Building a *ngalawa* double-outrigger logboat in Bagamoyo, Tanzania: a craftsman at his work

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English abstract: This article documents master logboat-builder Alalae Mohamed's construction of a *ngalawa* fishing vessel in Bagamoyo, Tanzania. The *ngalawa* is an extended logboat with double outrigger and lateen sail: used by low-income, artisanal fishers. It is the most common marine vessel type of the East African coast. This article follows the construction process from Alalae's selection and the felling of the tree(s) to the launching of the vessel. It outlines the tools and materials used, details the sequence he followed, and presents his choices and considerations made along the way. It is accompanied by a documentary film recording the construction process, a 3D digital model of the vessel and detailed construction drawings.

Swahili abstract: Makala hii inaelezea ufundi wa kuchonga ngalawa wa Mzee Mohamed Alalae ambaye ni mtaalam mahsusi wa kutengeneza chombo hiki katika pwani ya Bagamoyo, Tanzania. Ngalawa ni chombo cha usafiri cha majini ambacho hutumiwa na wavuvi na hasa wenye kipato cha chini. Katika Makala hii, tunaelezea mchakato wa utengenezaji ngalawa kuanzia hatua ya kuchagua mti, uchongaji wake hatua kwa hatua, hadi kukiingiza baharini. Makala hii pia, inaelezea zana za kiufundi na vifaa vinginevyo vinavyotumika kutengeneza ngalawa. Vile vile, makala hii inaambatana na filamu na michoro mbalimbali kuonesha mtiririko wa kutengeneza chombo hiki.

Keywords: Ngalawa, dugout, logboat, outrigger, Bagamoyo, Tanzania, fishing

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Introduction

The *ngalawa* logboat (Sw. pl. *ngalawa*) is by far the most common fishing vessel found today in the waters of the Zanzibar Channel, Tanzania, and probably also for the major part of its range of usage along the Swahili coast, which historically runs from Mogadishu, Somalia, in the north to northern Mozambique in the south; it includes also the Comoros Islands and northern Madagascar. Relatively low cost to commission and build, and normally powered by a sail, it is the stalwart of low-income, artisanal fishers working in the region's inshore waters, usually around reefs and sandbanks: more than 90% of boat-owning fishermen in Bagamoyo, Tanzania—the site of this research (Fig. 1)—own a *ngalawa*.

The etymology of the word *ngalawa* remains obscure, but its users have no difficulty identifying one, based on its construction features. It is an extended logboat with a double outrigger, a feature not seen in Africa outside the Swahili coast, nor indeed in the home regions of most scholars who have ventured to write about it. The outrigger consists of a frame comprising two lateral booms that extend longitudinal floats port and starboard outboard of the hull; this feature has long attracted the curiosity of outsiders, including travellers, maritime ethnographers and, more recently, tourists. The *ngalawa* normally also has a bow timber with an upturned lobe, called a *kasama*, and is usually rigged by a settee or lateen sail.

In this article, we explore and celebrate the expertise of an individual to whom, in contrast, the *ngalawa* is not an exotic object, but central to his livelihood on two levels. Mzee[1] Alalae Mohamed, a resident in his sixties of the town of Bagamoyo is both a renowned maker (*fundi*, pl. *mafundi*) of *ngalawa* in the area, and a fisherman who uses his *ngalawa* for fishing on an almost-daily basis. He is pictured throughout this article (e.g. see Fig. 5E below). We follow his construction of a *ngalawa* that the authors collaborated in 2019 as part of the *Bahari Yetu, Urithi Wetu* (Our Ocean, Our Heritage) project, a year-long initiative to explore the possibilities of promoting the maritime cultural heritage of Bagamoyo and its surrounding villages for social benefit.[2] In this article we document the construction process in conventional narrative form with associated images and illustrations, but also accompany it with a 43 minute documentary film and photogrammetry model (in 3D PDF format), supplied as supplementary materials.[3]

[1] *Mzee* is a Swahili word meaning 'old': it is used to signify respect to an elder.

[2] *Bahari Yetu, Urithi Wetu: Our Sea, Our Heritage*, funded by *Rising from the Depths*, a Global Challenges Research Fund initiative of the Arts & Humanities Research Council, project 1684750; Investigators: John P. Cooper, Elgidius B. Ichumbaki and Lucy Blue.

[3] Supplementary materials for this article can be accessed here: https://doi.org/10.1080/10572414.2021.2018243. A 43-minute documentary film detailing the construction of the Bahari Yetu, Urithi Wetu ngalawa, can be accessed here: https://zenodo.org/record/5975708#.YjNFTujP1pi.

Research Objectives

While the *ngalawa* has been the object of intermittent scholarly interest for some decades (see below), the process of making one has not been documented to the level of detail that more recent technological innovations allow. Consequently, we have the advantage over Morgan (1940), who offered the most detailed account of construction prior to this one. In addition, we take the opportunity to foreground not only the *ngalawa* as a made object, but Mzee Alalae as its maker, celebrating his agency and considerable skill: we recognise his crucial role in the knowledge-creation underpinning this article. By presenting a detailed account of his construction of a contemporary logboat, we also hope to provide resources on which scholars can draw in interpreting logboats found in archaeological contexts. Ownership of the *ngalawa* described in this article has now been transferred to the Association of Boat Builders and Vocational Training, Bagamoyo, a non-government organisation established with the support of the *Bahari Yetu, Urithi Wetu* project, where it will be used to advance the objectives of the association and its members.

Methodology

The authors who were present during the construction process (EI, PM, SR, TB) documented Mzee Alalae's construction of the *ngalawa* through close observation of his activities on a daily basis and via ongoing conversations with him during the construction process. Questions put to him on site often focused on understanding the sequence of construction, the nature and benefits of the materials he used, his choice of tools, his means of conceptualisation, and his overall strategy. Terminology for boat-parts and tools was also gathered. More general conversations, not always on site, focused on his family circumstances, his apprenticeship and experiences as a builder, and his opinions on the future of his craft. Oral exchanges were generally open-ended and free-flowing, without the use of fixed questionnaires: structure was provided by the build itself. The time taken for the build, and later ongoing encounters with Alalae, enabled conversational themes to be revisited and elucidated, and facts checked. The team supplemented these conversational exchanges with high-quality digital video recording using a Panasonic Lumix GH4 video camera, and stills photography using a Canon EOS 5D (Mark III). These two cameras were preferred due to their ease of use and previous successful usage (e.g. see Ichumbaki and Lubao 2020: 422). The documentary film of the process was created by Thobias Minzi, closely working with EI, the lead author.

The authors also made a 3D photogrammetry model of the vessel using a Sony Cyber-shot DSC-RX100 II compact camera, with post-processing conducted by Alessandro Ghidoni of the University of Exeter using and Metashape Pro[4] photogrammetry software (Fig. 2; see also supplementary materials). The 3D model was then used to reverse-engineer construction drawings using Affinity Designer vector drawing software (Figs. 3 & 4).

The *ngalawa* in scholarly literature

Apart from Falck's relatively brief section on the *ngalawa* in his 2014 article on boats and boatbuilding in Tanzania, published in this journal (Falck, 2014: 162–165), the majority of published scholarship on the *ngalawa* and similar outrigger vessels of East Africa have been by colonial-era Europeans. These inevitably reflect the European intellectual contexts of that

[4] Formerly Agisoft Photoscan Pro.

period, with its preoccupations with diffusionism and evolution, and, in some cases also, the unrelated supremacist ideologies of individual authors. This corpus identifies the *ngalawa* as occupying the central part of a wider East African maritime zone that is unique within Africa—and indeed Arabia, with which it had close maritime connections—by virtue of people's use of logboats with single or double outriggers. That zone comprises parts of Mozambique, the northern coast of Madagascar, the Comoros Islands, Tanzania, Kenya, and the southern-most part of Somalia (Haddon, 1918: 52, 49; Morgan, 1940: 27; Hornell, 1944a; 1944b; Grotanelli, 1955; Prins 1959: 205–206; Hatchell, 1961: 211). The area of specifically *ngalawa* usage is said to extend from northern Mozambique to southern Somalia, and to include Zanzibar and some of the Comoros Islands (Haddon, 1918: 49; Prins 1959: 205–206, 209–210). However, even this area includes variations in form—discussed below—particularly apparent in its northern and southern-most districts (Haddon, 1918: 49; Hornell, 1944b: 170–173). Indeed, the extent of valid applicability of the term *ngalawa* across the double-outrigger dugouts of this entire region merits further research.

The extant literature gives the impression that *ngalawa* use and distribution has grown since the early 20th century—despite unrealised forebodings of its imminent decline (Morgan, 1940: 27; Hatchell, 1961: 211; Falck, 2014: 172). At the time of his research, the maritime ethnographer A.H.J. Prins (1959: 205–206) places the greatest concentration of *ngalawa* in Zanzibar, adding that it was also common in Dar es Salaam. However, he adds that it was scarce or absent in the mainland coastal areas of Tanga, Pangani, and Bagamoyo. If that was indeed the case at that time, the situation is quite different today: the authors counted over 120 *ngalawa* on Bagamoyo beach on one day in August 2019 and over 130 on the same beach in early June 2020.

Most *ngalawa* in Bagamoyo and Zanzibar[5] today have a hull characterised by a deep 'U' shape in cross section that renders the vessel relatively fast in the water but unstable without the support of its outriggers. The upper sides of the hull comprise slab-like extension planks, while its characteristic prow is formed by attaching an additional bow timber (the *kasama*) with upturned forward projection.[6] Meanwhile, the stern converges to a narrow, straight, almost-vertical face onto which a rudder is mounted. This is the same hull form observed by authors as far back as Hatchell in Tanga in 1961 (210, 213–214). However, it becomes difficult to trace the particular bow shape into earlier published literature. A series of previous authors report double-outrigger logboats—some of which they identify as *ngalawa*, albeit variously spelt—but these have a flat, horizontally v-shaped prow timber, or none on smaller boats (e.g., Von Luschan, 1897: 256; Warrington Smythe, 1906: 315; Haddon, 1918: 51; Morgan, 1940: Figures. 1–5, 29, 30, plate facing page 30; Hornell, 1944: 174, plate 1 & 3). Other differences are also apparent: Warrington Smythe's 1906 vessel, for example, is beamier, and has several thwarts, while Weule's (in Haddon, 1918: 50) is an un-extended log of rounded cross-section and prominent tumblehome. Clearly, location (and perhaps inaccurate recording of form or name) must account for some of this variation, but the fact that the upturned prow form is

[5] The present article is primarily based on research conducted as part of the *Bahari Yetu, Urithi Wetu* project (c.f. above), but draws incidentally on research conducted as part of the British Academy/Honor Frost Foundation-funded *Boat Builders of Zanzibar: Nautical Technology and Maritime Identity in a Changing World* project (SL-08385): Principal Investigator, John P. Cooper; Co-investigator Lucy Blue.

[6] Swahili terms are provided in brackets after the English term in the article text; components of the hull are also labelled in Swahili and English in Fig. 3, while components of the rigging are labelled in Fig. 23.

not reported before 1961, and evidence that a different prow configuration exists earlier, is suggestive of possible change even in recent decades.

The published sources identify essentially two variations in the double outriggers used on East African logboats: the first has horizontal plank floats that lie flat on the water surface and are attached to stanchions that rise vertically to meet horizontal booms, which they join at right angles (von Luschan, 1897: plate XXVII, figure. 2g; Haddon, 1918: plate D, figures 1–2; Hornell, 1920a: 138; 1944b: 170–173); the second has obliquely set plank floats that are attached to stanchions that rake obliquely up to the booms (Haddon, 1918: plate D; Hornell, 1920a: 138; 1944b: 174; Morgan, 1940: plate facing page 30; Hatchel, 1961: 213–214; Falck, 2014: 163–164). The Bagamoyo and Zanzibar *ngalawa* belong to the latter group, while the former includes vessels from the far north of Kenya and, to the south, Mozambique (Hornell, 1920a: 138; 1944b: 170–173). Within the group of outriggers with oblique floats, Hornell (1920a: 138) identifies two varieties, based on lashing configurations: the Bagamoyo *ngalawa* conform to his 'Zanzibar form'. Bagamoyo's *ngalawa* have a stern-mounted rudder, as also observed by Haddon (1918: 49, 51), Morgan (1940: 29–30, Figure 3, plate facing page 30), Prins (1959: 207), Hornell (1944b: 174) and Wenban-Smith (1963: 166). Other types of double-outrigger vessel are simply steered by paddle and/or sail (Warrington Smyth, 1906: 315; Hornell, 1920a: 136–137).

Overwhelmingly, the published sources report the use of the lateen or settee sail (Haddon, 1918: 51; Morgan, 1940: 34–35; Hatchell, 1961: 211; Wenban-Smith, 1961: 166; Falck, 2014: 164), a situation that remains unchanged in Bagamoyo today. A very small number of *ngalawa* have supplementary outboard motors: their adoption was already being reported in the early 1960s (Hatchell, 1961: 215; Wenban-Smith, 1963: 166), but prohibitive cost continues to greatly limit their use.

The spatial and technological variation that colonial-era scholars observed among East Africa's outriggers has fuelled an eager discussion on the imagined origin and diffusion of outrigger technology within, and indeed to, the region (Warrington Smyth, 1906: 315; Crossland, 1918:167; Haddon, 1918: 49; Robinson, 1937: 65–67, 69–70; Morgan, 1940: 28; Hornell, 1920a: 134; 1932: 142; 1934; 1944a: 3–4; 1944b: 170, 181–185; Prins, 1959: 207, 208–209; Winkler, 2009: 29). Two core *prima facia* observations have driven this discussion, alongside the general archaeological preoccupation with diffusion typical of the period. One is the absence of the outrigger (double or otherwise) elsewhere in Africa and Arabia, contrasting with its presence in Sri Lanka and south-east Asia, albeit using quite different construction methods to those found in East Africa (Hornell, 1920b; Aguilar, 2006; Kapitän, 2009; Lacsina, 2020: 48); the other was evidence of the past transfer of Austronesian languages to Madagascar indicative of human connections (Hornell, 1944a: 3–4; 1944b: 181–183).

A further factor of the intellectual *zeitgeist*, however, was the simple presumption underlying diffusionism—that a given innovation can only occur once. This readily served a wider hegemonic discourse of racial and cultural superiority over 'the other' that was, as Said (1978) famously asserts, so central to the colonial project. James Hornell, perhaps the most prominent voice in the diffusionist discourse around the East African outrigger, is explicit in founding his position on racial supremacism: Neville Chittick (1980: 299) quotes him as asserting the "[the] well-recognized lack of skill shown in boat construction by the Bantu and the Negro unless and until they have received instruction from other races possessing such skill". More direct evidence of his racist motivations can be found in his writings on the sewn boats of Lake Nyanza/Victoria (Hornell, 1943: 10, 17, 22–23). Here he asserts that: "The lack of a sail in the lake craft, until it was introduced by the Arabs, was probably due to want of skill on the part of the Bantu borrowers of the hull design. The African negro is notoriously deficient in ability to handle sailing craft except after prolonged tuition by the European" (Hornell, 1943: 22). He goes on, claiming a non-African origin for the Nyanza boats, that: "It is also to be borne in mind that the negro in no other part of the continent has ever evolved a boat design in any way comparable in complexity and skilful construction with the canoes of the Victoria-Nyanza. The latter stand apart, *exceptional and foreign* to all other products of negro canoe-building, for elsewhere canoe design is crude and primitive…" (Hornell, 1943: 22; our emphasis). With such egregious evidence in mind, it is essential to approach European colonial narratives around the extra-African origins of East African outrigger vessels with ample scepticism.

Alongside notions of diffusion within the past scholarship come notions of technological evolution that constitute the threads of diffusionist lineages. Implicit within these are modernist notions of technological 'progress'. A number of scholars label the logboats used in East Africa and elsewhere in the Indian Ocean as 'primitive' (Robinson, 1937: 66; Morgan, 1940: 27, 28; Hornell, 1920a, 134; 1944b: 172; Bowen, 1952: 198–201) or at least towards the 'primordial' end of an imagined schema of watercraft evolution (Warrington Smyth, 1906: 315; Falck, 2014: 162). The attitude this designation licenses towards people *using* such logboats is tacit, but nevertheless palpable. In his book *The Shock of the Old*, a historian of technology David Edgerton attacks such 'non-sensical notions of modernity' (2019 (2006): xv), in which, characteristically, 'the assumption that the new is much superior to older methods is widespread.' He advocates, instead, a 'rethinking of our notion of technological time, mapped as it is on innovation-based timelines' (2006 (2019): xxi). Edgerton's key assertion is that we should, instead, approach technology applying a 'use-centred', rather than an 'innovation-centric' account (2006 (2019): xxiii). For economic historians of technology, he argues, 'the significance of a technology for an economy is the difference between the cost or benefit of using a technology and that of the best alternative' (2019 (2006): 5).

The implications of Edgerton's analysis for our appreciation of the *ngalawa* makers and users of Bagamoyo and elsewhere is clear: the *ngalawa* offers an optimised solution that balances cost, material availability, technical knowledge, nautical performance and effectiveness as a fishing vessel that is superior to any other within their circumstance. From this perspective, the *ngalawa* makers and users of Bagamoyo, and probably the entire Swahili coast, are rational agents of their own destiny, rather than the tradition-bound objects of primordial fate. It is ironic that another strand in the literature acknowledges the prowess of the *ngalawa* as a fast and effective vessel, capable of carrying a large area of sail and beating close to the wind: its vulnerability to leeway is a trade-off for the shallow draft necessary for beaching, and its requirement to wear that is common to all lateen-rigged craft of the western Indian Ocean (Warrington Smyth, 1906: 317; Morgan, 1940: 33–35; Prins, 1959: 205; Hatchell, 1961: 211; Wenban-Smith, 1963: 166).

Two previous accounts of the building of the *ngalawa* have been published: a more detailed account of Mr. Hamisi's construction of a *ngalawa* at Kilwa Kivinje by Morgan (1940: 28–35), as well as a brief one by Wenban-Smith (1963: 166). We make reference to both in our own account.

Mzee Alalae: the builder

Before detailing the *ngalawa* construction process, we begin with a biography of the builder, Mzee Alalae, and relate how he came to specialize in the building of this and other logboats as a craft profession. During our interviews with local fishermen as part of the *Bahari Yetu, Urithi Wetu* project, several cited him as the town's pre-eminent maker. Our interest piqued, team members went in search of him, and we found him at the beach while he was cleaning his nets. Later on, some of us (PM, SM, LB) went with him to his mother's home in Bagamoyo: this was the start of our collaboration.

Alalae is his mother's only son, and this was instrumental in taking him to the sea: she raised him alone, his father having divorced her before he was born, and Alalae still lives with her. His father moved first to Zanzibar for work, possibly in clove plantations, and later to Tanga, about 150km north of Bagamoyo. Because his father had left, and because his mother was partly abandoned, Alalae did not have the opportunity to interact with half- or stepsiblings from either parent. At primary school, he had nowhere to go for lunch. Instead, before returning to school at 2pm for the afternoon sessions, he would spend time at the beach, helping the returning fishmen in exchange for fish, which he sold for money to buy food or took home to his mother. On completing school, he drew on this experience and engaged formally in fishing activities, working together with Kojani people; these were renowned Zanzibari business fishmen from Pemba or Unguja who dominated the fishing industry in Bagamoyo in the late 1970s and 1980s and recruited many young people. He travelled with them to various islands and worked the entire central coastal area of Tanzania, gaining knowledge of both fishing and the sea.

Alalae's decision to learn boatbuilding came as a result of Tanzanian government campaigns against illegal fishing in the late 1980s and early 1990s. During that time, illegal fishers were either imprisoned or fined. He well remembers that, in 1987, a group of fishermen he had been working with were arrested and prosecuted, each being either fined 300,000 Tanzanian shillings (equivalent to USD 300 at the time) or imprisoned for three years. He was not working with the group that day but was nevertheless saddened that the men's bosses could not pay the fines and secure their release. The situation prompted him to consider seeking an alternative, independent living through boatbuilding.

Alalae is unusual among his boat-building peers in Bagamoyo in being entirely self-taught: skills are normally passed on between males within a family, or otherwise to an un-related apprentice. Rather than starting his learning process with a relatively complex *ngalawa*, he therefore began his building by attempting to carve a more straightforward variety of extended logboat without outriggers, known as a *mtumbwi* (pl. *mitumbwi*; or *dau*: Weiss, 1973: 176–179). He looked for a tree and, on finding an appropriate mango tree, felled it and started shaping it. As he had no teacher to guide him, he made several trips to the beach to look at existing *mitumbwi* as models for his own. After some weeks, he managed to produce a vessel that was, he says, 'neither bad nor good', but which would at least enable him to start fishing independently. From these beginnings, he began making and selling *mitumbwi* that could carry up to six people.

Alalae's first build of a *ngalawa* was unplanned. In 1992, he obtained a large tree to make a *mtumbwi* to carry up to 15 people. He relates that this tree had a good, straight branch extending off the main trunk that looked suitable to produce a small, narrow *mtumbwi*. It then occurred to him to attempt to make a small *ngalawa* from it. This was 2.5 *pima*[7] (arm-spans) long, and he did not venture to give it the upturned *kasama* bow timber characteristic of the *ngalawa*. This first *ngalawa* 'looked okay', he said, and indeed he secured a buyer. This was the beginning of his *ngalawa*-making, since many fishers subsequently approached him to carve one for them.

Many of the *ngalawa* Alalae produced during this time were small: he did not yet have the skills to produce larger ones, he says. The stimulus to produce a lager one came one day in 1995 or 1996, when he had a very good catch at the Kijitokamba fishing ground, about 15–20km north of Bagamoyo. The catch was so good that his boat could not carry all the fish, and he was forced to discard some. Alalae therefore decided to seek out a large tree and build a bigger *ngalawa* for himself. Once he found one, he did not want people to know he was building this new vessel, and so invited no one to his build site in the bush. When he finished the vessel, he says, it was both large and well made: people admired it and wanted to buy it. As a result, several fishers engaged him to make one for them. At the time—between 2001 and 2004—there were many mango trees in the Bagamoyo area, and urban growth was prompting new residents to cut some down. As a result of demand and the ready availability of mango trees he made and sold several. In this way he became a specialist *ngalawa* maker and continues to build them today. Since Alalae is self-taught, this article reflects his own approach to construction—other builders might do it differently.

Building the *Bahari Yetu, Urithi Wetu ngalawa*

Building the *ngalawa* for the *Bahari Yetu, Urithi Wetu* project took nearly a month in total, in phases spread across October, November and December 2019. The process began with a search for suitable trees: Alalae located the main tree, a mango, near Matimbwa village, 20–25km southwest of Bagamoyo, and identified a cashew tree for the *kasama* about 7km northwest of the town (for discussion about timber selection see below). The construction process began with the felling and rough shaping of the main tree under Alalae's watchful eye; the cashew tree was tackled the next day. After felling and roughly shaping the various elements of the hull at the felling sites, all were transported by truck to Bagamoyo, where the final hull shaping, and assembly of parts took place on a grassy area outside the town's historic Boma building. Fitting out, including assembly of the outrigger, took place on the nearby beach, with the launch taking place on 9 December 2019.

Tools and equipment

Building the *ngalawa* from start to finish required a range of equipment and materials that are summarised in Tables 1 and 2, respectively. Alalae already owned most of the tools he needed; materials other than the timber, were procured from either Bagamoyo or Dar es Salaam, about 70 km to the south. While Alalae directed a chainsaw operator in felling and giving preliminary shape to the main elements of the vessel, all remaining woodwork was done using hand tools. Alalae used two varieties of axe, three types of adze, two types of chisel and two types of saw to reduce, shape and finish the timbers (Table 1; Fig. 5). He and his assistants used two felling axes, (*shoka ndefu*; Fig. 5B) for rougher, large-volume

[7] The *pima*, or arm span, is a familiar measurement among the boat builders of Bagamoyo; for matured persons, it is typically ranging between 1.5m to 2.5m depending on the height of the respective person.

reduction, and swapped the haft out of one of these for a shorter, offset haft, to create a hand axe (*shoka fupi*; Fig. 5C), for finer work on vertical faces. The offset haft of this smaller axe kept knuckles away from the timber surface. The adzes used were a two-handed foot adze (*shoka ya kuchongea*; Fig. 5D), used in the reduction of horizontal surfaces, a shipwright's adze (Fig. 5E) also used in the reduction of plank timbers, and a hand adze with a narrow blade (*patasi*, pl. *patasi*) for working in the confined spaces at the bow and stern (Fig. 5F). He also used a long-handled ship's slice (*mpaya*) to smooth these inner faces (Fig. 5G). Alalae sometimes used a flat chisel (*patasi*; Fig. 5H) where an axe or adze would not reach, driving this with a ball-pane hammer (*nyundo*).

The saws (*misumeno*, sing. *msumeno*) comprised two 'pruning' saws that cut on the pull stroke (Fig. 5I), which Alalae and his assistants deployed in the seams between the principal components of the hull to achieve a tight fit, and a hand saw (Fig. 5J), used for several purposes including achieving a tight seam between the *kasama* and the hull, and cutting scarf-joint faces on the *kasama*. He drilled nail holes using a bow drill (*Keikei na uta*; Fig. 5K), and used more than one bit on the drill, swapping these out with the help of the hammer. He used the hammer and a straight gouge (*mangabu*) to create recesses for nail heads—and also to create the hole for the halyard at the head of the mast (Fig. 5L). He used a metal rasp (*tupa*, sing. and pl.) to sharpen his tools. Nails were driven home using a nail punch (*pini panchi/senta panchi*) and temporary ones removed using pincers (*plaizi*). Measuring and marking-out implements included string (Fig. 6A) and small nails to anchor it, sometimes used with home-made ink; straight sticks used to evaluate symmetry (Fig. 6B); and two types of pen (*kalamu*)—a simple stick dipped in ink to mark out cut lines (Fig. 6C), and a forked stick with adjustable spacer, that can be used with ink to transfer shape from one timber to another for trimming purposes (Fig. 6D)—in fact, Alalae tended to use both types of *kalamu* in the same manner, working freehand and by eye. A short, sharp straight knife (*chembeu*) was used to insert the caulk (*calafati*) between the planks to prevent leakage.

Finding the tree(s)

The construction process began with the search for a suitable tree for the core element of the hull. Many *ngalawa* today are made from logs of mango (*mwembe*; *Mangifera indica*; c.f. Morgan, 1940: 28) and sometimes the inferior cashew (*mkorosho*; *Anacardium occidentale;* Desai *et al.,* 2017). Alalae said that there are, in his experience, four other, more desirable species, but these are difficult to source. He named these, in descending order of preference, as *mkungu* (*Terminalia catappa*; Mbuya *et al.,* 1994: 40), *mkenge pori* (a variety of *Albizia*; Mbuya *et al.,* 1994: 39), *mjani mpana* (literally, 'broad leaf') and *mg'ong'o* (marula; *Sclerocarya birrea* subsp. *Caffra*; Mbuya *et al.* 1994: 40).

Whenever he moves around Bagamoyo and its environs, Alalae makes a mental note of potential or suitable trees for boat carving. For instance, when the authors first proposed building a vessel to him, he recommended approaching Bagamoyo's School of Library Archives and Documentation Studies (SLADS), where he knew there was a large mango tree. In the end, SLADS' management were not ready to part with the tree, as they needed it for both shade and fruit: they offered another, fallen tree instead, but Alalae rejected it because of holes in its trunk. He then drew on his own memory bank to suggest other trees. But in the end, all our approaches regarding these came to naught.

Our search for a suitable mango tree—and if not, a cashew—then extended to villages outside Bagamoyo town. We came to hear of trees in villages inland: Alalae and one of us (SR) made survey visits to talk with the families who owned them. Many were unwilling to sell, however, because the trees were fruiting, and the harvest was just two months away. After visiting several families and villages, we finally secured provisional agreement to buy a mango tree from a family in Matimbwa village (Fig. 7A), although they insisted on time for further deliberation. A week later, a member of the family communicated to us that they were prepared to sell one tree, with a 2.25m girth, for TZS[8] 400,000 (USD 190): we signed a sale and purchase contract with them, which also approved of the tree being felled to build a *ngalawa*. We later learned that agreement within the family had not been easy: some had wanted to sell, but others not. Neighbours told us the family farm was the joint inheritance of four people. Only one lived nearby, and because he benefited from the annual harvest, he opposed the sale. The others backed the sale because they would benefit from it in a way they did not profit from the harvest, as they lived away. After securing the main tree, Alalae asked us to seek a second, this time to make the *kasama*. He insisted this be cashew, as the *kasama* needed to be lighter in order to allow the *ngalawa* to sit in the water with a slightly raised bow. We found and bought one in Mtambani village, 2.5km inland, but a 7 km drive from the shore avoiding mangroves and the Ruvu river mouth (Fig. 7B). It had already been cut down a month or so previously and cost just TZS 60,000 (USD 28).

With both trees secured, Alalae confirmed he had all he needed to start building, and logistical arrangements began. This principally involved us negotiating build time with him, as he would have to stop fishing for almost a month in total in order to complete the build. He also said he would need two assistants at the felling sites, and one once the incomplete vessel had been transported to Bagamoyo shore for further shaping. One of the assistants, Hamis Jecha, was a chainsaw operator, whose skills Alalae needed to fell the mango tree, remove branches from both trees, rough shape the main hull and *kasama*, and cut planks from the mango trunk. The other assistants, Hamis Mulile and Daudi Nguvu, helped reduce the log using hand tools. We also had to seek permission from the Matimbwa village leadership to fell the mango tree and transport it to Bagamoyo. The village executive officer granted it, subject to payment of a TZS 10,000 (USD 5) village government fee and other approvals being in place. We did not need the same approvals in Mtambani as the tree had already been felled, and hence our purchase was not considered destructive.

The whole process of seeking, negotiating for and obtaining a suitable tree took about two weeks, and marked the first major task in the whole *ngalawa* build. The relative speed by which a tree was secured was because the team worked closely with Alalae, who gave suggestions on where to find it, and helped to negotiate with the owners of the mango tree. It would have taken much longer without him.

Cutting and shaping the main trees

The chainsaw operator felled the mango tree on 18 October 2019 under the supervision of Alalae, a process that took less than two hours (Fig. 8A). Using arm spans as a measure, Alalae then measured out the length he desired for the main logboat section of the hull: as it was large, he was able to measure out 3.5 arm spans (about 5.25 m) (Fig. 8B). A further 4.5m

[8] TZS stands for Tanzania shillings: the currency in use in the United Republic of Tanzania. At the time project implementation, the exchange rate for the US dollar and Tanzania shillings varied between 2100 and 2200 shillings for 1 US dollar.

section of the trunk—above the section allocated for the hull—was identified in order to through-and-through cut six planks about 7.5–9.5cm thick for use in various parts of the build, chiefly the extension planks and outrigger floats.

Alalae then directed his assistants, as well as the academic team and some local onlookers, in orienting the main hull section into the best position for shaping. The group supported the trunk using supports cut from the branches of the tree during this process. Once he was satisfied with the orientation, Alalae began directing the chainsaw operator in shaping the outside of the main log (c.f. Wenban-Smith, 1963: 166). This began with him establishing the centre line of the log and setting a rope/ string along it. Before fixing the ends with a nail, he used a straight twig as an offset from the string every half-metre or so to establish the hull's core symmetry. Using a hand axe, he then chipped out two lines in the bark along each side of the log to mark out where he intended the upper edges—the 'proto-sheer'—of the dugout part of the hull to be (Fig. 9A). He did this freehand: when asked how he knew where to make the mark, his response was simply "*ni uzoefu tu*"— "only (by) experience" (c.f. Wenban-Smith, 1963: 166). Asked later how a carver with less experience than him might go about the process, Alalae said that symmetry could be achieved by flipping an offset string from port to starboard along the centre line, with the intended cut line marked with a boatbuilder's pen (*kalamu*) and ink.

Alalae again used only his judgement in establishing the rake of the bow and stern: he set the stern at the denser base end of the trunk, and the bow at its lighter upper end. At this stage, he had the chainsaw operator taper the stern to a relatively fine, slightly raking face, approaching its final form (Fig 9B). Still with the chainsaw, he directed that the bow be shaped to a more obtuse form, with a broader forward face, in order to allow for the latter attachment of the *kasama* timber (Fig 9C). Alalae then directed the chainsaw operator to reduce the sides of the log in order to establish the overall outer shape of the hull. Following Alalae's axe-marked guidelines, the chainsaw operator removed a thin vertical section along the sides, tapering it inward at the bow and stern (Fig 9D). Alalae used wooden wedges, driven into the chainsaw cuts with the poll of a felling axe, to help cleave away the larger waste pieces.

Alalae then directed his attention to the process of *kumogoa*—reducing the interior of the hull. First, he directed the chainsaw operator to make a deep, vertical incision along the centre line, followed by two inward-sloping incisions about 30cm deep along the inner of the two lines he had previously marked along the hull sides—the chainsaw operator made these oblique in part to err on the side of caution, and in part so that these incisions would meet subsequent incisions and so allow waste timber to be removed in sections (Fig. 10). He then made a further longitudinal incision equally spaced between the already-made central cut and each of the outer incisions. These intersected with adjacent cuts to form segments. By then cutting lateral incisions across the segments with the chainsaw at intervals, these could be levered free using the felling axe (Fig. 10).

On the following day (19 October 2019) Alalae turned his attention to the section of the mango trunk he had earmarked for planking and other elements. With assistance, he positioned this slightly s-shaped section of trunk for cutting, its ends pointing upwards and downwards so as to achieve the optimal shape and breadth in the final planking. Once the chainsaw operator had trimmed obvious protuberances, they together marked out a centre line down the log. They did this by wetting a string with a home-made ink that Alalae had made by grinding the powder contents of a dry-cell battery and mixing it with water. Having tensioned the string along the length of the log, Alalae then flicked it down onto the bark, leaving a line of ink (Fig. 11A): Subsequent lines were marked some 3 inches (7.6cm) apart on each side. The chainsaw operator then used the full length of his saw to cut a vertical incision along each of these lines (Fig. 11B). As the saw was not long enough to pass right through the log, Alalae drove wooden wedges to separate the planks completely (Fig. 11B). The process produced six through-and-through cut planks from this trunk section: two were destined for use as extension planks and two as outrigger floats; the remaining two would be cut up to form various hull elements such as thwarts and the rudder.

The next day (20 October) was the chainsaw operator’s last day on the build. First, attention returned to reducing the interior of the hull. This involved using the chainsaw to remove the longitudinal ridges left during the previous round of reduction, while keeping within the bounds set by Alalae’s axe-marked lines. This process took the interior depth of the cavity to some 25–30cm below the emergent sheer line. The chainsaw operator then roughly shaped the bow under Alalae’s direction, readying it in a preliminary fashion to take the intended *kasama* timber. In the meantime, Alalae also marked out the almost-vertical rake of the stern using a *kalamu* and ink: again, he did this by eye and from experience (Fig. 12). The chainsaw operator then also trimmed this. By the end of the day, the result was that the broad shape of the *ngalawa*’s dugout section had been roughed out, in addition to the required planks (Fig. 13).

Attention then turned to carving the *kasama* prow timber from the cashew tree at Mtambani. The tree had already been felled and was lying in such a way that Alalae’s intended *kasama* timber was upside down relative to its orientation on the boat. He therefore decided to direct the chainsaw operator to shape it *in situ*. As with the mango tree, Alalae used a hand axe to mark out the intended cut lines, including marking out a slanting top section that would become the *ngalawa*’s characteristic prow lobe (Fig 14A). The two sides of the forward part were shaped to create the pointed forward end of the *kasama* that forms the upper part of the bow, the aft part was carved to form extensions to the port and starboard sheer lines of the dugout, thus continuing forward the extension achieved by the main extension planks. Because the *kasama* was being shaped upside down, Alalae kept a close eye on the chainsaw operator during this process to avoid error, giving him directions every now and then (Fig 14B).

The chainsaw operator’s involvement was now complete, and the next day (21 October) Alalae returned to the Matimbwa mango-tree site, this time with two new assistants. They took turns with the two felling axes to start further reducing the interior of the hull by hand, working first on the rough ridges and blocks left by the chainsaw, then working down the inner faces of the sides to reduce their thickness (Fig 15A). They lowered the floor further using an axe to incise downwards (Fig 15B) and an adze, cutting horizontally, to remove exposed ridges (Fig 15C). Alalae’s attention then turned to the outside of the hull. He reinstated the longitudinal centre line and used a twig as an offset to assess the state of symmetry of the hull before proceeding. At the bow, he used a twig and ink to draw out—again, freehand—the jointing configuration required for uniting the *kasama* with the hull (Fig. 16).

Alalae then directed the men in rolling the logboat onto its starboard side in order to start reducing the lower parts of the outer hull. Mr. Daudi Nguvu—one of Alalae’s assistants and a skilled axeman—stood on the port sheer line of the hull and began to progress aft along the hull from the bow, making a series of deep linear incisions in its side as he went, about 40cm apart and vertical relative to the final orientation of the hull (Fig. 17A). The traces of some of the deepest of these can still be seen low down on the starboard side of the completed hull (Fig. 2). For his part, Alalae began at the stern, but preferred to stand on the ground, his feet by the starboard sheer line, and to lean over the hull to cut. Having made these incisions, the men worked to remove the material left upstanding in between them, cutting it away in large chunks—thereby reducing and tapering the outside of the hull towards its final 'u'-shape cross section. They also worked by eye to further reduce the bow and stern areas (Fig. 17B). This done, they then put down the axes and began to adze the outer hull, fairing away any coarseness the axes had left (Fig. 17C). Having completed the port side, they then rolled the hull over and repeated the process on the starboard. Returning the vessel to vertical, Alalae and his assistant then used axes—hand and felling—to finesse their work, narrowing an over-thick area on its outboard side, and reducing the stern further. Using mainly a felling axe, they then resumed their reduction of the interior of the hull—targeting both the sides and the floor.

Their final task of the day was to give the bottom of the outer hull a straight, flat and narrow bottom face. Standing on the upturned hull, one of Alalae's assistants used a foot adze to remove the bark still remnant on this area (Fig 18A). Alalae then affixed two nails in the upturned hull a little off centre to mark the first of the outer edges of the flat bottom: one was close to (but not at) the bow, and the other, likewise, near the stern. Running a taut, inked string between the two and then flicking it, he left a line along the length of the hull as a guide (Fig 18B). Having repeated this for the other side, he and his assistants adzed away the timber between these lines to form a flat horizontal face—the very base of the hull (Fig 18C). They then ran and flicked an inked string some 3cm to either side of the centre line of that face and proceeded with adzes to reduce the lateral timber outside these lines, thereby fining the lower sides of the hull further towards the desired 'u' shape (Fig 18D).

Initial reduction of the log at the felling site was now complete, and plans were made to transfer the hull from Matimbwa to Bagamoyo. It had taken five days to fell the mango tree, remove branches from it and the cashew tree, and reduce both to their rough hull and kasama shapes, respectively, before transfer to Bagamoyo. Mzee Alalale said that this was quick compared to the time he normally spends, and gave two reasons for this. First, we used the chainsaw for three consecutive days, whereas Alalae normally hires it for less than a day, thereby reducing cost. Second, we had a vehicle at our disposal, and could deliver Alalae to the felling site earlier than he could when walking to the site as he normally would. Without these benefits, he said that the work would take two to three weeks.

In principle, the whole build could have been accomplished at the felling site; however, the distance from Matimbwa to Bagamoyo—partly on an unmade road—made daily travel time-consuming and tiresome for all involved. The distance was further than Alalae would normally have travelled to source a tree, and its removal was only possible because project funds allowed the hire of a truck. The wider outreach objectives of the *Bahari Yetu, Urithi Wetu* project meant that the building process was also intended as an educational and outreach exercise, targeting secondary and primary-school students, visitors to the town, and passing townspeople: they would have the opportunity to ask questions of the *fundi* and, in that way, directly experience *ngalawa* building (Fig. 19).

Transferring the hull to the truck on 22 October involved hauling it some 200m to the nearest access point using coconut logs as rollers—a job that took eight people about an hour. The team were also required to consult the Department of Forestry of Bagamoyo District Council

(BDC) before removal: after submitting an explanatory letter to BDC's director, the council granted permission, subject to the acquisition of a permit from the Bagamoyo office of the Tanzania Forest Services (TFS) costing TZS 44,000 (USD 22). This specified both the species of tree and registration number of the vehicle carrying it. All papers were to be shown on demand at checkpoints *en route*: in the end, police checked them twice. The cashew tree did not have to pass through the same bureaucracy as it was sourced closer to Bagamoyo and had already been felled before purchase.

Continuing building the *ngalawa* at the Boma

Alalae continued his work at the Boma site in Bagamoyo, carving and assembling the partially shaped mango and cashew logs and other elements—such as the extension planks, thwarts and beams—necessary to complete the build. He began with shaping the *kasama*, a job that would take two-to-three days: in the meantime, he and his assistant made sure the main hull would not start distorting as it continued to dry: he did this by inserting three temporary wooden braces inside of the hull, one at each end, and another in the middle.

Alalae began the *kasama*-shaping process by using a string to measure the various dimensions of the front of the hull where the timber would be attached, transferring these measurements onto the *kasama* using the boatbuilder's pen and ink. The *kasama* itself began the process upside-down on the ground, but it was reoriented repeatedly throughout the measuring and fitting process. Alalae used the hand axe to roughly shape the timber until he achieved the approximate shape and size required (Fig. 20A). He and his assistant presented the *kasama* to the hull multiple times during the process, trimming it accordingly until it fitted as Alalae wanted: every time he presented it, he used the pen and ink to mark excess material for removal (Fig. 20B). Once he was satisfied that the *kasama* fitted relatively well, he put temporary nails (*misumali ya kuzuilia*) at the corners to hold it in place and used a pruning saw (*msumeno wa kuvutia*) to trim and fit the seam between it and the main hull (Fig. 20C). He then left the *kasama* attached to the main hull while he prepared to fit the extension planks. All of these measurements he did by eye and judgement born of experience.

Alalae did not reduce the *kasama* entirely to its final shape at this stage; he left significant amounts of material, both internally and externally, along the jointing faces to allow for final finishing and alignment. By using temporary nails, he then secured it in position on the main hull and continued with limited shaping inside so that the *kasama* and main hull were well orientated with respect to each other. Alalae then set a string centre line along the entire dugout-plus-*kasama* assembly to verify they were straight, mutually well aligned and symmetrical. Only once he was satisfied did he continue reducing the internal and external faces of the *kasama* with a foot adze while it was still positioned on the hull. Subsequently, he inserted some temporary nails to keep it in place. Alalae insisted that late-stage carving of the *kasama* should be done with it in position on the hull to avoid over-reduction. He also emphasized that shaping the external faces should be largely completed first so as to determine the thickness of the extension planks, which would be fitted next. Using the forked boatbuilder's pen, Alalae measured the thickness of these as-yet unworked planks, and from that determined the necessary degree of reduction of the *kasama* on its external face. He then reduced the *kasama* to completion, resulting in a completely shaped and balanced hull from end to end, excepting the extension planks, which were yet to be added. Part of the *kasama* timber had a natural cavity in it, to which a graving piece was added and fixed using four nails: the fitting was so fine such that no caulking *(calafati)* was needed to seal it, given that the joints would for the most part remain above the water line.

The length of the *kasama* on a given *ngalawa* is fairly standard across vessels relative to that of the dugout part of the hull: nevertheless, Alalae expressed the view that, within reason, the longer the *kasama* was relative to the hull, the greater the stability of the vessel in the water. However, on the very largest of *ngalawa* he indicated that even a short *kasama* would be adequate. In the present case, the *kasama* measured 2m from the prow tip to its furthest point aft on the starboard side, and 1.6m on the port side, where it was followed by the 0.4m graving piece. The aft ends of the *kasama* were then cut with a hand saw to form obtuse scarf joints with the 3-inch-thick (7.6cm) extension planks (Fig. 20D).

Attaching the extension planks

With the edges of the *kasama* and hull already reduced to their desired thickness, care would be needed in adding the extension planks. Alalae stressed that nowhere should the planks, *kasama* or main hull be less than 2 inches (5cm) thick, measured by eye: "if the planks [i.e. timbers] are thin, they become affected by waves, such that they bend or break."[9]

Presenting the first, unshaped, extension plank to the main hull, Alalae tested it in order to understand how much to reduce its upper and lower edges to form the sheer line and a tight seam with the upper edge of the dugout hull below. Again, he used the forked builder's pen to mark portions of the edges to be removed (Fig 21A). To achieve areas of hull curvature, the plank faces had also to be reduced using an adze: he also used the pen to indicate where these areas of reduction should start and end. In order to balance the planks and hold them in place during the shaping and balancing process, temporary supporting nails were nailed obliquely into the upper edge of the main hull from inside and out (Fig 21B). Each plank was also held in place by two temporary wooden cross-spawls—called *miti ya kuzuilia* (literally 'supporting pegs'). Then, using the pruning saw, Alalae continued to cut along the seams so as to remove protuberances and match the curvature on each faying surface (Fig. 21C).

Once the shaping of each extension plank had been completed, Alalae fixed each to the hull using three temporary wire nails, one at each end and another near the middle. This left open the possibility of further fine tuning of their shape and position, if needed. He then shaped and added further small extension timbers on each side of the hull directly aft of the main extension planks (Fig. 3); he also inserted a small, quadrilateral graving piece at the stern where part of the bolus of the original log had been hollow (Fig. 3).

The next stage was to create the final nailing system for the extension planks, which were set flush to the dugout portion of the hull. The nails used were iron, hand-made, and 5 inches (13cm) long; they had round, flat heads with tapering shafts of a square cross section. These Alalae arranged inboard and outboard at varying intervals along the hull, ranging from 0.23–1.65m, although most were spaced between 0.35m and 0.5m apart (Fig. 3). At each nail location, Alalae cut a triangular recess for the nail head using a flat chisel and the hammer, after which he drilled the nail hole using a bow drill (*keikei*; Fig. 21A–B). This process ensured the correct trajectory for the nail, while preventing the nail head from damaging the timbers. On their final insertion, Alalae would bend the shaft of each nail a little to make it grip the

[9] "*Mbao zikiwa nyembaba zinapigwa na upepo mpaka zinajikunja au kuvunjika*."

hole and preventing it backing out. The ends of the main extension planks were nailed neither forward to the *kasama* timber against which they were scarfed, nor aft to the small plank that completed them towards the stern: lateral movement of each main extension plank was instead checked by a combination of tight jointing between it and the contiguous *kasama* (forward) and small extension plank (aft), alongside the tying effect of the thwarts, boom-lashing beams, the lashed booms themselves, the mast beam, and rubbing strakes, all of which are in contact with the planks (Figs 3 and 4).

With the extension planks set in place, Alalae resumed fine reduction of the inboard face of the *ngalawa* hull in order to fair the surfaces, a process known as *kufutia* (literally 'smoothening'). This was done using a foot adze for the base and a ship's slice on the sides. Once it was complete, Alalae again braced three pieces of wood within the hull to prevent shrinkage. These were to remain in place until work on the hull was almost complete. Shaping of the outer hull was with a foot adze (*shoka ya kuchongea*) and hand adze (*shoka ndogo ya kuchongea*); interior vertical surfaces were smoothed with a ship's slice (*mpaya*). Once done, Alalae proceeded to firmly nail all the hull elements to ensure that they were secure.

Fitting thwarts and beams

Alalae then supported the hull in an upright position in order to fit the vessel's two thwarts (*kiwango*, pl. *viwango*). Judging the location by eye only, he set the aft thwart (*kiwango cha nyuma*) 95cm aft of the mast (*mlingoti*);[10] its function is for sitting during fishing or in order to trim the vessel. He then set the forward thwart (*kiwango cha mbele*) 93cm aft of the point where the *kasama* starts to curve upwards; this is for a second crew member to sit in order to trim the sail or change tack under the direction of the skipper. The latter operates the tiller (*kana*, pl. *makana*) from a seating position at the stern. The thwarts—cut from one of the mango planks—were each 23cm sided and 3.5cm moulded. They were indented equally (*kupishana*) by 7cm at both ends to create a semi-dovetail joint, enabling a tight fit with the sheer (Fig. 3, plan view), and also fixed in place with nails driven vertically downward into the upper face of the extension planks.

Next, Alalae fixed the mast beam (*kiwango cha mstamu*), which was also hewn from one of the mango planks and measures 23cm sided and 6.5cm moulded. By eye, he set this 1.3m aft of the forward thwart: unlike the thwarts, which were jointed into the sheer, he seated this on top of the sheer, nailing it down into the hull with four five-inch nails. He then used a chisel to cut a mast hole in it. Then, he fitted a small graving piece to the sheer, and used the hammer to nail the internal parts of the stern, spacing the nails at intervals of 10–70cm. By using the foot adze, Alalae then continued fairing parts of the stern, including the sheer and extension planks. He then shaped and fitted two further roundwood beams—one aft, called *kigongo cha mbele* (literally, 'fore beam'); and one amidships, called *kigongo cha kati* (literally, 'middle beam')—to which the outrigger booms would later be lashed (Fig. 4, lateral cross-section). Using nails, he then secured the graving pieces (*chipi*) that filled the natural holes in the *kasama* and stern, as well as the rubbing strakes (*papi*).

The final work on the stern included further fairing of the outboard surface, as well as using knives and chisel to caulk the seams, particularly those of the extension planks and *kasama*: the material used was cotton soaked in coconut oil a method reported elsewhere for *ngalawa*

[10] Mlingoti generically means 'pole' in Swahili: here, it refers to the mast.

(Wenban-Smith, 1963: 166; Falck 2014: 170) and more widely in the western Indian Ocean on plank-built vessels. De Leeuwe (2004: 53) mentions the use of *sifa*—an oily reduction of shark liver and other oils—in caulking, but we neither observed nor heard of this in Bagamoyo. Other plank-boat builders we met instead confirmed a wider western Indian Ocean practice of using *sifa* as a protective hull coating, used above the waterline, that prevents desiccation and cracking (Morgan, 1940: 30; Wenban-Smith, 1963: 166; Prins 1965: 303; Agius *et al*., 2014: 156).

Making and affixing the rudder

Alalae used a foot adze to carve the rudder (*usukani*) from one of the planks cut from the main mango trunk in Matimbwa. Its final height was 1m and the maximum width across the blade was 0.4m: its thickness varied between 6cm at the blade edge and 9cm at the leading edge (Figs 3 and 4, plan and profile views). Alalae explained that the latter should be similar in width to the aft face of the stern, and that the foot of the rudder should end at least an inch (2.5cm) or so higher than the bottom of the stern face to prevent it from catching the bottom or snagging over ropes or nets: on this boat, the distance was twice that (Fig. 3, profile view). Alalae insisted that the lower forward corner of the rudder should also be rounded to facilitate this, but that the lower aft corner could be right-angled or rounded, depending on the taste of the maker: that decision simply helped differentiate the rudder from others, rather than having a technical significance. The rudder is then hung on the stern face using two gudgeon and pintle pairs: the gudgeons are known in Kiswahili as *rumada jike* ('female') and the pintles as *rumada dume* ('male').

Making the outriggers

Alalale carved the outrigger floats (*mabawa*, sing. *bawa*) from two of the six planks he had had cut from the original mango tree. However, the outrigger booms (*mikingiko*, sing. *mkingiko*) and stanchions (*mbela,* sing. *mbela*) required a strong but lighter timber: he identified appropriate tree species as *mkenge pori* (c.f. above), *msekundanzi*, and *muharubani* (neem; *Azadirachta indica* (Mbuya *et al.*, 1994: 41, 112–113)[11]). Inappropriate timbers, he said, were *msinzi* and *mkandaa* (species of mangrove) because they were too heavy. In this build, Alalae used neem for the stanchions, and eucalyptus (*mkaratusi*; Mbuya *et al.*, 1994: 39, 272–281) for the booms. He also used the latter for the mast and yard (*foromali*).

Once shaped with the foot adze, the floats in this build ultimately measured 3.53m in length on the port side and 3.63m starboard (Fig. 3, plan view), the difference being due to nature of the planks used. In carving them, Alalae sought to ensure a weight balance so as to level the vessel in the water. This he did initially by picking up each outrigger during the shaping process to judge, which was heavier, making reductions to the heavier one accordingly. He insisted, however, that he could not be absolutely sure that the *ngalawa* would balance until

[11] Where it appears as *mwarubaini*.

it was in the water. He also carved both outriggers into a slightly concave shape, to enable it to rest in the water more easily, he said.

Alalae then fixed the stanchions to the outrigger floats using locked through-teazle-tenon joints (Fig. 22A; Davies and Jokiniemi, 2008: 439). He cut two square through-mortises into each outrigger float to accommodate the stanchions; on the end of each of the latter he carved a teazle tenon. He then passed these through the mortises and locked the joint by passing an iron pin—each a repurposed bolt—through a hole drilled at 90˚ through the tenon. The two aft stanchions measured 1.05m and 1.06m in length, respectively, while those forward measured 0.95m and 0.92m—a difference that went on to influence the ultimate angle of the booms for the purpose of balancing the vessel on the water (see below).

Joining the stanchions to the roundwood booms involved cutting rectangular through-mortises some 11–12cm across into the former about 60% of the way along their length from the outrigger-float end. Alalae then squared the ends of the booms to form tapered stump tenons and passed these through the mortises: the ends of these stumps would ultimately form anchor points for the rigging (see below). He then used nylon rope to lash the stanchions to the booms: the protruding inboard end of each stanchion formed a lever that helped maintain the tension of the completed lashing (Fig 22B).

Having completed assembly of the outrigger structure, Alalae, with assistance, rested it temporarily on the *ngalawa* sheer, without fixings, in order to establish the balance point. That established, he then proceeded to lash the outrigger booms to the roundwood beams that he had inserted in the hull for that purpose (Fig 22C). The distance between the outriggers and the side of the *ngalawa* was slightly less forward (2.2m) than aft (2.3m), meaning that they made a slight—only slight—plough formation in the water (Fig. 3, plan view). Alalae said that the positioning of the outriggers varied from vessel to vessel, depending on size, and emphasised the importance of a balanced outrigger assembly for speed and stability.

Making the sail

Alalae is not himself an expert in making sails, but his assistant, Mr. Daudi, is. There was some discussion between the two men about the best size for the sail, particularly around the length of the foot. Whereas Alalae maintained that this should be the same as that of the hull (about 8m)—illustrating by pointing to his left arm with his right—Daudi argued that it should be at least half an arm span longer. In the end, Alalae deferred. The making process began with clearing an area of level ground, onto which Daudi marked out a lateen sail plan using wooden pegs and string and *pima* measurements. Using a sharp knife, he cut long panels from a sheet of cotton canvas he had bought from Dar es Salaam and laid these parallel to each other over to the marked plan. They then hand-stitched these together, and later on attached the boltrope using needles and thread. Fig. 23 shows a rigging plan for the *ngalawa*.

Registration, testing and launch

With all the hull works complete, the team proceeded to register the *ngalawa* in the fisheries department of Bagamoyo District Council (BDC)—completing forms requiring the *ngalawa*'s name, size, owner, areas of operation and uses. We named the boat *Bahari Yetu Urithi Wetu* (Our Ocean, Our Heritage) after our academic project, and registered it as a multi-purpose vessel (No. TZ CBG 1479). A fisheries department officer then inspected the vessel to confirm the information given, and BDC granted the license, renewed annually, on payment of a USD 15.

Alalae then proceeded to trial the vessel close to the shore at Bagamoyo in order to refine the by-eye judgements he had made during the build: he had made no measurements using a metric scale during the build. He identified three areas that needed rectification: one outrigger was heavier than the other; the sail was small in comparison to the size of the hull; and some seams leaked. Returning ashore, Alalae reduced the weight of one outrigger and caulked the leaks, while Daudi added an extra 1m strip of canvas to the luff of the sail, make the foot 9.5m long—in the end, 1.5m greater than the total hull length.

Launch of the *Bahari Yetu Urithi Wetu ngalawa* took place on 9 December 2019, with the maiden voyage taking place to the nearby tidal sand bar of Mwambakuni (Fig. 24A and B). Alalae recommended limiting the company to seven for this trip, as the wood had not yet fully seasoned; he said the vessel would ultimately be able to carry nine. The trip was enjoyable and uneventful.

Discussion and conclusion

This article is the most comprehensive documentation to date of the construction of the most popular fishing vessel of the Swahili coast, following as it does the making of a double outrigger *ngalawa* logboat from the felling of the main mango tree to launching of the finished vessel. The research underpinning it is also the first to make a visual record of the construction process using digital still and video photography alongside the textual account, and the first to make a metric record, in this case using 3D photogrammetry. The most detailed prior endeavour to record *ngalawa* construction was by Morgan (1940), who had none of these resources at his disposal. This is also the first report of *ngalawa* construction from the northern part of Tanzania's coast: previous accounts have come from further south—Kiswere, Kilwa Kivinje, Mtumbo, Mtandura and Kilwa Kisiwani (Morgan 1940).

This article also enters a new territory in East African nautical scholarship in foregrounding the role and craftsmanship of a particular builder, Mzee Alalae Mohamed, as both agent of the construction process and intellectual property holder. Alalae is all the more remarkable as a maker given the original motivation for, and manner of, his acquisition of this knowledge: a logboat-making career was his strategic choice, and he is entirely self-taught in building not only the *ngalawa*, but also the *mtumbwi* and at least one other logboat form: he was not part of a master-apprentice tradition. The methods he deploys draw on the same toolset, material resources and socially held concepts of what constitutes a *ngalawa* as other builders, but they are nevertheless of his own derivation and development: some three decades of praxis means that he is now able to do much of his marking out and shaping by eye alone, and certainly without relying on extra-somatic metric scales. This article celebrates his virtuoso achievements.

As much as Alalae would like to coach younger people in acquiring boat-carving skills, very little is happening in reality. Generally speaking, the passing-on of boat-building and boat-carving skills from elders to the next generation is decreasing significantly, largely due to a lack of economic incentive. Alalae related that young men and women are not interested in learning *ngalawa* building. By way of illustration, he talked about the two assistant he had been working with. He believed one, who was not related to him, not to be serious about learning the skills, and that, rather, he was passing the time outside of the best fishing season. Alalae also cited his own grandson, with whom he lives, saying that he is interested in learning, but that the wider family had discouraged him on the grounds that he cannot make a good living that way.

In the face of the 'primordial' aura that logboat technologies retain for so many nautical scholars, this article has also presented Alalae's construction of a *ngalawa* in its modern Tanzanian context. We have dwelled on Alalae's early life and formation as a builder as a vital thread in the ultimate making of the *Bahari Yetu, Urithi Wetu ngalawa*. Meanwhile, the social negotiations between the authors and Alalae over his availability and the price of the job, with the owners of the trees over felling and price, the various official permits sought for felling, transportation and *ngalawa* use—all proved as much part of the process for *ngalawa* builders and users as the choice of log or tool which followed. This embeddedness of the *ngalawa* within its social, economic and resource context is fundamental to our understanding of it as a consistently popular vessel among Tanzanian and other East African fishers. Here we return to Edgerton's notion of 'use-centred' appreciations of technology: the *ngalawa* serves the purposes of Bagamoyo's fishers not because of its newness or oldness, 'primordialness' or 'modernity', but because it optimises a range of factors, among which are the local material-resource base, the economically attainable toolset and skillset of local fishers, the types of fishing it enables, and the income it makes possible for this community of makers and users.

The authors have little immediate interest in contributing to long-standing academic speculations about the origins of the double-outrigger *ngalawa* as a type, nor indeed new data to present in that regard. However, it should be said that curiosity about history of this dependable and striking vessel is, perhaps unsurprisingly, not exclusively the preserve of academics. During a community co-creation workshop in Bagamoyo at the start of the *Bahari Yetu, Urithi Wetu* project, one participant elder urged this as a research objective. In reality, we are far from discovering the deep history of the type, and this situation is unlikely to change, except through a chance archaeological discovery that local taphonomy renders improbable. Speculations about the diffusion of outrigger technology from elsewhere in the world—tainted, as they are, by overt or tacit racism—have proved sterile in terms of insight into people's day-to-day nautical technological strategies. What we hope this article offers, instead, is a way of looking at notionally 'traditional' technologies through a lens that appreciates them first and foremost as modern practices serving the multiple needs of a contemporary seafaring community, rather than proxies in a discourse of denigration.

In Memoriam

We dedicate this article to the memory of our dear friend and colleague Noel Fidelis Lasway, a deeply committed advocate of the preservation of heritage in Tanzania: he passed away on 5 May 2020, a day declared by UNESCO to celebrate Africa's natural and cultural heritage. Noel was Dr. Elgidius Ichumbaki's graduate student and contributed greatly in accomplishing various activities of the *Bahari Yetu Urithi Wetu* project. He is sorely missed.

Acknowledgements

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Fig. 1—Map showing the location of Bagamoyo, Tanzania, and other places mentioned in the text. (Image: John P Cooper)

Fig. 2—Screen grab of a 3D digital model of the *Bahari Yetu, Urithi Wetu*, the extended dugout *ngalawa* built in 2019 by Mzee Alalae Mohamed. (Image: Authors & Alessandro Ghidoni)

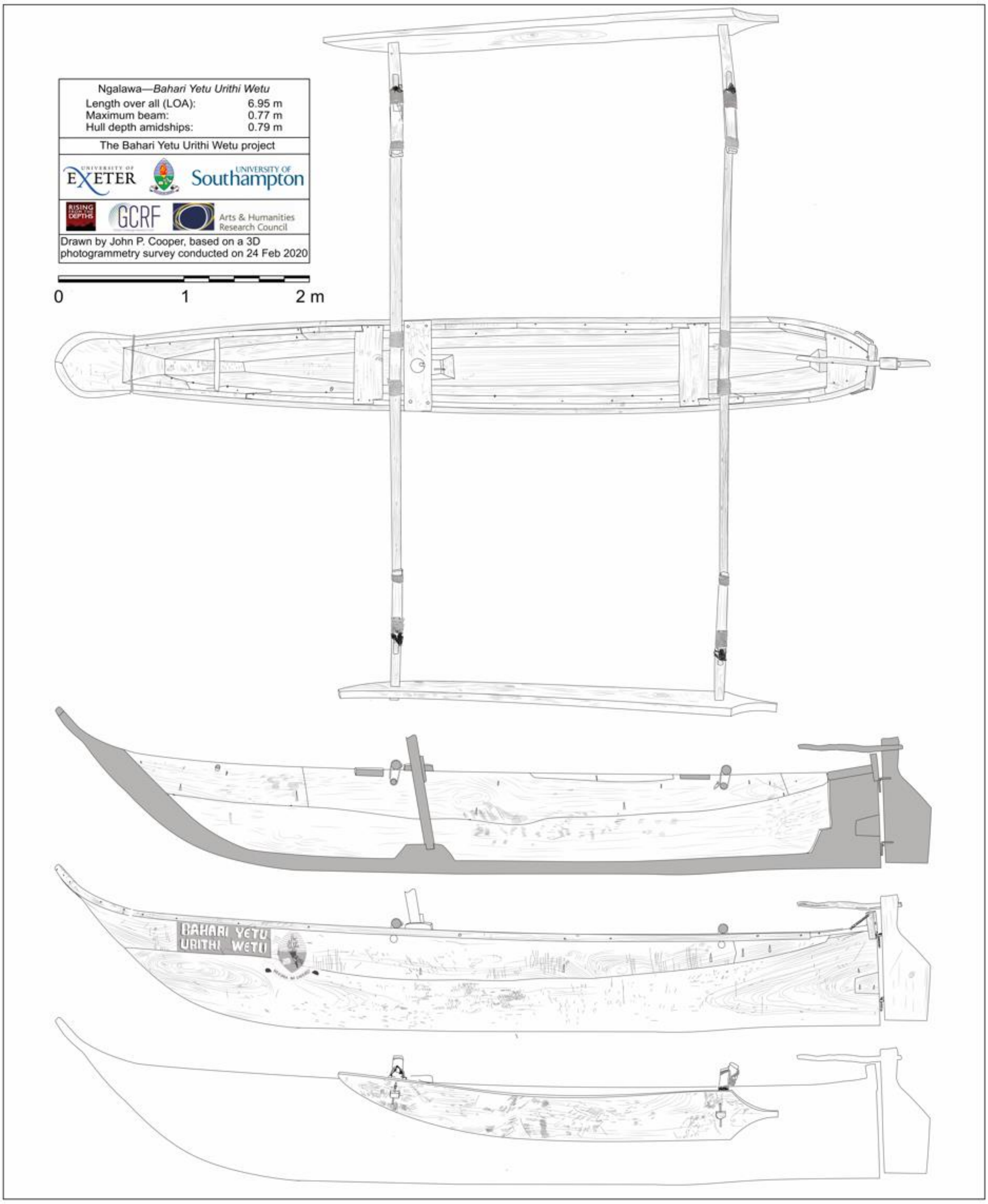

Fig. 3—Construction drawings of the *Bahari Yetu, Urithi Wetu*: plan and profile views, including cross sections (Image: John P. Cooper).

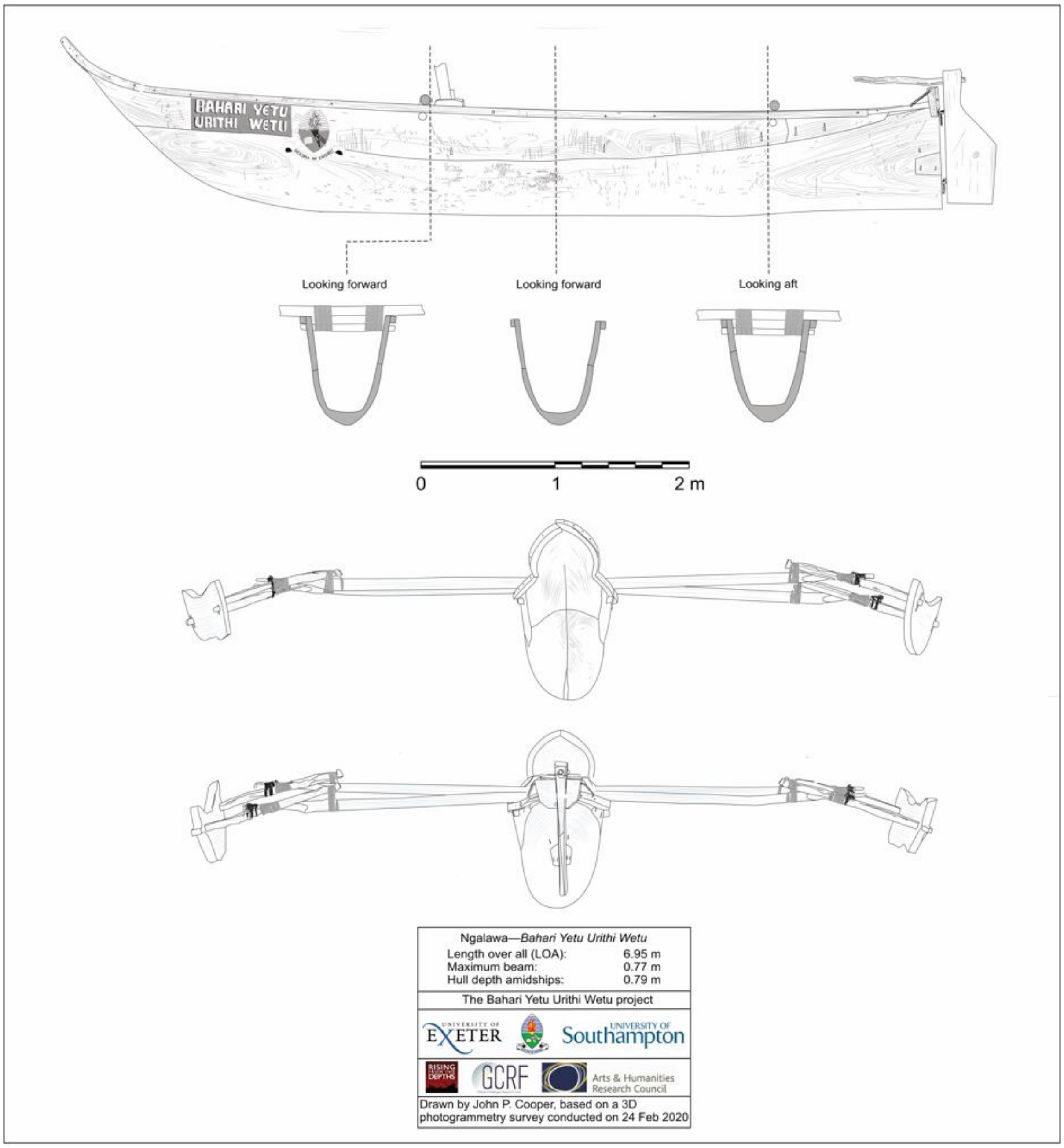

Fig. 4—Construction drawings of the *Bahari Yetu, Urithi Wetu*: end views and lateral cross-sections. (Image: John P. Cooper)

Fig. 5—Tools used on the *ngalawa* build: (A) Chainsaw; (B) Felling axe; (C) Hand axe with offset handle; (D) foot adze; (E) shipwright's adze; (F) hand adze with narrow blade; (G) ship's slice; (H) flat chisel; (I) pruning saws; (J) hand saw; (K) bow drill; (L) straight gouge, (Images: Elgidius Ichumbaki and Tobias Minzi).

Fig. 6—Measuring and marking implements used on the *ngalawa* build: (A) string and small nails to anchor it, sometimes used with home-made ink; (B) straight sticks used to evaluate symmetry; two types of pen (*kalamu*)—(C) a simple stick dipped in ink to mark out cut lines, and (D) a forked stick with adjustable spacer, used with ink. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 7—The two main trees used in building the *Bahari Yetu, Urithi Wetu*: (A) the mango tree at Matimbwa, felled for the purpose, used to make the hull, extension planks, outrigger floats, rudder, thwarts and graving pieces; (B) the already felled cashew tree at Mtambani used for the *kasama* prow timber. (Images: Elgidius Ichumbaki).

Fig. 8—The mango tree at Matimbwa: (A) being felled; (B) measured out in arm spans by Alalae. (Images: Elgidius Ichumbaki and Tobias Minzi).

Fig. 9—Rough-shaping the dugout with a chainsaw: (A) Alalae marks out the line of the 'proto-sheer' with a hand axe; (B) tapering the stern; (C) shaping the forward end of the dugout to receive (ultimately) the kasama prow timber; (D) reducing the sides outside the marked proto-sheer line. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 10—Removing segments of log that were cut using the chainsaw. (Image: Tobias Minzi).

Fig. 11—Cutting the planks: (A) marking out by flicking a line of inked string; (B) splitting off the through-and-through-cut planks with a wedge. (Images: Tobias Minzi).

Fig. 12—Alalae marks out the intended rake of the stern. (Image: Tobias Minzi)

Fig. 13—The state of the hull after almost all reduction using the chainsaw has ended. Only the rake of the stern—marked by the line—has yet to be cut. (Image: Tobias Minzi)

Fig. 14—Roughly shaping the *kasama* prow timber: (A) Alalae marks out cut lines with a hand axe; (B) The chainsaw operator shapes the timber; (C) the *kasama* takes shape. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 15—Reducing the interior of the dugout: (A) reducing the sides with felling axes; reducing the floor with (B) felling axes and (B) a foot adze. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 16—Alalae marks out by hand the bow of the dugout to create the jointing configuration for the *kasama* prow timber. (Image: Elgidius Ichumbaki and Tobias Minzi).

Fig. 17—Reducing the exterior of the dugout: (A) cutting vertical incisions using a felling axe; (B) removing material between the vertical incisions; (C) fairing the hull surface using a foot adze. (Images: Tobias Minzi)

Fig. 18—Shaping the base of the hull: (A) removing remnant bark; (B) flicking a cut line onto the hull using taut, inked string; (C) reducing the base of the outer hull to a narrow, flat face (D) reducing the lower sides of the hull to achieve its narrow, ultimately v-shaped cross section. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 19—School students experience the *ngalawa* build outside the Boma building at Bagamoyo. (Images: Elgidius Ichumbaki)

Fig. 20—(A) Alalae roughly shapes the *kasama* prow timber with a felling axe; (B) marking excess material for removal using the forked pen (*kalamu*); (C) parallel lines marked on the *kasama* and the bow determine the material, mainly on the former, that will be reduced; (D) the butt joint of the *kasama* to which the extension plank will be joined. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 21—(A) Marking out sections of the extension plank edge to be removed, using the boatbuilder's pen; (B) temporary nails hold the plank in place during shaping; (C) cutting along the seam with a pruning saw to achieve a tight seam. (Images: Elgidius Ichumbaki and Tobias Minzi)

Fig. 22—Outrigger jointing and lashing: (A) the through-teazle-tenon jointing of the outrigger float to the outrigger stanchion; (B) the through-mortise jointing and lashing of the outrigger stanchion to the outrigger boom; (C) Alalae and his assistant lash the boom to the dedicated beam fixed within the hull (Images: Lucy Blue)

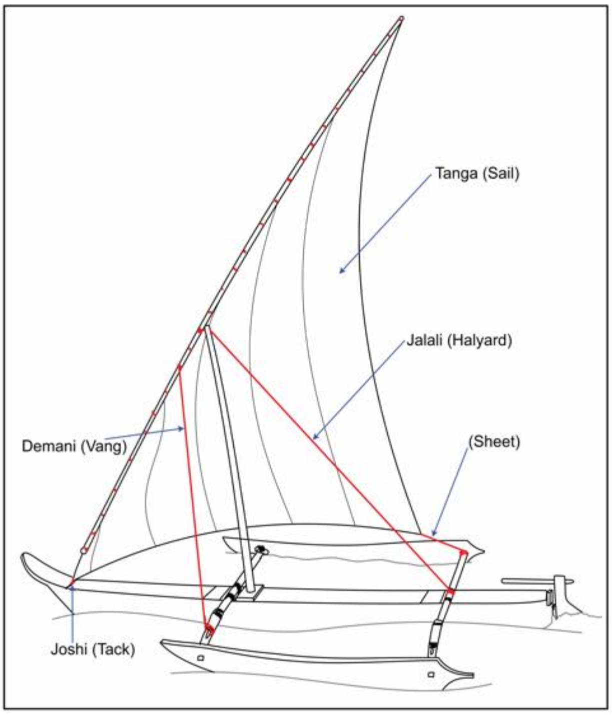

Fig. 23—Plan of the rigging of the *Bahari Yetu, Urithi Wetu*. (Image: John P Cooper)

Fig. 24—(A) The launch of the *Bahari Yetu, Urithi Wetu*, 9 December 2019; (B) setting off. (Images: Tobias Minzi)

Table 1: tools and equipment used in building the *Bahari Yetu, Urithi Wetu*

Terminology		**Description and use**
English	**Swahili**	
Chainsaw	*chensoo*	Husqvarn 365 Special (Fig. 5A), used to fell the mango tree used for the main hull and planking and cut the prow-timber (kasama) section from the fallen cashew tree; to roughly shape and to reduce the weight of the main hull (Fig. 9) and prow timber (Fig. 14B) at the tree sites; to cut a second section of the mango-tree trunk into six planks (Fig. 11).
'Spanish wedge' axe blade —with felling-axe handle	*shoka ndefu*	An axe blade corresponding in form to Salaman's 'Spanish wedge' type (1975: 56). The long, felling-style handle is removable for conversion to a hand axe (see below). Used for general, large-scale reduction of timber before finer reduction and fairing by hand-axe, adzes and ship's slice (Figs 5B, 10, 15A&B and 17A&B).
—with hand-axe handle	*shoka fupi*	The very same axe blade as above, but with a short, offset handle swapped into it. Used for fine reduction and fairing work on quasi-vertical faces. The offset handle keeps knuckles clear of the timber surface (Figs 5C, 9A, 14A and 20D).
Foot adze	*shoka ya kuchongea* (Coastal people)*; tezo* (inland people).	A large, two-handed adze with an oval socket and head, rounded poll and slightly curved cutting edge. Used inboard and outboard on the hull and other timbers to reduce and fair horizontal surfaces (Figs 5D, 15C, 17C, 18AC&D).
Shipwright's adze		A two-handed adze with a square pin on the poll (which was not deployed) used to reduce the planking (Fig. 5E; Salaman, 1975: 28–29).
Hand adze	*Shoka nyembamba*	A small, acute-angled adze with narrow blade use for shaping in the inner hull at bow and stern (Fig. 5F).
Ship's slice	*Mpaya*	Cuts on downward stroke to make fine reductions from, and also to fair, the inner face of the hull (Salaman, 1975: 143)(Figs 5G and 19).
Hand saw	*Msumeno*	A regular handsaw for general cutting (Fig. 5J; Salaman, 1975: 421–423).
Pruning saw	*Msumeno wa kuvutia juu na chini*	A pistol-gripped 'pruning' saw that cuts on the pull stroke. Used to cut along the seam between abutted timbers to remove excess wood and achieve a tight fit (Figs 5I and 21C).
Ball-pane hammer	*Nyundo*	Used to drive nails fixing the various timbers to the hull and also the chisel (Fig 5H and 21B).
Nail punch	*Pini panchi/senta panchi*	Used to drive nails fully into their recesses.
Pincers	*Plaizi*	Used to remove temporarily fixed nails.
bow drill	*Keikei na uta*	Used to drill nail holes, with the rope (*uta*) of the drill's bow looped around the spindle (Fig. 5K). There are various sizes of spindle/bit (*keikei*) depending on the nature of the nail. The longer the nail the longer the bit: a five-inch nail requires a four-inch *keikei*.
Straight gouge	*Mangabu*	Used to create recesses for the nail heads (Fig. 5H).
chisel	*Patasi*	Used to reduce parts of the trunk where an axe cannot reach.
Knife	*Kisu*	Used for various purposes, including cutting cordage, sail-fabric panels, inserting caulking between the planks and the hull.
Needle	*Sindano*	Used to sew the panels of sail fabric together to make a complete sail.
Hand cart	*Guta*	used generally to transport the hull and other timbers from place to place where no vehicle is available; in the case of this build, to move the completed hull from the Boma site to the beach for fitting out and launch.
Vehicle/truck	*Gari*	Used to transport the main log and the log for the kasama from the felling site to the Boma work site.

Table 2: materials used in building the *Bahari Yetu Urithi Wetu*

Material required			**Description and application**
English	**Swahili**	**Species identification**	
Mango (tree)	*Mwembe*	*Mangifera indica*	The main tree, its trunk supplying the main log for the hull as well as a second that yeilded six planks used for the outrigger floats, extension planks and various other timbers in the build (Figs 7A, 8 and 9).
Cashew (tree)	*Mkorosho*	*Anacardium occidentale*	The (shorter) trunk of an already felled tree, used to make the *kasama* prow timber (Figs 7B, 14).
Eucalyptus pole(s)	*Mti ya mkaratusi* (pl. *miti ya mikaratusi*)	*Eucalyptus* Spp.	Used for various elements of the vessel: the outrigger booms (*mikingiko;* Figs 2–4 and 22), mast (*mlingoti)* and yard (*folomali).*
Neem timber(s)	*Miti ya muharubani*	*Azadirachta indica*	Used for the outrigger stanchions (*mbela;* Figs. 2–4 and 22).
Caulking material (cotton)	*Calafati*	n/a	Oiled raw cotton, used to caulk the seams between the dugout hull and the extension planks and prow timber (*kasama*).
Coconut oil	*Mafuta ya nazi*	n/a	Used to lubricate the caulking cotton to ease insertion between the seams and promote waterproofing.
Sail fabric	Tanga [Ichu: 'Tanga' is 'sail', so 'sail fabric' must be something like '(fabric) ya tanga']. Can you complete this?	n/a	Cotton canvas.
Cordage	*Kamba*	n/a	Ropes, strings and threads of different sizes. Nylon rope was used to lash the outrigger booms to the hull beams, and the outrigger stanchions to the outrigger booms. Others were used for the rigging**,** including mast and yard attachment and sail bolt ropes**.** Thread was used to stitch the sail panels. String was also used to make various measurements while sizing and shaping the logs.
Dry-cell battery powder	*Unga wa betri*	n/a	Extracted and ground to a black powder that was mixed with water to an ink to mark the logs and subsequent timbers for cutting (Figs 6AB&D, 11A, 12, 16, 18B, 20B and 21A).
Nails	*Misumari*	n/a	Used for temporary and permanent fixings. Temporary wire and hand made iron nails were deployed during the building process to hold various elements (e.g. the *kasama*, extension planks, etc) as they were shaped and adjusted before final fixing (Fig. 21B&C). Five-inch round-headed nails with square cross sections were used in the final fixing of the extension planks, *kasama*, thwarts and beams to the hull (Figs 2–3, 21B).
Gudgeon and pintles	Rumada dume na rumada jike	n/a	For hanging the removable centre rudder (Fig. 3).
Grapnel anchor	Nanga	n/a	A 6kg steel anchor.

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