightly reddish, wood moderately heavy and hard, less durable.
TS: growth ring boundaries distinct, wood diffuse-porous, vessels solitary, in radial rows and clusters of 2-4(6), tyloses present, fibres medium thick- to thick-walled, axial parenchyma in short uniseriate tangential bands, apotracheal diffuse and diffuse-in-aggregates, TLS and RLS: rays up to 12-seriate, more than 100 cells high, uniseriate rays 3-4 cells high, homocellular, composed of procumbent cells, sometimes heterocellular, with one row of square and/or upright marginal cells, vessel perforations both simple and scalariform, prismatic crystals in procumbent and square/upright ray cells and in chambered axial parenchyma cells [Plate 16]. Literature: GALE and CUTLER (2000: 180-182). Sample: Saudi Arabia (Jeddah / Ship 1).

31. ***Populus* sp.** (Salicaceae): non-coniferous softwood.
Heartwood pale yellow to reddish yellow or pale brown, sapwood nearly white, wood light to moderately heavy, relatively soft and less durable.
TS: growth ring boundaries distinct, wood diffuse-porous, vessels solitary and in radial rows of 2-4, fibres thin- to medium thick-walled, axial parenchyma sparse, in marginal bands, up to 3 cells wide, TLS and RLS: rays uniseriate, up to 22 cells high, homocellular, composed of procumbent cells, vessel-ray pits considerably larger than intervessel pits [Plate 17]. Diagnostic remarks: The wood is similar to that of *Salix*, which can be distinguished by 1-2 rows of square and/or upright marginal ray cells. GALE and CUTLER (2000: 190-193): Sample: Saudi Arabia (Jeddah / Ship 1).

32. ***Quercus* sp., deciduous** (Fagaceae): temperate hardwood.

Heartwood yellowish brown, sapwood pale, wood heavy, hard, strong and durable.

TS: growth ring boundaries distinct, wood ring-porous, vessels predominantly solitary, occasionally in pairs, wide earlywood vessels and small latewood vessels, arranged in a diagonal/radial or dendritic pattern together with tracheids and vasicentric parenchyma cells, tyloses present, fibres medium thick- to very thick-walled, axial parenchyma in tangential bands, up to 3 cells wide, paratracheal scanty, apotracheal diffuse and diffuse-in-aggregates, TLS and RLS: rays of two distinct sizes, numerous uniseriate and a few very wide rays, up to 18-seriate, homocellular, composed of procumbent cells, sometimes weakly heterocellular, prismatic crystals in procumbent ray cells and in chambered and non-chambered axial parenchyma cells [Plate 18]. Literature: FAHN et al. (1986: 106-109, Plates 32A,B, 32D, 33A). Sample: Egypt (Rasheed / Lahma Shipyard).

33. ***Quercus* sp., evergreen/*Lithocarpus* sp.** (Fagaceae): temperate to tropical hardwood, *Lithocarpus* spp.: threatened IUCN Red List species.

Heartwood reddish brown, sapwood pale, wood heavy, hard, strong and durable.

TS: growth ring boundaries distinct, indistinct or absent, wood diffuse-porous, vessels predominantly solitary, occasionally in pairs, arranged in a diagonal/radial pattern or dendritic, tyloses present, fibres very thick-walled, axial parenchyma in tangential bands, up to 3 cells wide, paratracheal scanty, apotracheal diffuse and diffuse-in-aggregates, TLS and RLS: rays in two distinct sizes, numerous uniseriate and a few wide rays, up to 12-seriate, aggregate, homocellular, composed of procumbent cells, sometimes weakly heterocellular, prismatic crystals in procumbent ray cells and in chambered and non-chambered axial parenchyma cells. Diagnostic remarks: The wood of both genera is very similar. *Lithocarpus* is distributed in temperate Asia and from Pakistan to Indonesia. In *Casuarina* (Casuarinaceae), tyloses are absent, both simple and scalariform perforation plates and also biseriate rays occur. Literature: FAHN et al. (1986: 107, Plate 32C). Samples: Eritrea (Massawa / Tuwalet), Djibouti (Ras Ali).

34. ***Shorea* sp.** (Dipterocarpaceae): tropical hardwood, mahogany, meranti, threatened IUCN Red List species.

Heartwood yellowish brown to reddish brown, sapwood pale yellow, wood either heavy, hard and strong or moderately heavy, soft and strong, durable.

TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres medium- to very thick-walled, axial parenchyma in bands, up to 3 cells wide, including short and long lines of axial resin canals, paratracheal vasicentric, aliform, lozenge-aliform, winged-aliform, confluent and apotracheal diffuse, diffuse-in-aggregates. TLS and RLS: rays 1-3(4)- or 1-5(6)-seriate, up to 70 cells high, heterocellular, with 1-4 rows of square and/or upright marginal cells, axial parenchyma sometimes storied, intervessel pits vestured, in some species radial canals present, prismatic crystals in square/upright ray cells and in chambered and non-chambered axial parenchyma cells, in some species also in procumbent ray cells [Plate 19]. Diagnostic remarks: The wood is recognizable by its tangential lines of axial resin canals included in parenchyma bands and fewer and larger vessels compared to *Hopea*. *Dryobalanops* has predominantly solitary vessels. Literature: OGATA et al. (2008: 94-105, Figures 83-93). Samples: Saudi Arabia (Farasan Islands / Saddayn, Jeddah / Ship 1, Jizan / Al Hafa), Yemen (Aden / Dakkat al Ghaz; Mocha).

35. ***Swietenia* sp.** (Meliaceae): tropical hardwood, mahogany, populations of the Neotropics: CITES species, Appendix II and threatened IUCN Red List species, grown in Asian countries.
Heartwood reddish brown, sapwood yellowish, wood moderately heavy, hard and strong, durable.
TS: growth ring boundaries indistinct or absent, wood diffuse-porous, vessels solitary and in short radial rows and clusters of 2-3(4), fibres thin- to thick-walled, axial parenchyma in bands, up to 5 cells wide, marginal up to 3, paratracheal scanty and occasionally vasicentric, intercellular axial canals of traumatic origin occasionally present, TLS and RLS: rays (1)2-4(5)-seriate, up to 25 cells high, heterocellular, with 1-2 rows of square and/or upright marginal cells, rays, axial parenchyma and vessel elements regularly or irregularly storied, prismatic crystals in square/upright ray cells and occasionally in axial parenchyma cells [Plate 20]. Diagnostic remarks: see *Khaya* sp. Literature: WHITE and GASSON (2008: 66-69). Sample: Egypt (Rasheed Shipyard).

36. ***Tamarix aphylla*** (L.) KARST. (Tamaricaceae), syn.: *Thuja aphylla* L., pro parte, athel tamarisk: subtropical hardwood.
Yellowish white, moderately heavy and hard, not durable.
TS: growth ring boundaries distinct, wood semi-ring- to diffuse-porous, vessels solitary

and in clusters of 2-4, fibres medium thick-walled, arranged in a radial/tangential pattern, axial parenchyma paratracheal vasicentric and confluent, TLS and RLS: rays up to 20-seriate, heterocellular, with one or more rows of square and/or upright marginal cells, sometimes composed of mixed procumbent, square and upright cells, sheath cells present, axial parenchyma and vessel elements storied, prismatic crystals in square/upright ray cells [Plate 21]. Diagnostic remarks: *Tamarix* can be separated from *Balanites aegyptiaca* (Zygophyllaceae) due to the distribution of axial parenchyma, which is paratracheal scanty, apotracheal diffuse and diffuse-in-aggregates in *Balanites*. *T. aphylla* has wider rays compared to other *Tamarix* spp. (*T. nilotica* (EHRENB.) BUNGE 3-10-seriate). Literature: NEUMANN et al. (2000: 416-421). Sample: Egypt (Quseir / Qassas Shipyard).

37. ***Tectona grandis*** L. f. (Verbenaceae), teak, Indian oak: tropical hardwood.
Heartwood golden brown to dark brown, sapwood grey to pale yellow, wood moderately heavy, hard and strong, durable.
TS: growth ring boundaries distinct, wood ring- to semi- ring-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres medium thick-walled, axial parenchyma in marginal bands including earlywood vessels, paratracheal scanty and vasicentric, TLS and RLS: rays (2)3-4(5)-seriate, up to 40 cells high, homocellular, composed of procumbent cells, or heterocellular, with one row of square and/or upright marginal cells, intervessel pits vestured, fibres septate and non-septate [Plate 22]. Diagnostic remarks: *Toona* (Meliaceae) can be separated by the absence of tyloses and septate fibres. Literature: ILIC (1991: 68, 466). Samples: Eritrea (Museum), Djibouti (Godoriya, Obock Shia, Ras Ali), Saudi Arabia (Jizan / Al Hafa), Qatar (Doha / Sheikh Faisal Museum, Al Thani Workshop).

38. ***Terminalia* sp.** (Combretaceae): tropical hardwood, several threatened IUCN Red List species.
Wood yellowish to dark brown, reddish brown, heavy, hard, strong and moderately durable.
TS: growth ring boundaries distinct, indistinct or absent, marked by more thick-walled fibres or slightly darker tint in latewood, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, tyloses present, fibres thin- to thick-walled, axial parenchyma in marginal bands, up to 3 cells wide, paratracheal aliform, lozenge-aliform, winged-aliform, confluent and apotracheal diffuse, intercellular axial canals of traumatic origin

occasionally present, TLS and RLS: rays uniseriate or 1-3(4)-seriate, up to 30 cells high, heterocellular, with one row of square and/or upright marginal cells, intervessel pits vestured, prismatic crystals in square/upright ray cells and in chambered axial parenchyma cells. Literature: NEUMANN et al. (2000: 250-253). Samples: Eritrea (Massawa / Tuwalet), Djibouti (Godoriya).

39. ***Ziziphus spina-christi*** (L.) WILLD., syn.: *Rhamnus spina-christi* L., Christ's thorn, ***Ziziphus* sp.** (Rhamnaceae), *Z. spina-christi*, *Z. mauritiana* LAM., *Z. abyssinica* HOCHST. ex A. RICH.: tropical and subtropical hardwood.
Wood reddish brown, heavy, hard and durable.
TS: growth ring boundaries distinct, wood diffuse-porous, vessels solitary and in short radial rows of 2-3, occasionally in small clusters, fibres medium thick- to thick-walled, arranged in radial rows, axial parenchyma in marginal bands, up to 3 cells wide, paratracheal scanty, vasicentric, and apotracheal diffuse, TLS and RLS: rays uniseriate, rarely 2-3-seriate, up to 24 cells high, heterocellular, composed of mixed procumbent, square and upright cells, prismatic crystals in procumbent, square/upright ray cells, rarely in non-chambered axial parenchyma cells [Plate 23]. Diagnostic remarks: The *Ziziphus* spp. are very similar in their wood anatomy. *Z. spina-christi* cannot be separated from *Z. mauritiana* (NEUMANN et al. 2000: 378-383). The samples from the Arabian peninsula were assigned to Z. *spina-christi* due to the geographical location. Literature: FAHN et al. (1986: 144, Plate 58D). Samples: Eritrea (Massawa / Tuwalet), Djibouti (Ras Ali), Saudi Arabia (Farasan Islands / Khutub, Jeddah / Ship 1), Yemen (Al-Qudbah, Khor al-Ghurayrah, Mocha), Oman (Wadi Bani Kharus).

12.5.5 Glossary

axial parenchyma	parenchyma in direction of vessels and fibres
apotracheal	not associated with vessels
paratracheal	associated with vessels
marginal	at the beginning (initial) and/or end (terminal) of a growth ring
reticulate	net-like, in bands of about the same width like the rays, with about equal distance between the rays and between the bands
scalariform	ladder-like, in bands narrower than the rays, with greater distance between the rays than between the bands
vasicentric	complete sheaths around vessels of variable width, round to oval
sheath broad	more abundant around vessels
aliform	around vessels with lateral extensions
lozenge-aliform	elongated lateral extensions that form a lozenge or diamond shape
winged-aliform	elongated lateral extensions that appear wing-shaped
confluent	coalescing vasicentric or aliform parenchyma often forming irregular bands
cross-field pits	tracheid to ray pitting
cupressoid	pits with apertures oval in outline confined within the limits of the pit borders
piceoid	pits with slit-like apertures often extending beyond the pit borders
pinoid	pits of variable shape and size with oval to rounded apertures and often indistinct or narrow borders
diffuse-porous	vessels of about the same size distributed evenly throughout the growth ring
druses	star-shaped aggregates of crystals
epithelial cells	cells lining a canal or cavity, usually with a secretory function
heartwood	inner part of a woody stem or branch which has lost the ability to conduct water

helical thickenings	wall material deposited in a helix on the inner side of the secondary cell walls
heterocellular rays	rays composed of more than one cell form, procumbent body ray cells and square/upright marginal cells or mixed procumbent, square and upright cells
homocellular rays	rays composed of only one cell form, procumbent or square/upright cells
included phloem	secondary phloem embedded in the secondary xylem
laticifers	secretory structures that produce latex
prismatic crystals	solitary rhombohedral or octahedral crystals of calcium oxalate
ray tracheids	tracheids which accompagny the rays of many conifers occurring at the ray margins or in between
rays and/or other wood elements storied	rays and/or axial parenchyma, vessel elements, fibres arranged in horizontal series
rays in echelon	rays arranged in oblique series
ring-porous	vessels of the earlywood distinctively larger (more than two times) than those of the latewood
sapwood	outer part of a woody stem or branch including living cells
secondary phloem	tissue for the translocation of assimilated products
secondary xylem	tissue for the transport of water characterized by vessels and/or tracheids
semi-ring-porous	vessels of the earlywood somewhat larger (about two times) than those of the latewood or all of the same size, but more closely spaced
tracheids	tubular cells in the xylem that function primarily in the transport of water and mineral salts
traumatic resin canals	lysigenous ducts containing resin induced by mechanical injury
tyloses	intrusion of a ray or parenchyma cell into a vessel

vessel perforations	perforated end cell walls of vessel elements
scalariform	ladder-like, perforation plates with a number of elongated parallel openings separated by bars
simple	perforation plates with a single opening

12.5.6 ***Plates***

Anatomical views are given for a selection of taxa identified from the samples [Figure 2].

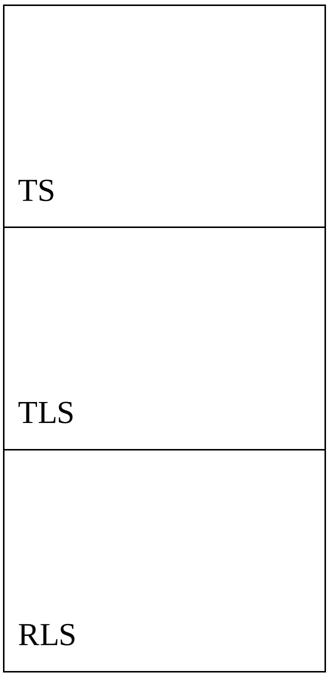
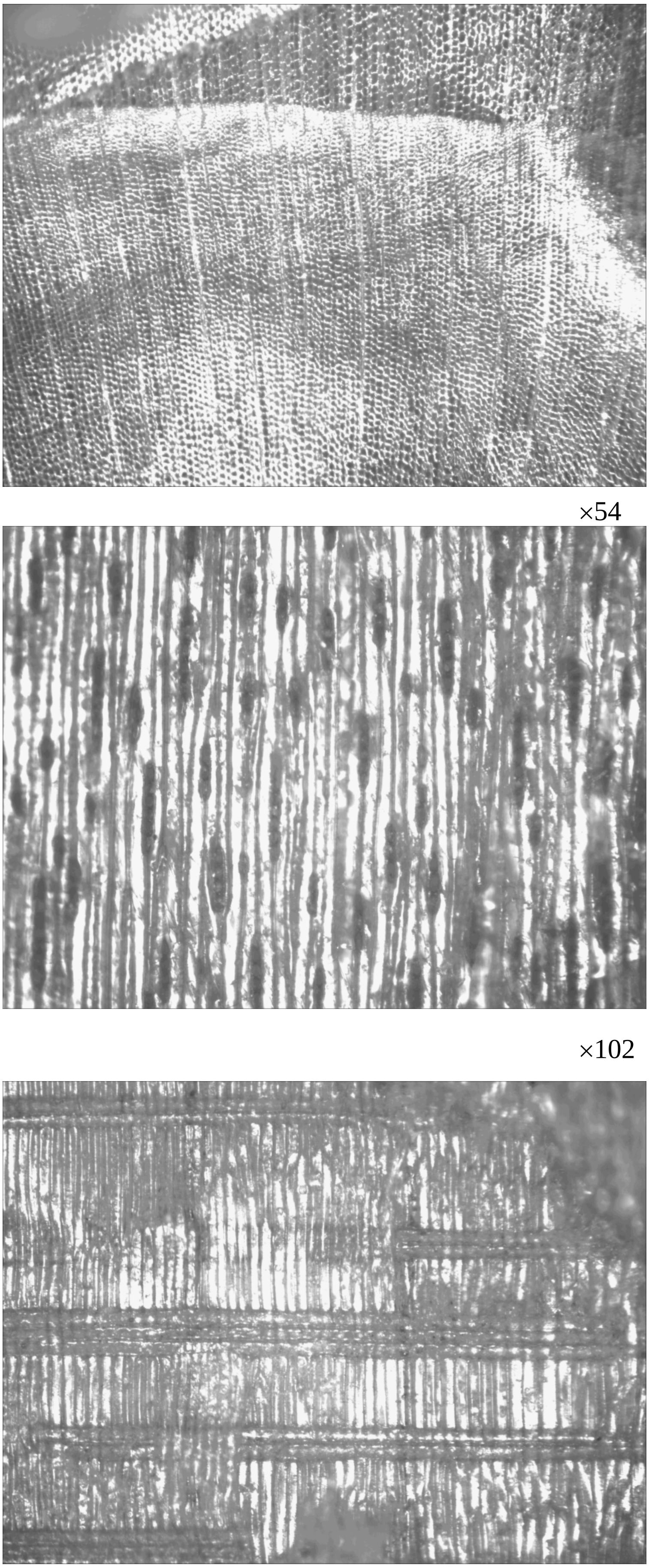


Figure 2: Table arrangement



a

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b

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c

×102

Plate 1: ***Juniperus* sp.**

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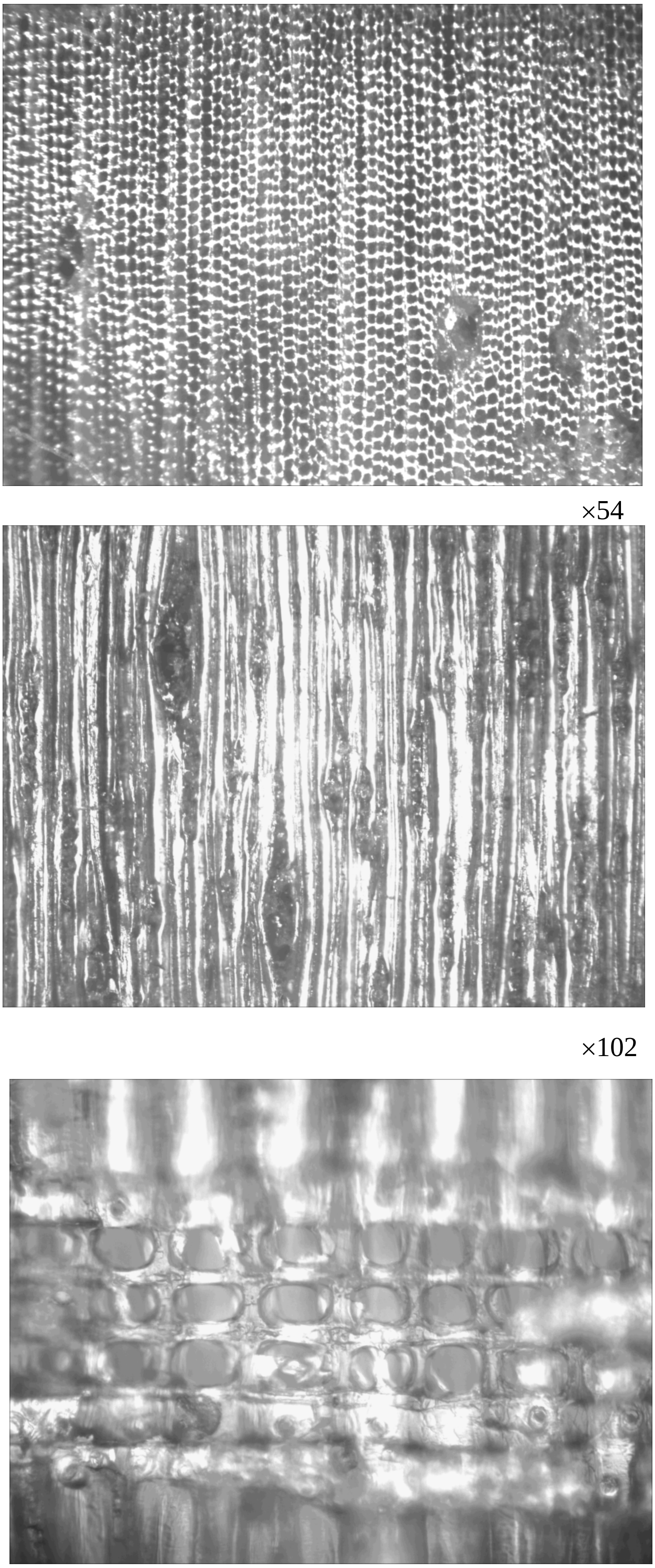

b

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Plate 2: ***Pinus* sp.**

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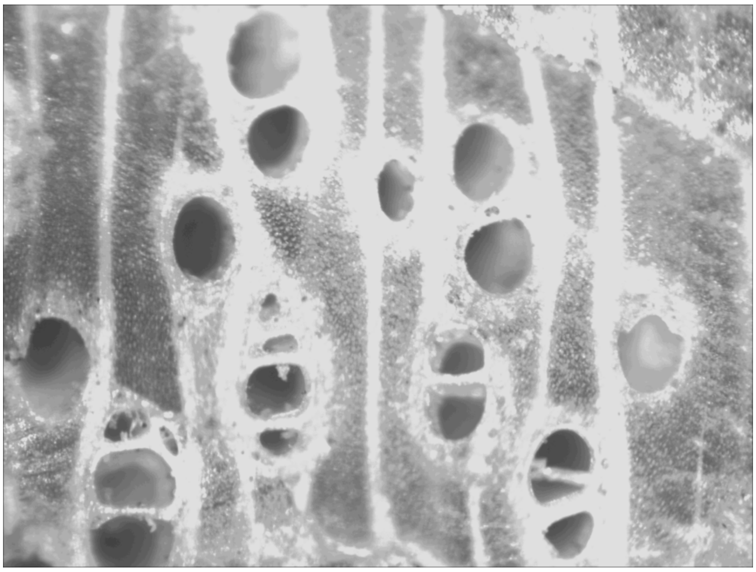

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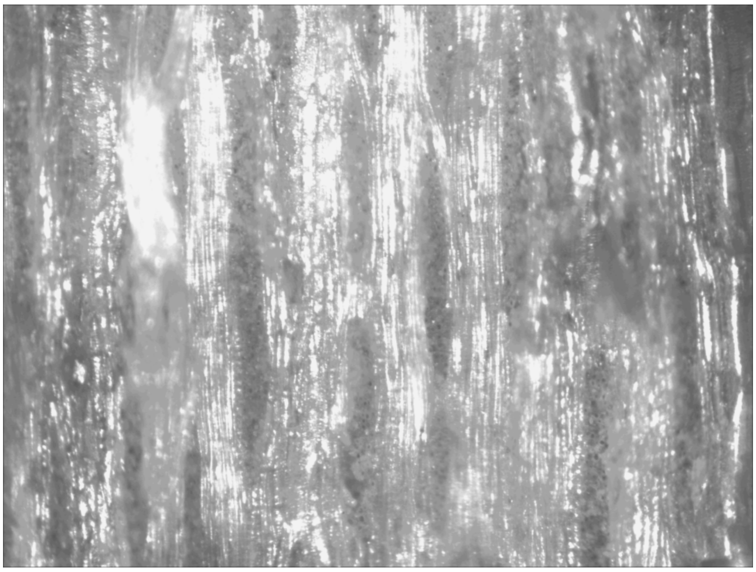

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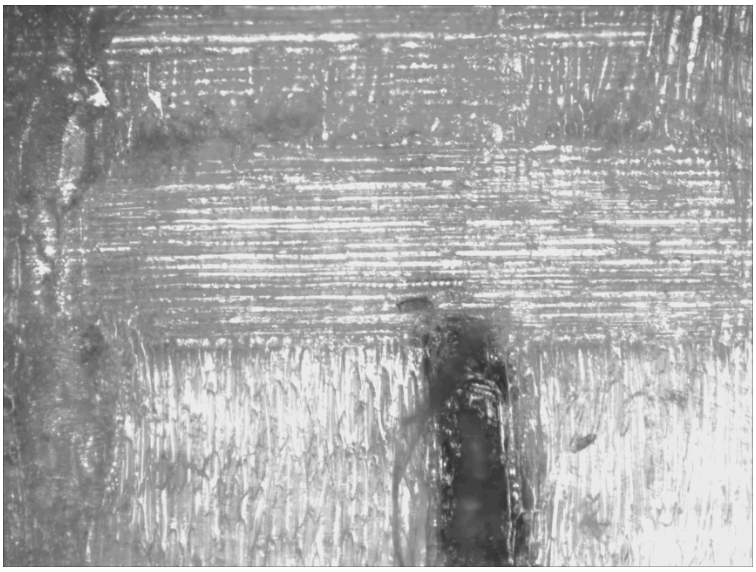

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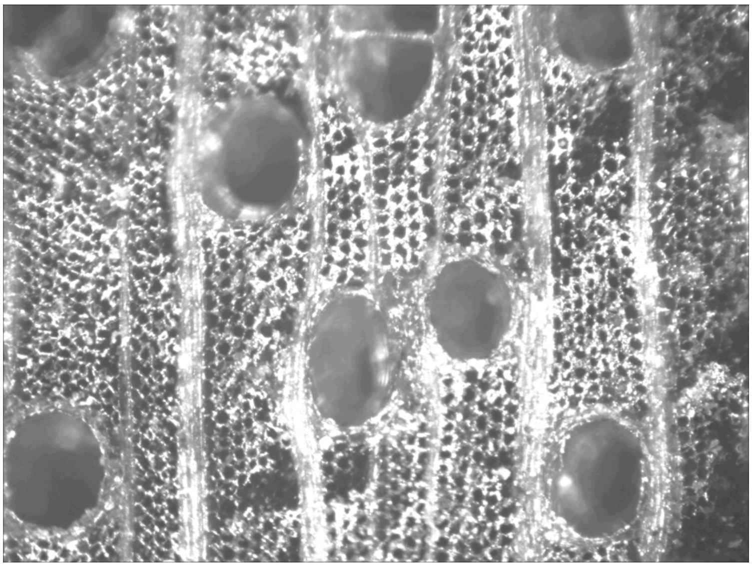
Plate 3: ***Acacia nilotica***.

a



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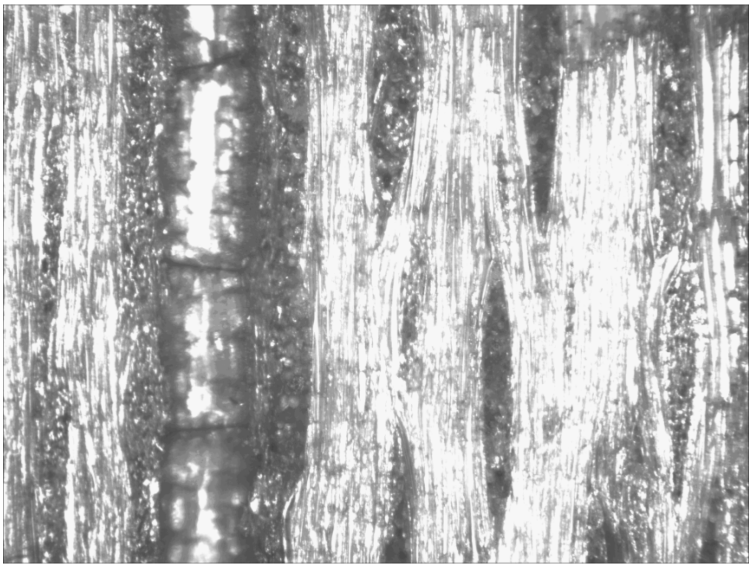

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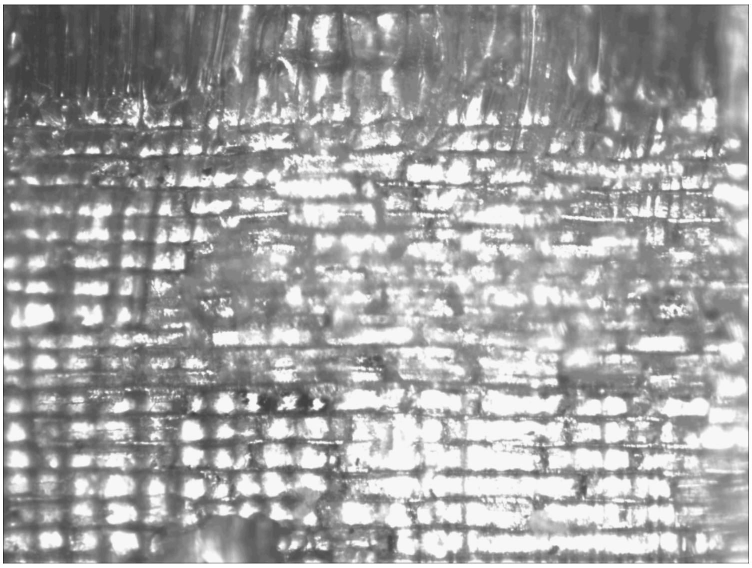

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Plate 4: ***Artocarpus* sp.**

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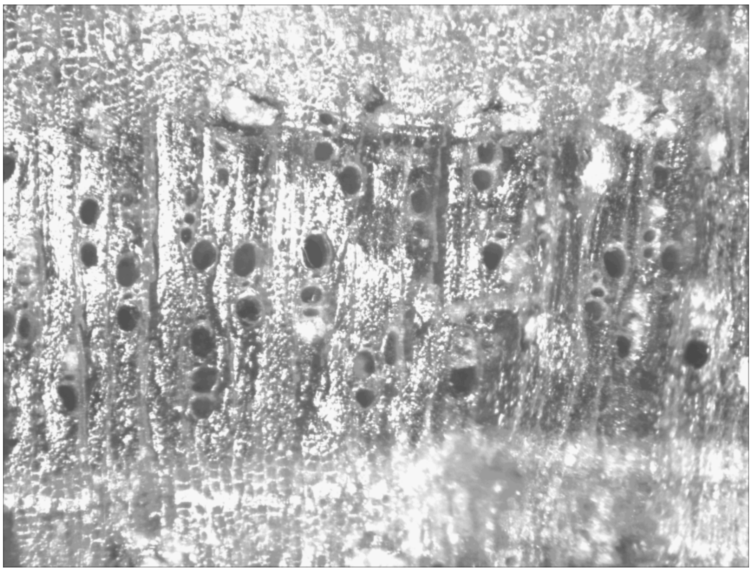

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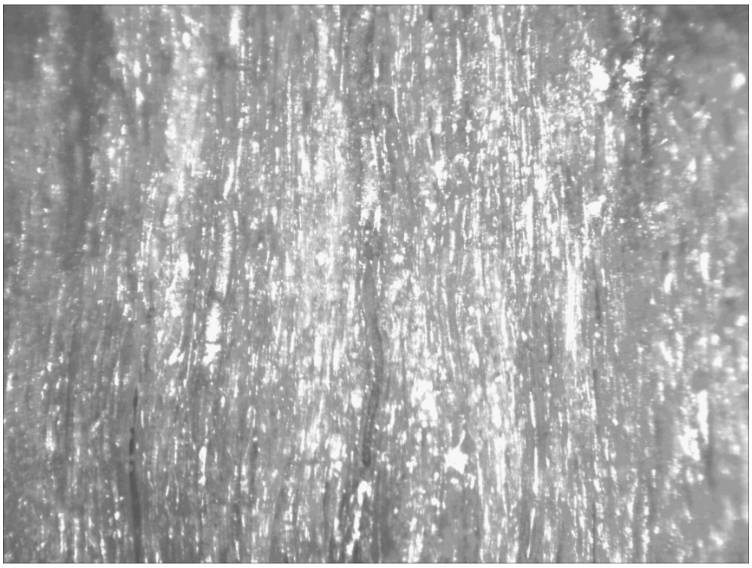

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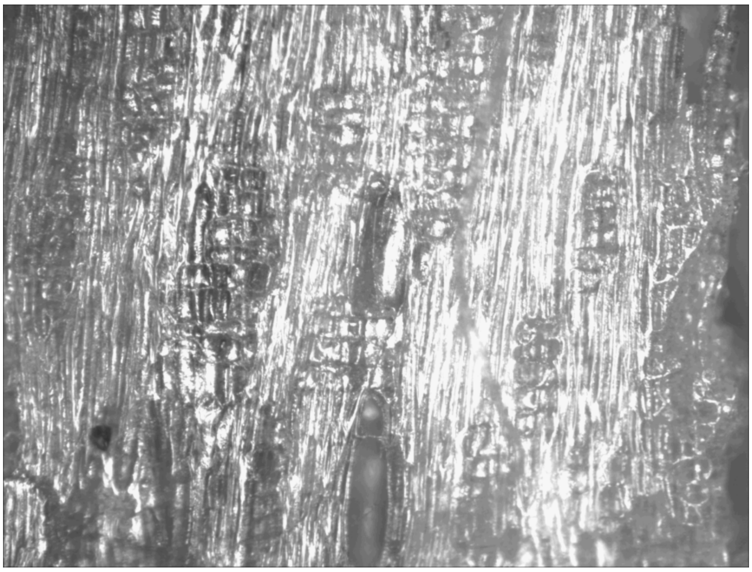

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Plate 5: ***Avicennia marina***.

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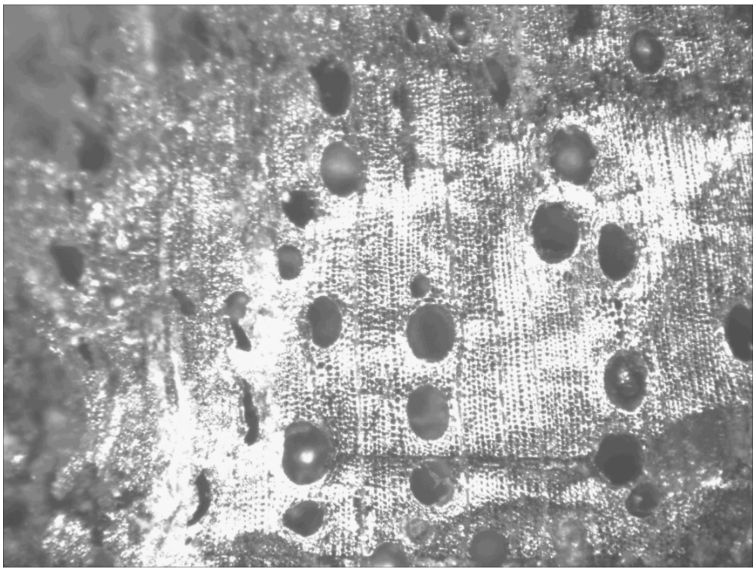

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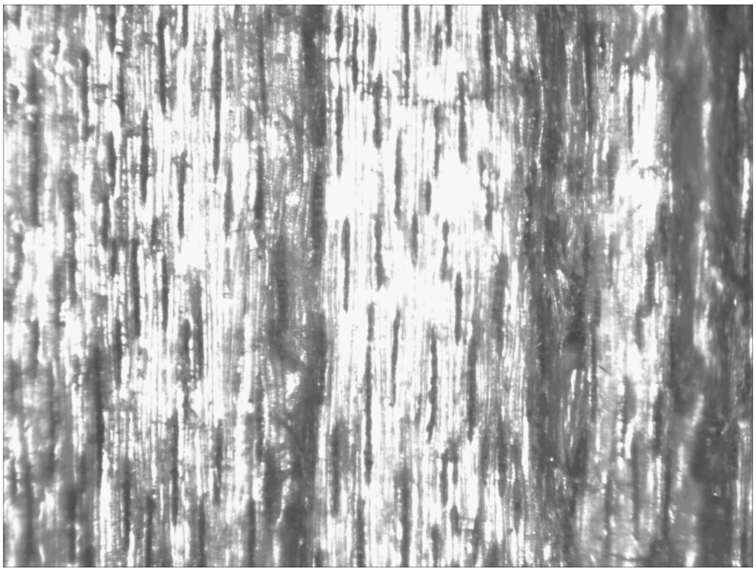

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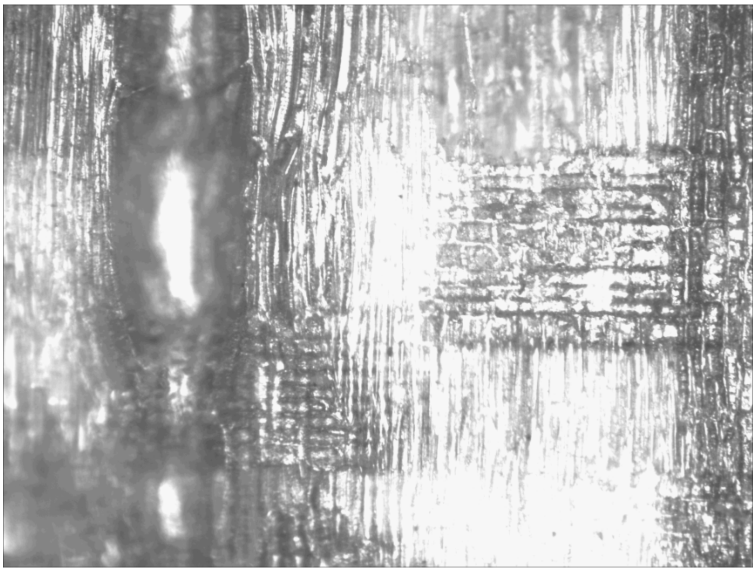

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Plate 6: ***Calophyllum* sp.**

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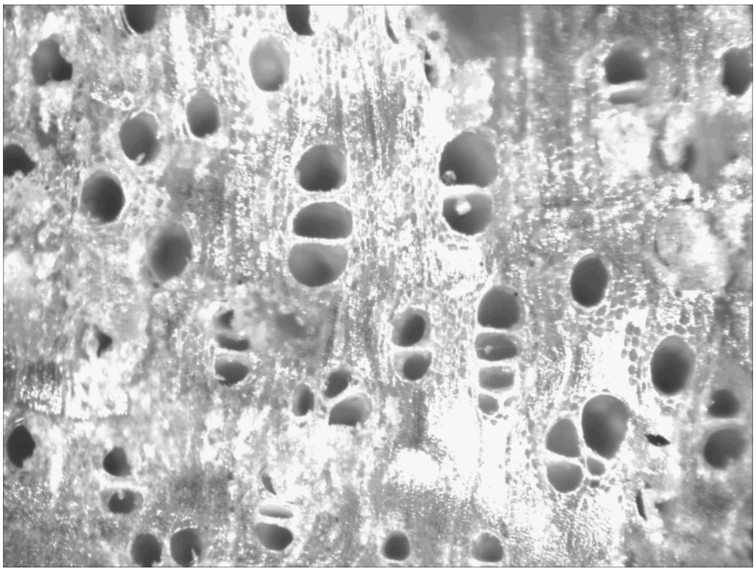

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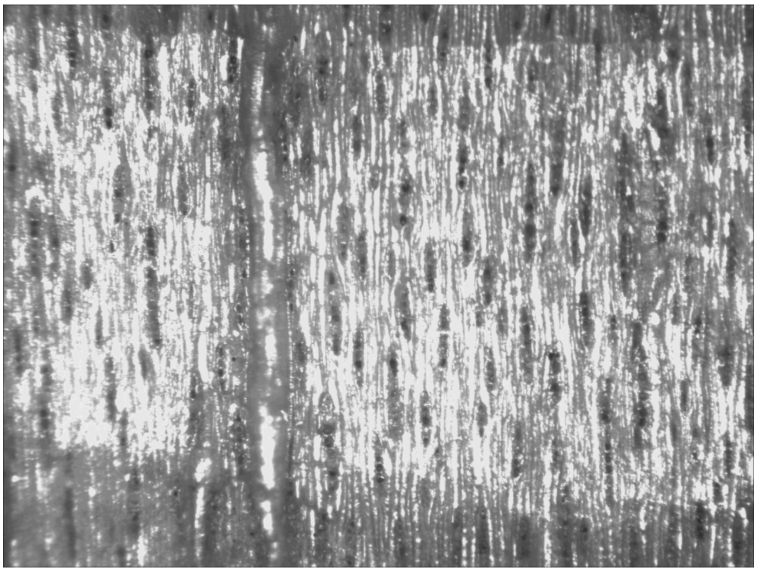

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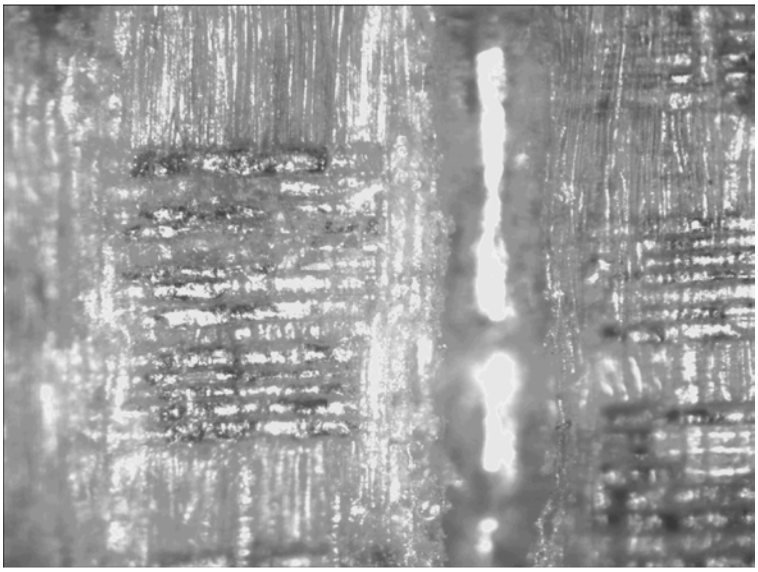

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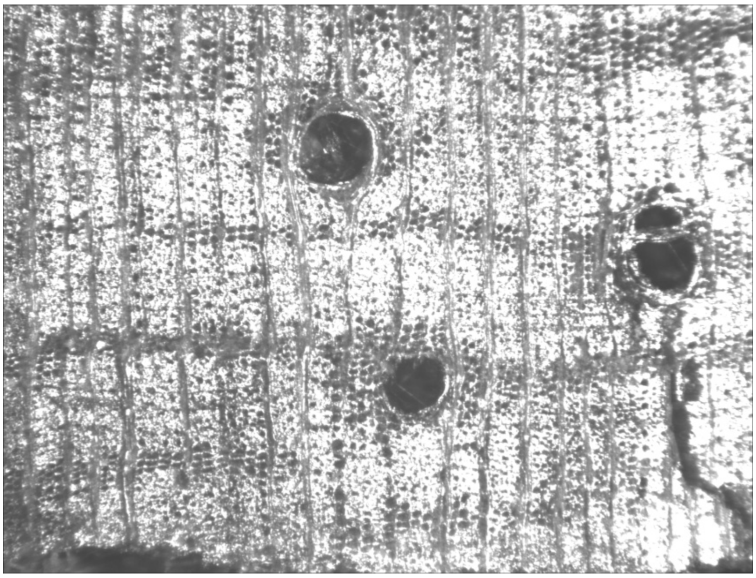
Plate 7: ***Conocarpus lancifolius***.



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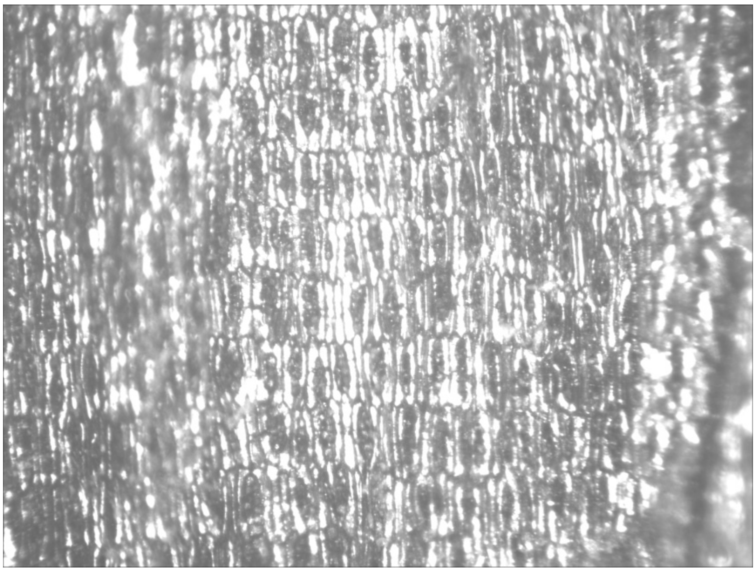

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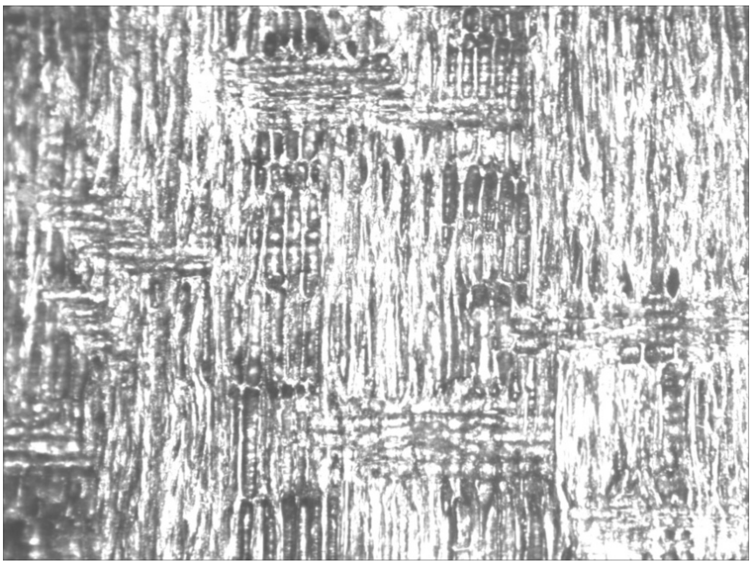

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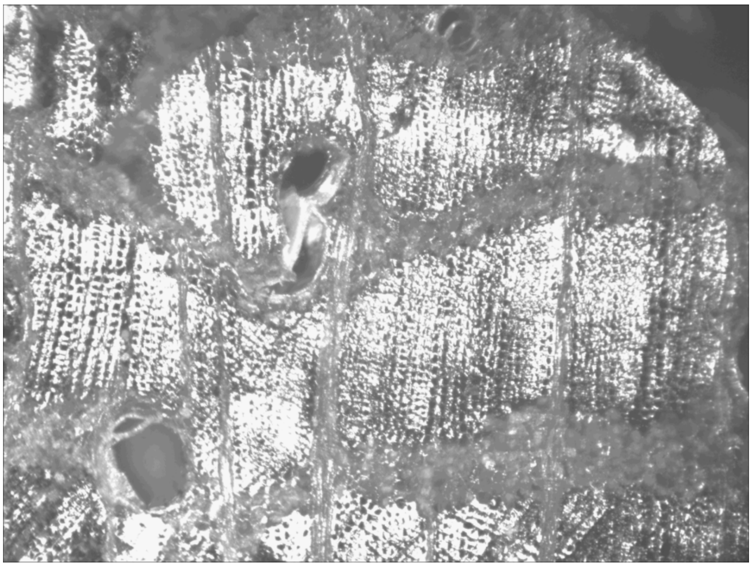
Plate 8: ***Dalbergia* sp.**



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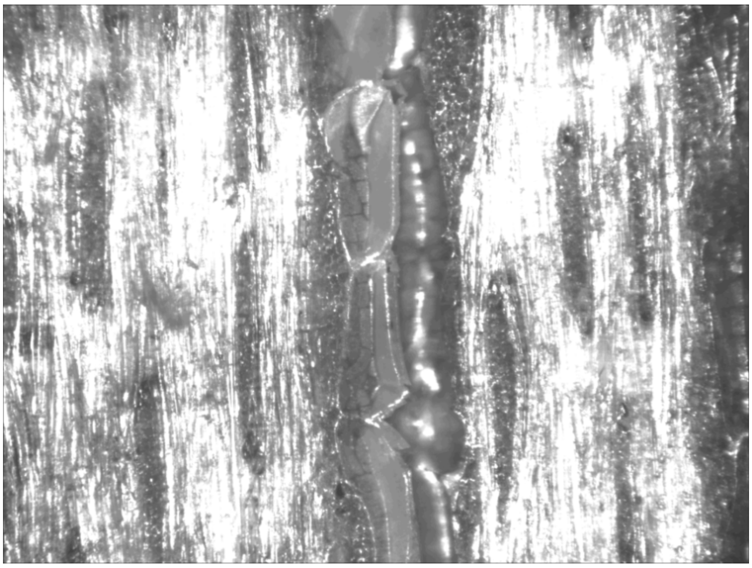

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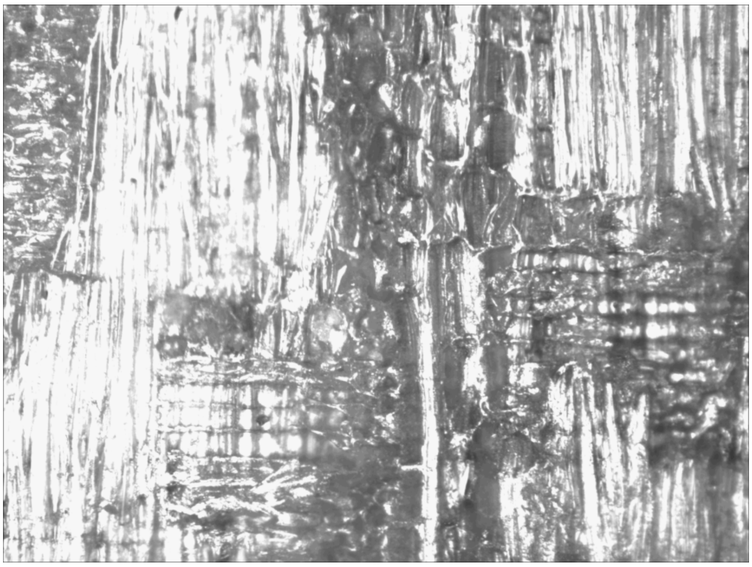

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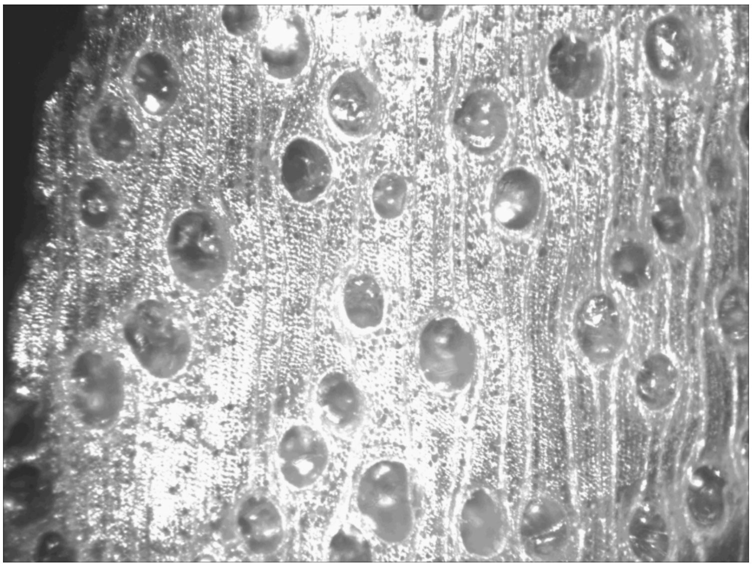
Plate 9: ***Entandrophragma* sp.**

a



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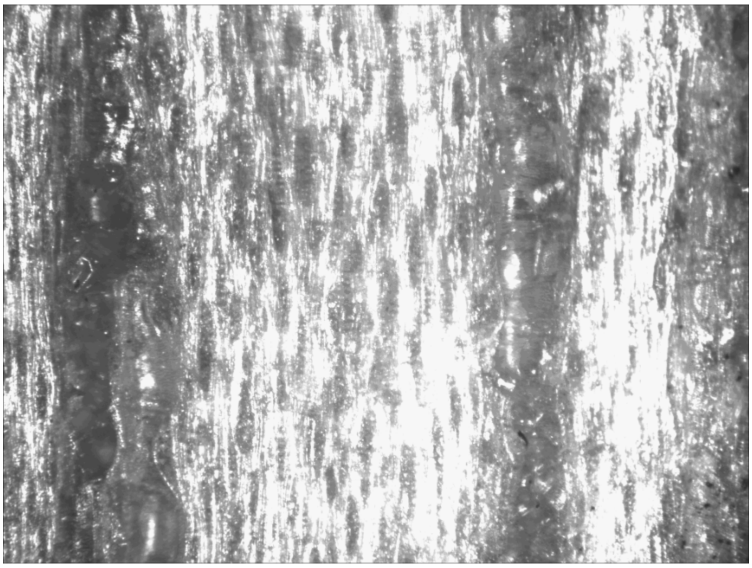

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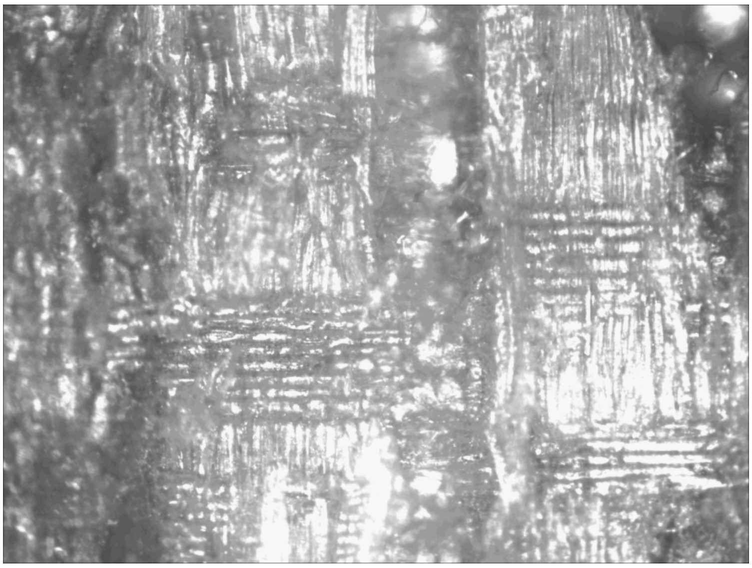

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Plate 10: ***Eucalyptus*/*Corymbia* sp.**

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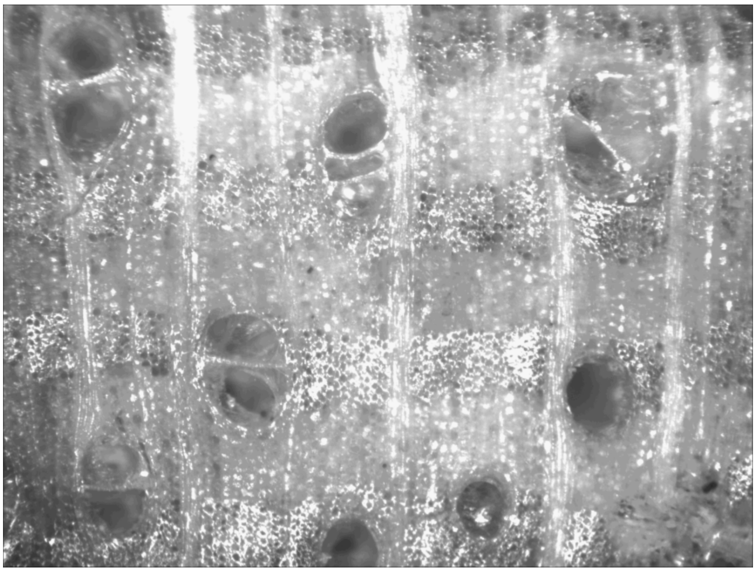

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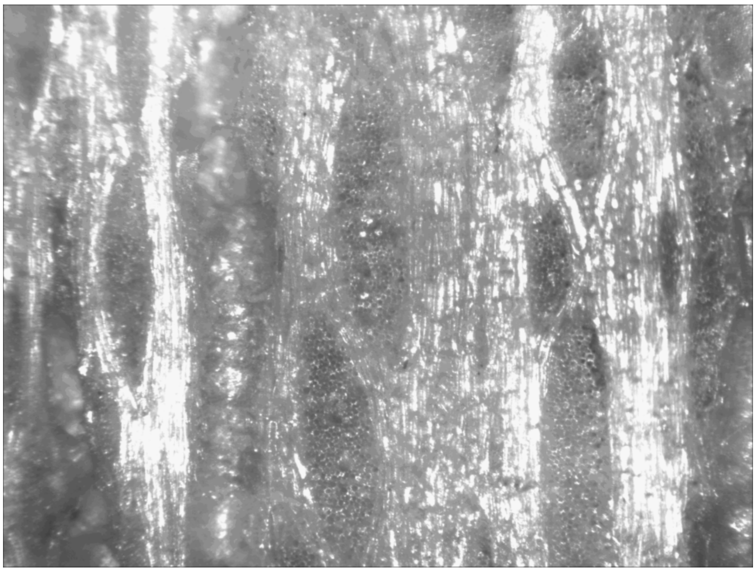

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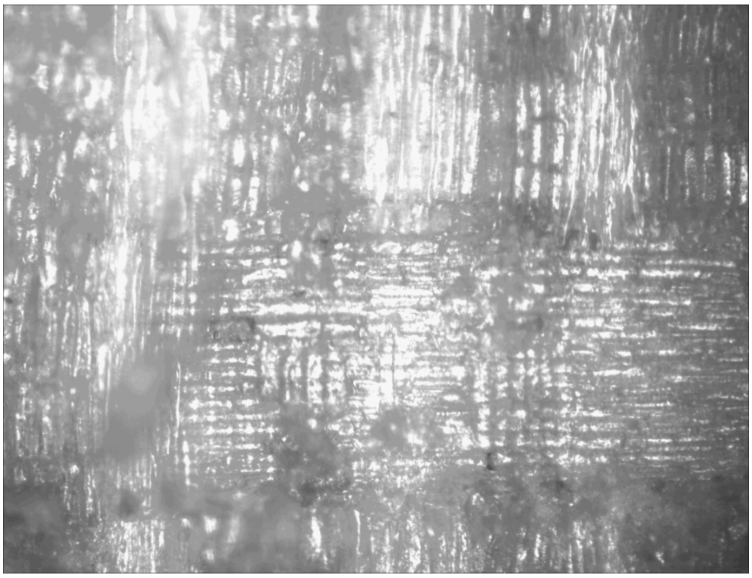

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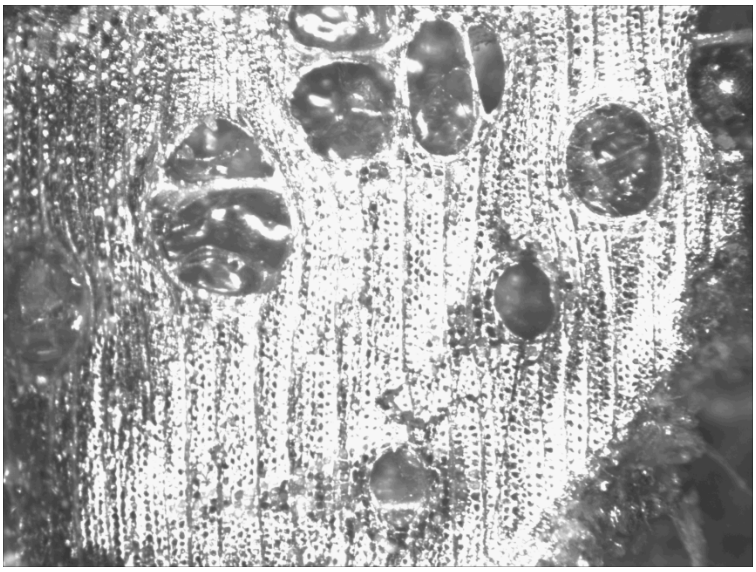
Plate 11: ***Ficus sycomorus***.



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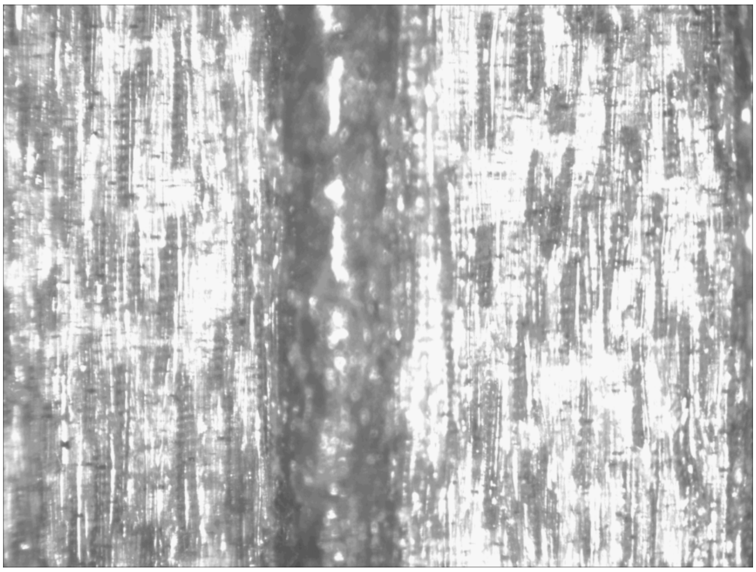

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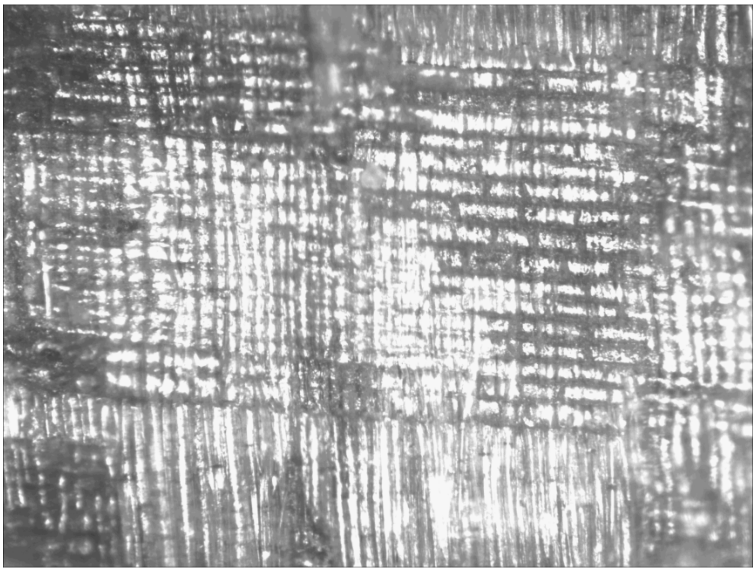

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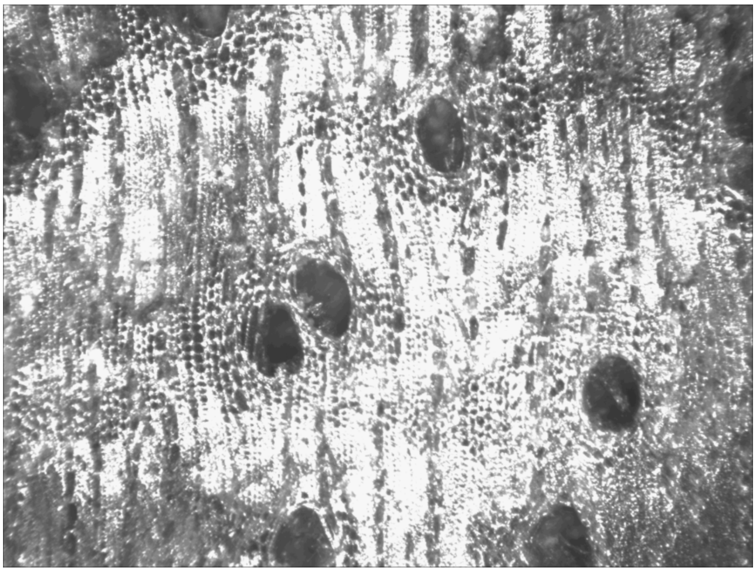
Plate 12: ***Lagerstroemia* sp.**

a



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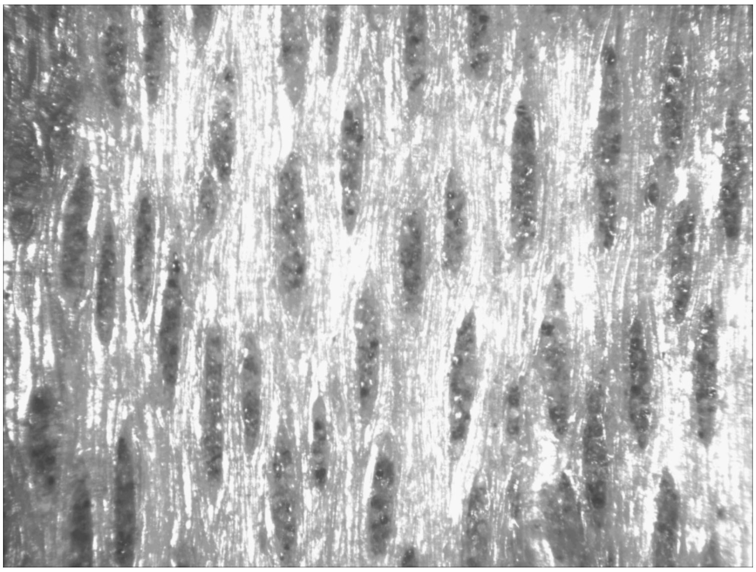

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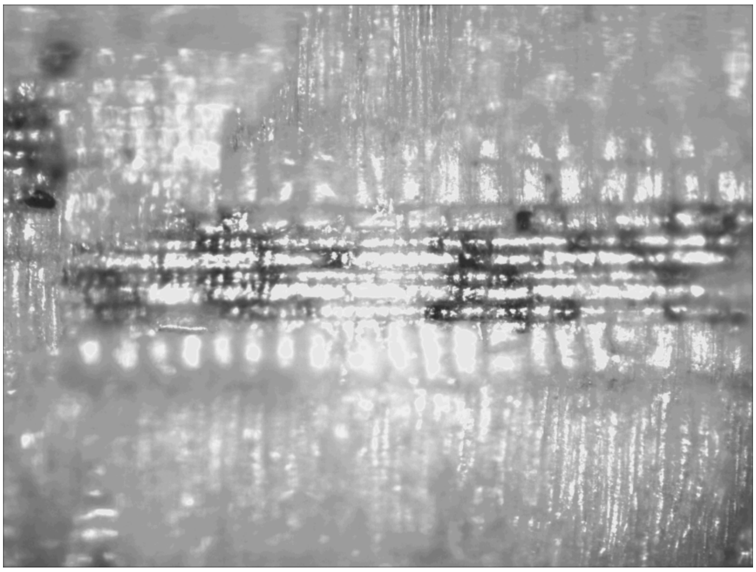

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Plate 13: ***Mangifera indica***.

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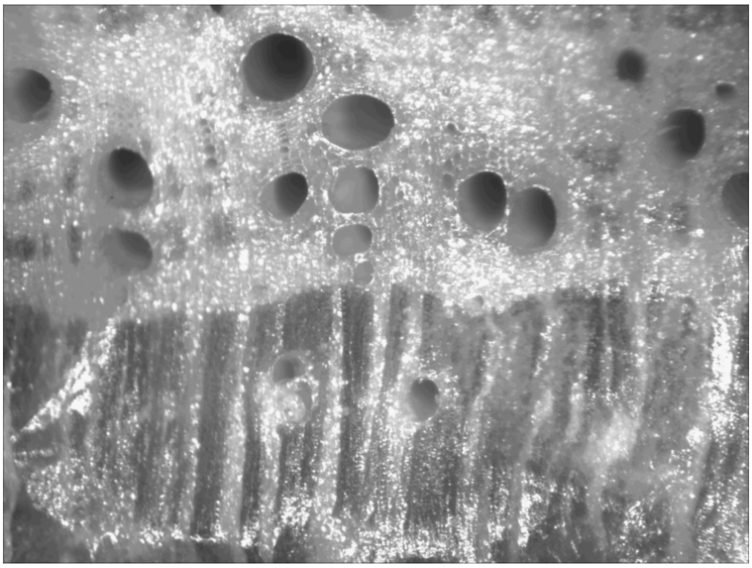

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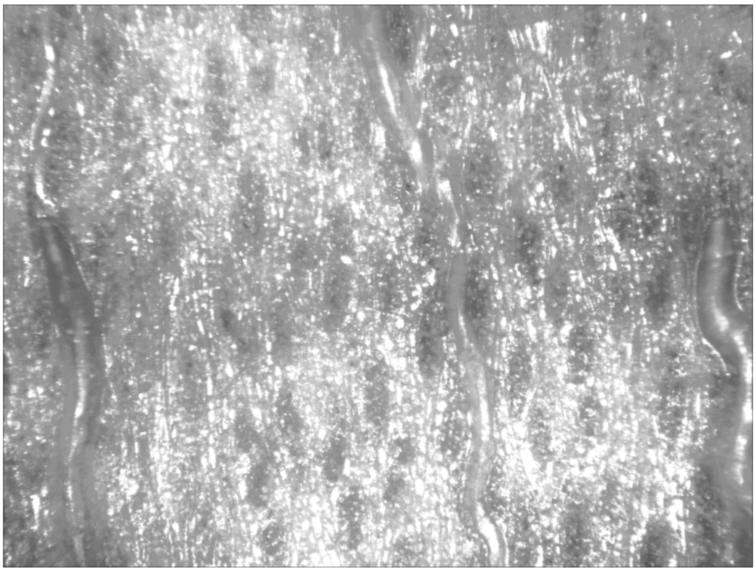

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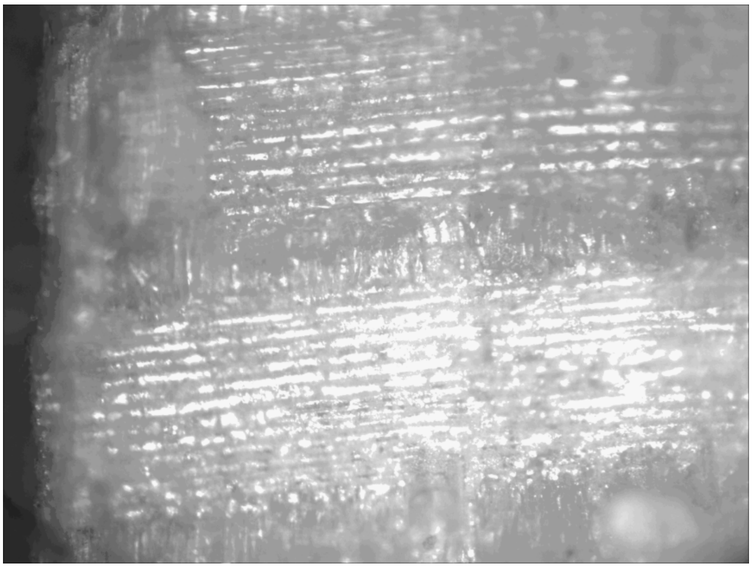

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Plate 14: ***Melia azedarach***.

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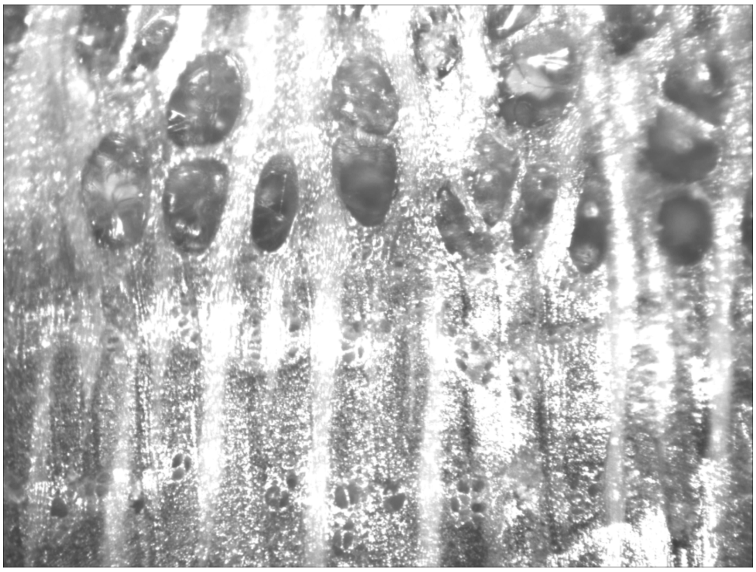

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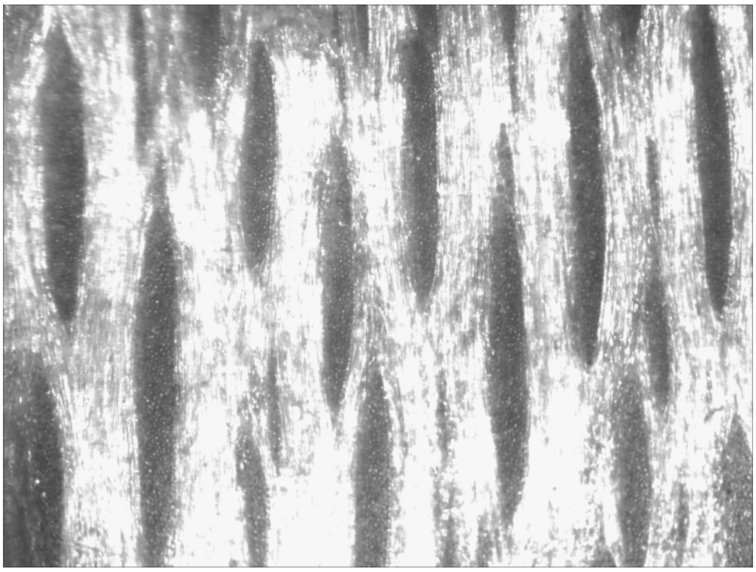

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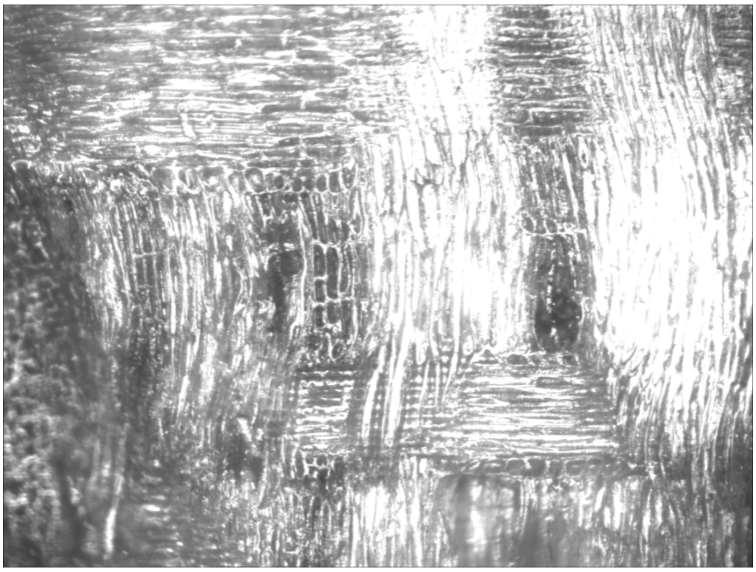

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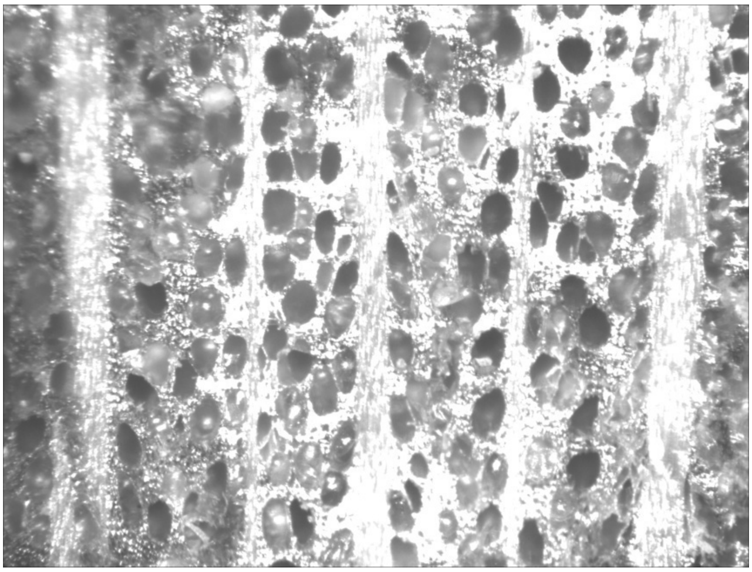
Plate 15: ***Morus* sp.**

a



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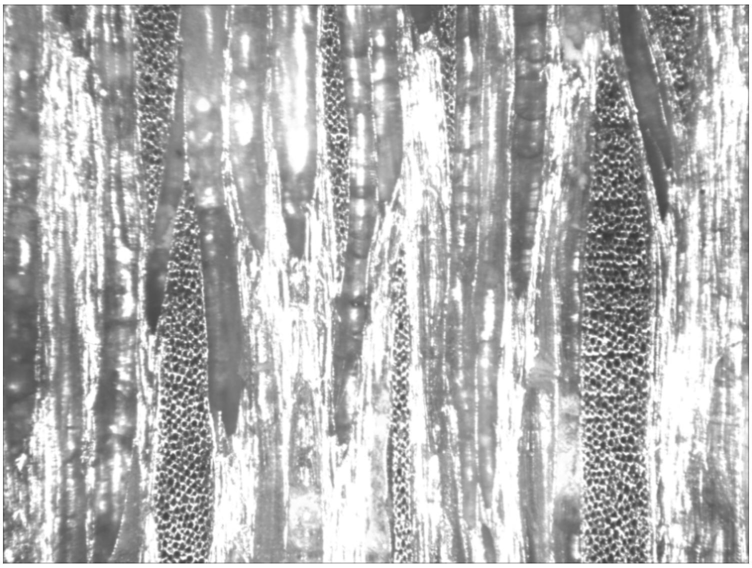

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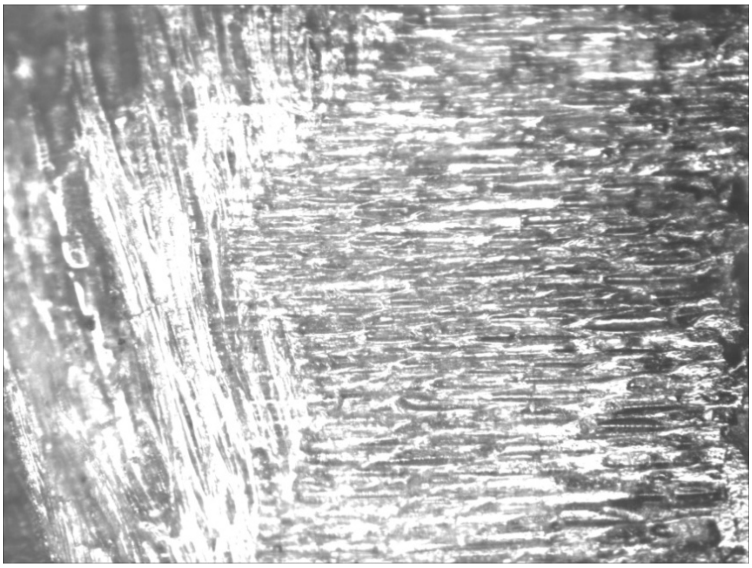

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Plate 16: ***Platanus* sp.**

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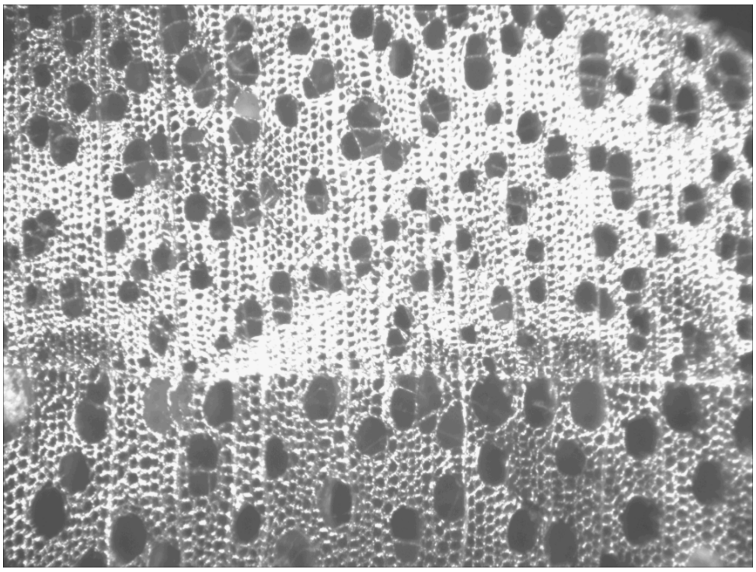

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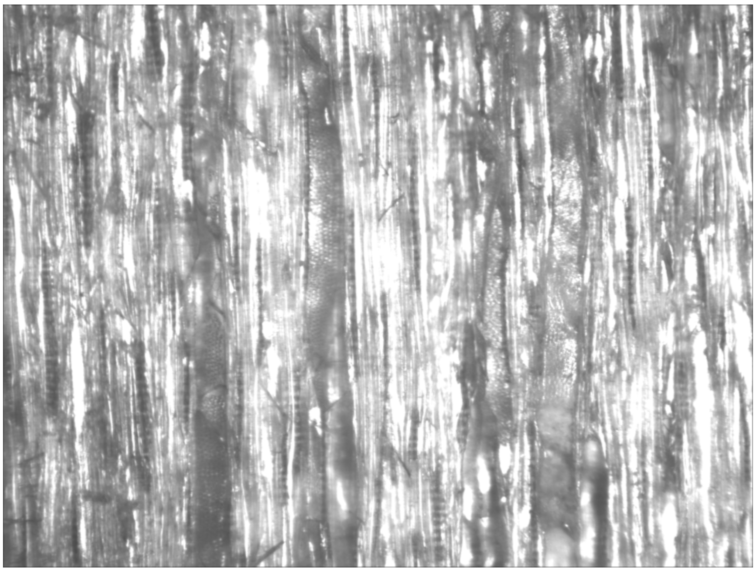

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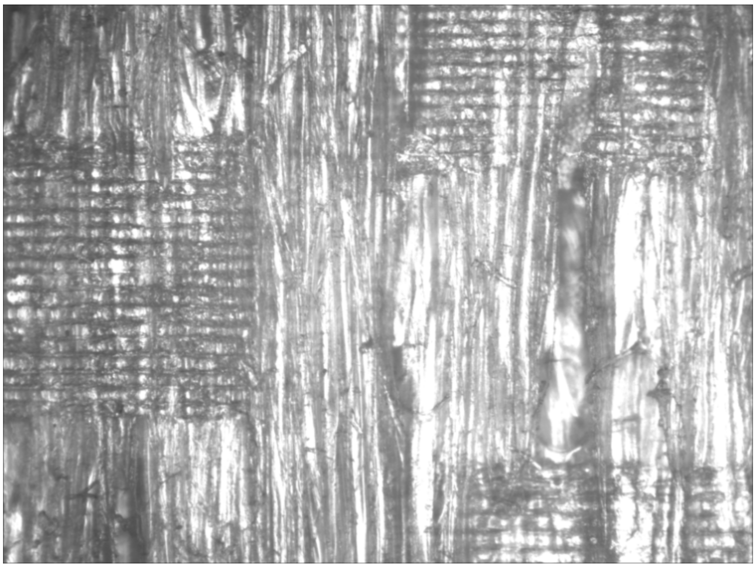

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Plate 17: ***Populus* sp.**

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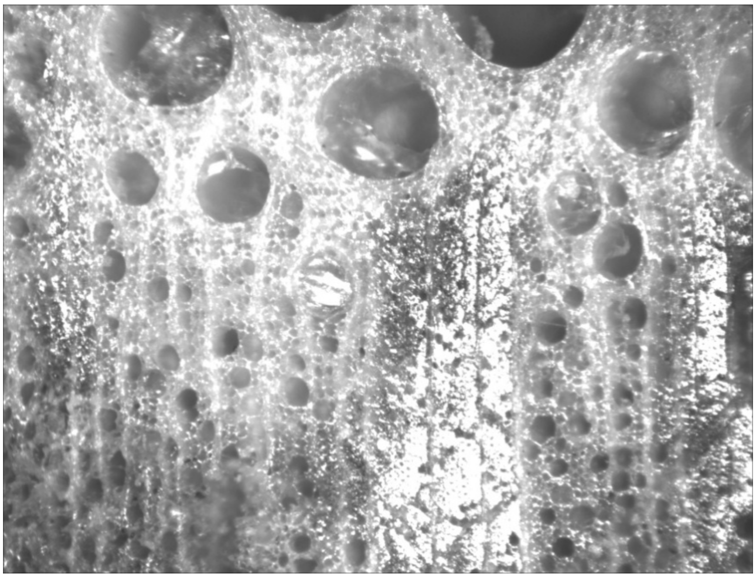

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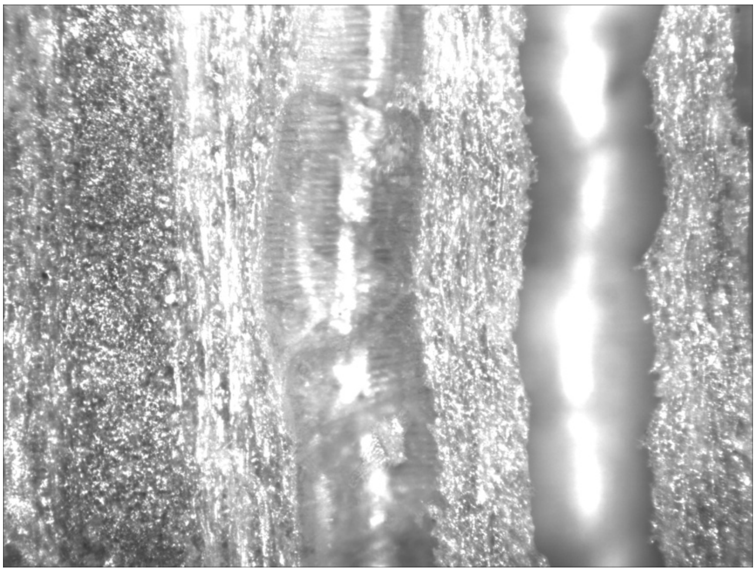

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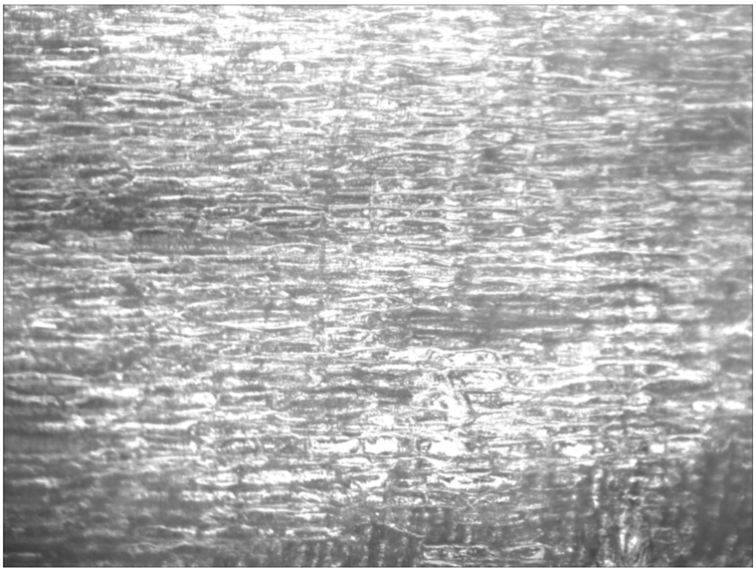

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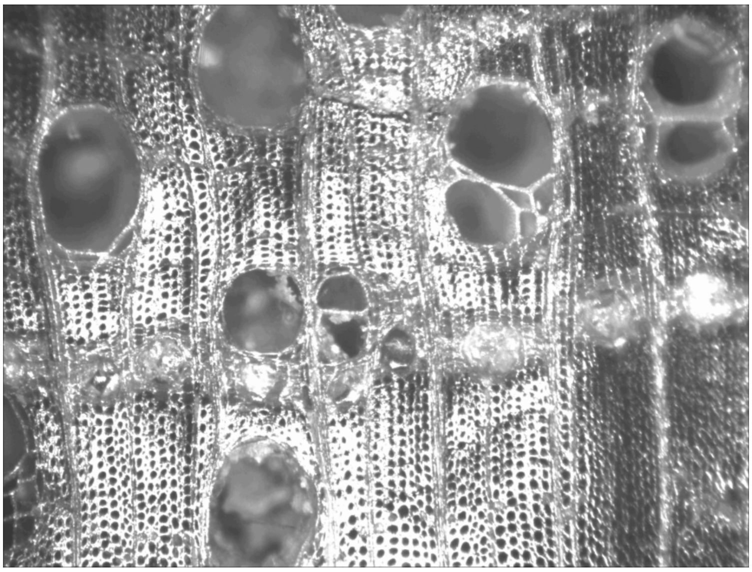
Plate 18: ***Quercus* sp., deciduous**.

a 

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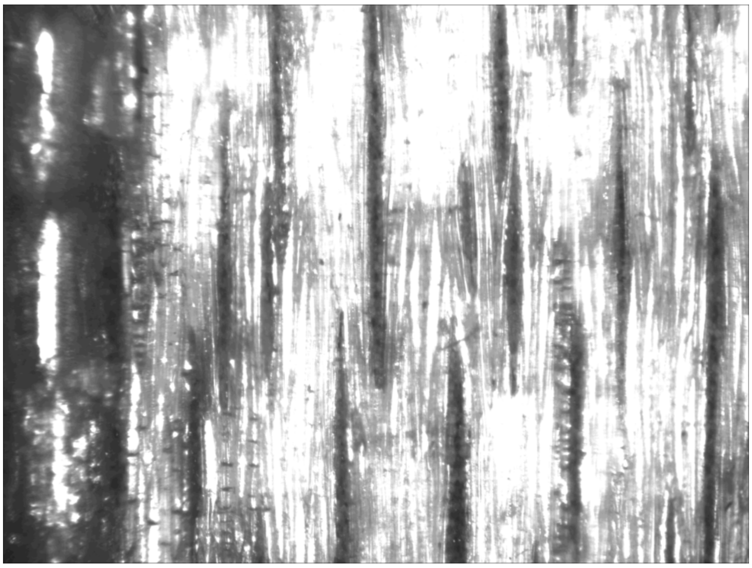
b 

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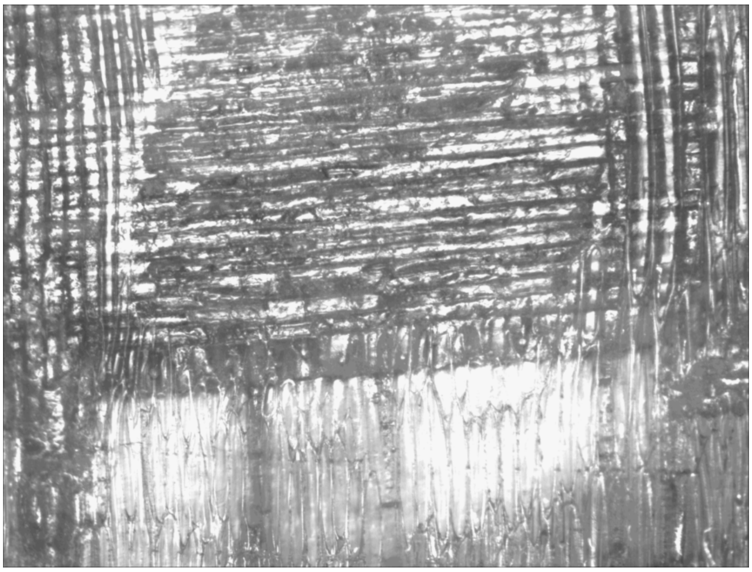
c 

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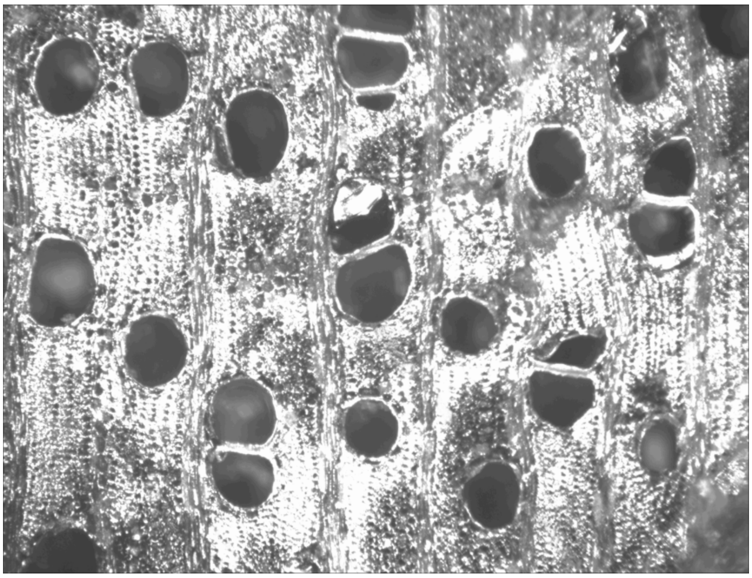
Plate 19: ***Shorea* sp.**

a



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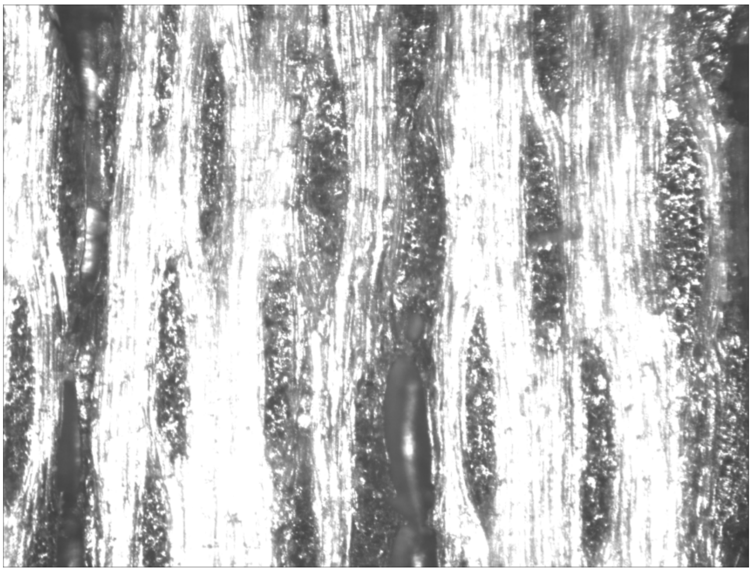
b



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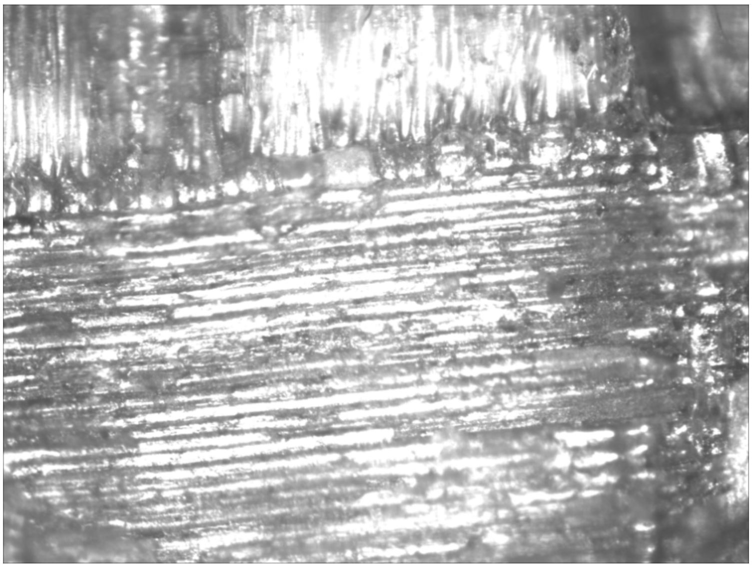
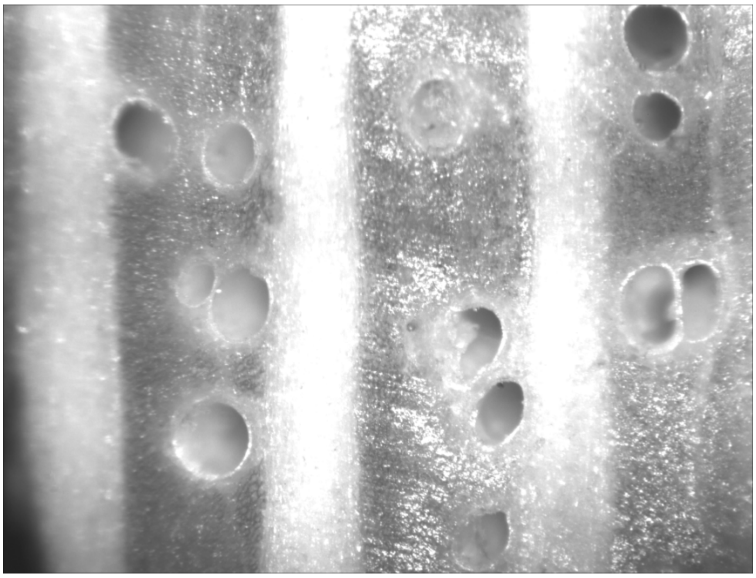
c



×102

Plate 20: ***Swietenia* sp.**

a 

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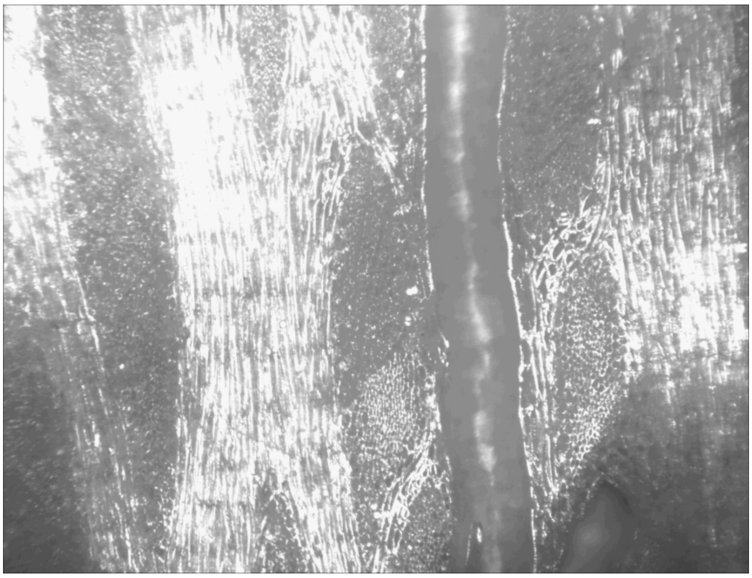
b 

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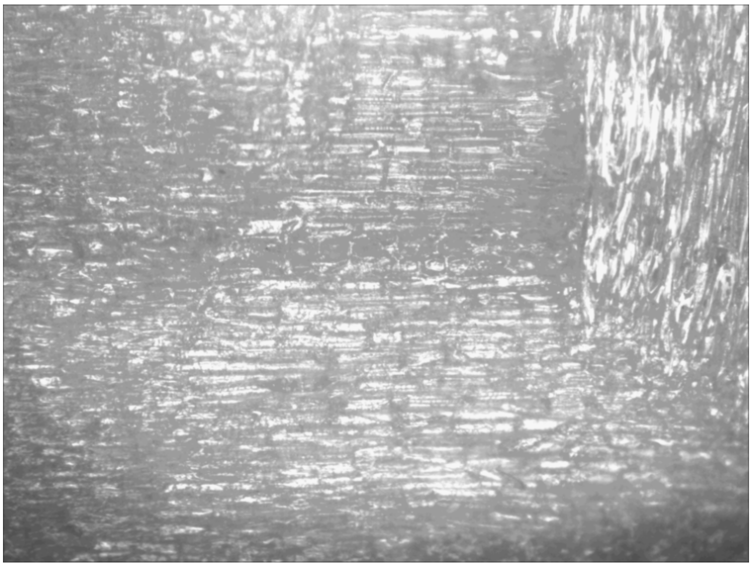
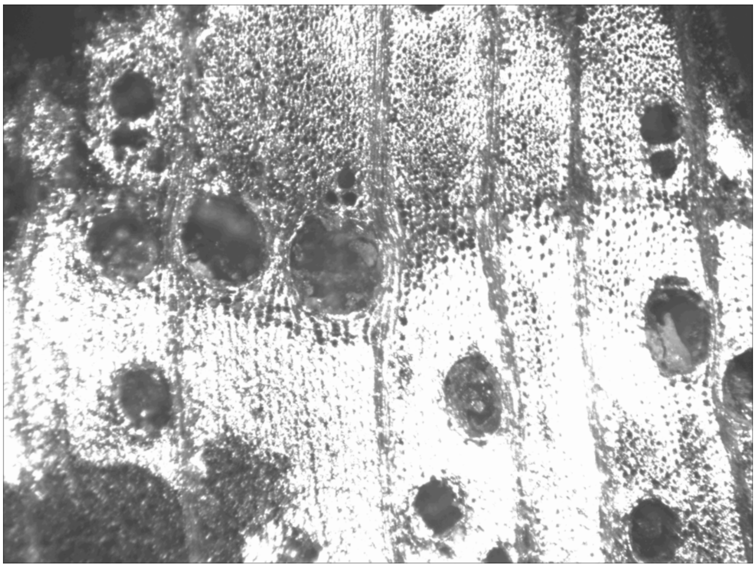
c 

×102

Plate 21: ***Tamarix* sp.**

a



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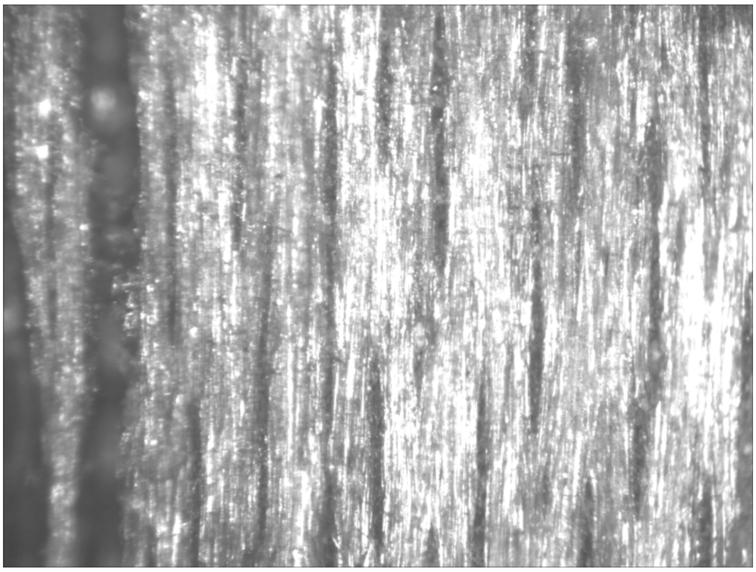
b



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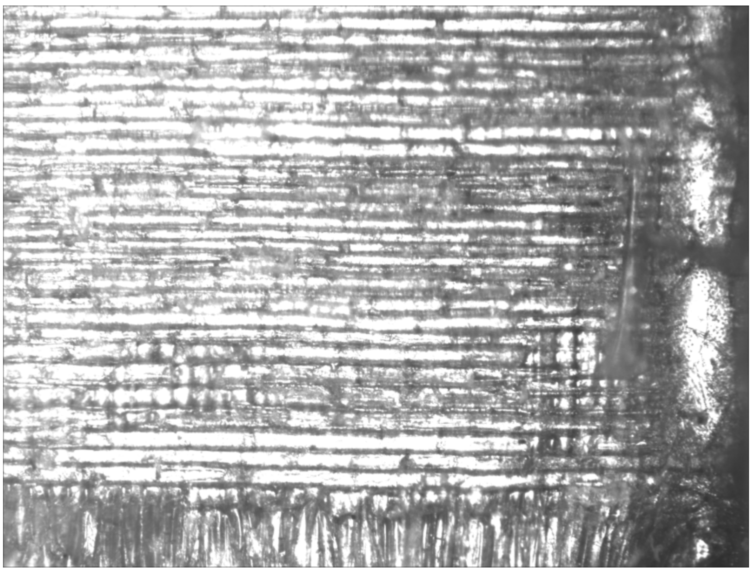
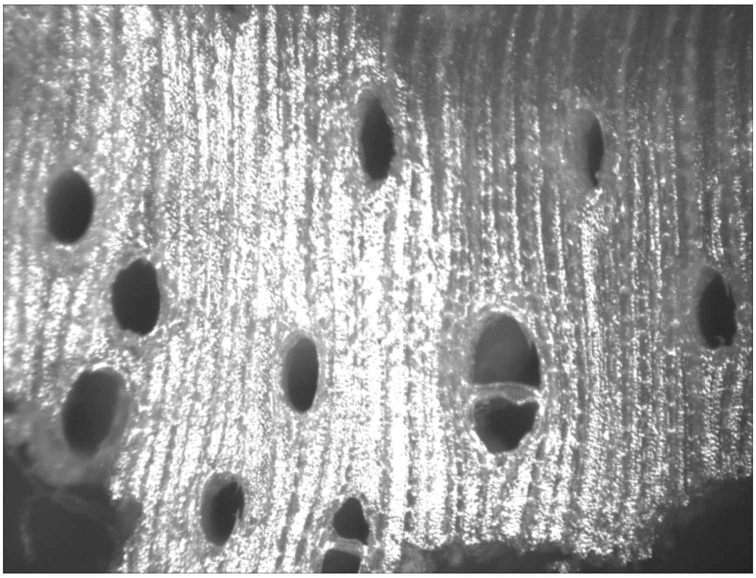


×102

Plate 22: ***Tectona grandis***.

a



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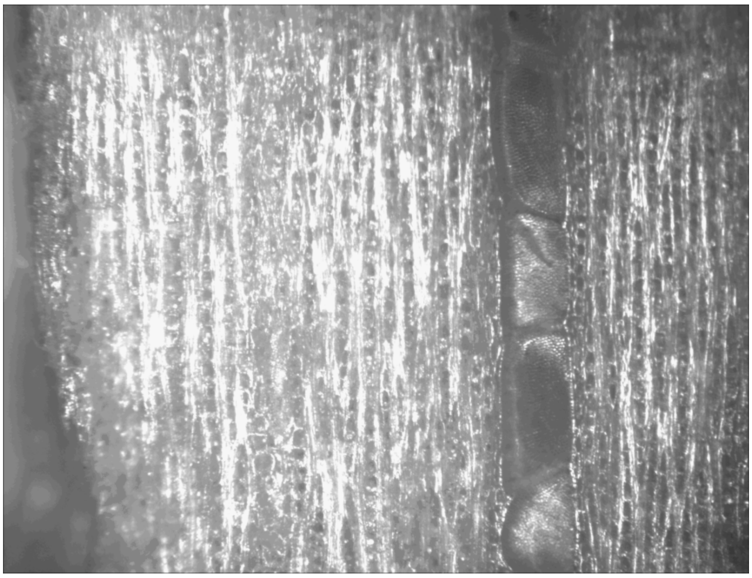

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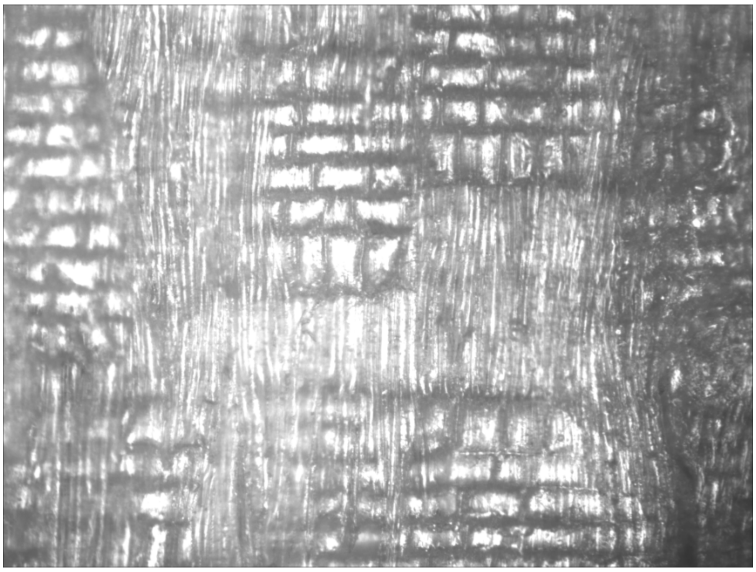

×102

Plate 23: ***Ziziphus* sp.**

12.5.7 Samples and localities

Plate 1: *Juniperus* sp., Sample 6, top of false stern post, Ship 1, Jeddah, Saudi Arabia

Plate 2: *Pinus* sp., window-like cross-field pits, Sample 7b, rudder, Ship 1, Jeddah, Saudi Arabia

Plate 3: *Acacia nilotica*, sawn timber, Sant, 16/01/12, Qassas Shipyard, Lake Burullus, Egypt

Plate 4: *Artocarpus* sp., Houri Sample H3, 05/03/09, Film, Oman

Plate 5: *Avicennia marina*, framing timber (natural crook) on a Saddāfa, Saddufa? Boat 1, 27/02/11, Massawa, Eritrea

Plate 6: *Calophyllum* sp., Keel timber 1, 05/03/09, Mahoot Island, Oman

Plate 7: *Conocarpus lancifolius*, Sample 23, collected from a tree, Ma'alla, Yemen

Plate 8: *Dalbergia* sp., hulk, lower stern post (with prop shaft pole) and rudder on the beach (abandoned), 16/10/09, Ras Ali, Djibouti

Plate 9: *Entandrophragma* sp., sawn timber, Mogono, 12/01/12, Alex Anfushi, Egypt

Plate 10: *Eucalyptus*/*Corymbia* sp., sawn timber, Kafur, 16/01/11, Qassas Shipyard , Lake Burullus, Egypt

Plate 11: *Ficus sycomorus*, sawn timber, Jummayz, 15/01/12, Lahma Shipyard, Rasheed, Egypt

Plate 12: *Lagerstroemia* sp., Sample 10, Aden, Yemen.

Plate 13: *Mangifera indica*, TS: Sample 12, Xx, Eritrea, TLS: Houri Sample H1, 05/03/09, Film, Oman, RLS: As-Suwaih Houri, 23/03/07, Oman

Plate 14: *Melia azedarach*, Sample 22, collected from a tree, Ma'alla, Yemen

Plate 15: *Morus* sp., Tut, 16/01/12, Qassas Shipyard, Egypt

Plate 16: *Platanus* sp., Sample 30, Ship 1, Jeddah, Saudi Arabia

Plate 17: *Populus* sp., Sample 18, plank after one side of gear lever hole, Ship 1, Jeddah, Saudi Arabia

Plate 18: *Quercus* sp., deciduous, sawn timber, ‘Arū, 15/01/2012, Rasheed, Lahma Shipyard, Egypt

Plate 19: *Shorea* sp., sawn timber, Khashab Ahmar, May 2010, Al Hafa,

Jizan, Saudi Arabia

Plate 20: *Swietenia* sp., sawn timber, Mogono, 15/01/12, Rasheed Shipyard, Egypt

Plate 21: *Tamarix aphylla*, sawn timber, Athl, 25/01/2012, Qassas Shipyard, Quseir, Egypt

Plate 22: *Tectona grandis*, Sample 11, Xx, Eritrea

Plate 23: *Ziziphus* sp., collected from a tree, Farasan Island, Saudi Arabia

12.5.8 ***Literature***

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12.6 Appendix 5: Certificates of Ethics

UNIVERSITY OF EXETER

SCHOOL OF HUMANITIES
AND SOCIAL SCIENCES
incorporating the Institute of Arab and Islamic Studies

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CERTIFICATE OF ETHICAL APPROVAL

School/Academic Unit:
Institute of Arab and Islamic Studies, School of Humanities and Social Sciences, University of Exeter

Title of Project:
MARES

Name(s)/Title of Project Research Team Member(s):
Dionisius Agius, John Cooper, Julian Jansen-Van-Rensburg, Lucy Semaan, Chiara Zazzaro

Project Contact Point:
Email: d.a.agius@exeter.ac.uk

Brief Description of Project:
This project focuses on the maritime traditions of the peoples of the Red Sea and Arabian-Persian Gulf. Drawing on ethnography, archaeology, history and linguistics, it seeks to understand how people have inhabited and navigated these seascapes in late antiquity and the medieval period, and how they do so today

This project has been approved for the period
From: July 2009
To: October 2011

School Ethics Committee approval reference: 01.07.09/i

Signature...H. Farmand........................ Date...25th Sept '09...........
(Mary Carter – Chair HUSS School Ethics Committee)

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CERTIFICATE OF ETHICAL APPROVAL

Academic Unit: Institute of Arab and Islamic Studies

Title of Project: MARES

Name(s)/Title of Project Research Team Member(s): Lucy Semaan

Project Contact Point: ls336@exeter.ac.uk

This project has been approved for the period
From: February 2009
To: January 2012

College Ethics Committee approval reference: 16.11.11-xiv

Signature.. Date 2/12/2011
(Jonathan Githens-Mazer – Chair SSIS College Ethics Committee)

13 Arabic-English glossary of general and maritime terms

Adum	Axe
ᶜAdem (pl.)	Frames
ᶜafsha	Perhaps a synonym of *kirda*
Arīna	Keel, synonymous with *hirāb*
Arya/erya	Yard
Baghwa	A young tree, or sapwood, Egyptian Arabic
Badan	Bow, stem. Also cargo boats in Oman, which were regularly used in the East Africa trade until the middle of the last century
Baṭṭīkha	Lower sternpost
Baṭūs	Cap rail synonymous with *ghaṭa*
Baṭūs al-kabs	Rubbing strake at the level of the deck
Bibbeh	Round stern
Berwāz	Rubbing strake of cap rail
Biṭān/*Biṭāna*	Inner stempost
Bulat (pl.)	Egyptian Arabic equivalent of flitch
Buṭāna/*Buṭān*	Internal (stempost) support
Būz	Stem
Daffa	Rudder, synonymous with *sukkān*
Dagal	Mast, synonymous with *ṣāri*
Dawaqīs (pl.)	Crossbeams

Dawaranāt (pl.)	Curved or round pieces and motifs in decoration of leisure boats
*Dila*ʿ (sg. *Dulu*ʿ)	Frames
Dooni	A cargo or fishing dhow. *Dooni* is Somali and *doni*, *doynik,* or *doonik* is Afari
ʾErya	Yard in Egyptian Arabic
Fāra	Plane
Farmal (pl. *farāmil*)	Yard synonymous with *tirmān*
Faramān	Yard
Flitch	A slab of timber cut from a tree trunk
Forma	Template of a boat part in Egyptian Arabic
Gadah	Prow, Stern
Gallābeh (sg. *Gallāb*)	Wood merchants in Egyptian Arabic
Garīna	Egyptian variant of *arīna*, keel
Garya	Crossbeam
Ghaṭa	Cap rail, synonymous with *baṭūs*
Ghurāb (pl. *ghirbān or aghriba*)	War vessel of different sizes operated by oars and sails, also crow; raven
Ḥaddafa	Oar or paddle
Hadrūs (pl. *hadārī*)	Floor timber
Ḥammāl	Scaffolding
Ḥigra/*Ḥigr*	Lower stempost
Hinnām	Stempost

Hirāb	Keel synonymous with *arīna*
Ḥomra	Red pain to powder to cover the string that traces sawing lines on a plank.
ʿidil	Straight in Egyptian Arabic
ʿidān (sg. *ʿūd*)	Frames
Jalba (pl. *jilāb* or *jalbāt*)	A Red Sea light passenger and cargo vessel; pilgrim ferry boat; light and swift scouting boat used by the Portuguese
Kabīna	Cabin
Khums	Futtock or floor frame
Kirda	Lower sternpost where a shaft and propeller are fitted in
Kortāt/kawortāt (Sing. kaworta, kurti, kawert)	Fore-deck planks
Loḥ	Plank
Al-madīna al-ṣināʿiyya	Industrial neighbourhood in a town or city
Maltam	Rainy winter season on the Mediterranean coast of Egypt in vernacular Egyptian language
Matraḥa	Oar or paddle
Mazariʿ (sg. *mazraʿa*)	Plantation, farming land
Mīda	Keelson
Migdāf	Paddle or oar
Minshār yadawī	Manual saw
Muʾakhira	Stern

Muqaddima	Stem
Naqrafūs	Timber elbow, planking of transom stern not a right angle
Qadaḥ	Stern
Qaʿda	Cross-beam
Qazaq (pl *Qazaqāt*)	Slipway (Badawi & Hinds 1986: 699); My Egyptian informants use it more broadly to designate a boatyard.
Qiswa	Planking
Quntura	Rising wood
Qūs al-khalfī	Stern
Rubāṭ (pl. *arbiṭa*)	Stringer
Ṣaddāfa	Boat used for pearling
Ṣadr/ṣidr	Bow, stempost
Samaka/*samka*	Sternpost, lower sternpost
Samara	Wood grain
Ṣāri	Mast synonymous with *dagal*
Sharbatli	Mature tree in Egyptian Arabic
Shilmān/*shalmān* (pl. *shalamīn*)	Frame
Silaḥ	Longitudinal piece of timber that is on top of the keel towards the ends of the boat for reinforcement.
Sukkān	Rudder, synonymous with *daffa*
Ṣunnāra	Fish line

Tadrīb mihanī	Artisanal training
Talwiḥ	Act of building the hull planks
Tashtīb	Dividing rooms of cabin in Egyptian Arabic
Tirmān	Yard synonymous with *farmal*
Tirs	Sternpost
Trabel	Keel
Ṭornaṭa	One tonne of wood in Egyptian Arabic
Wistaniyya	Lower sternpost
Zunnār/Zinnār	Rubbing strake
Zunnār al-bordi	Group of the last three planks below the cap rail

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