6. Subtropical Wetland Adaptations in Uruguay during the Mid-Holocene: An Archaeobotanical Perspective

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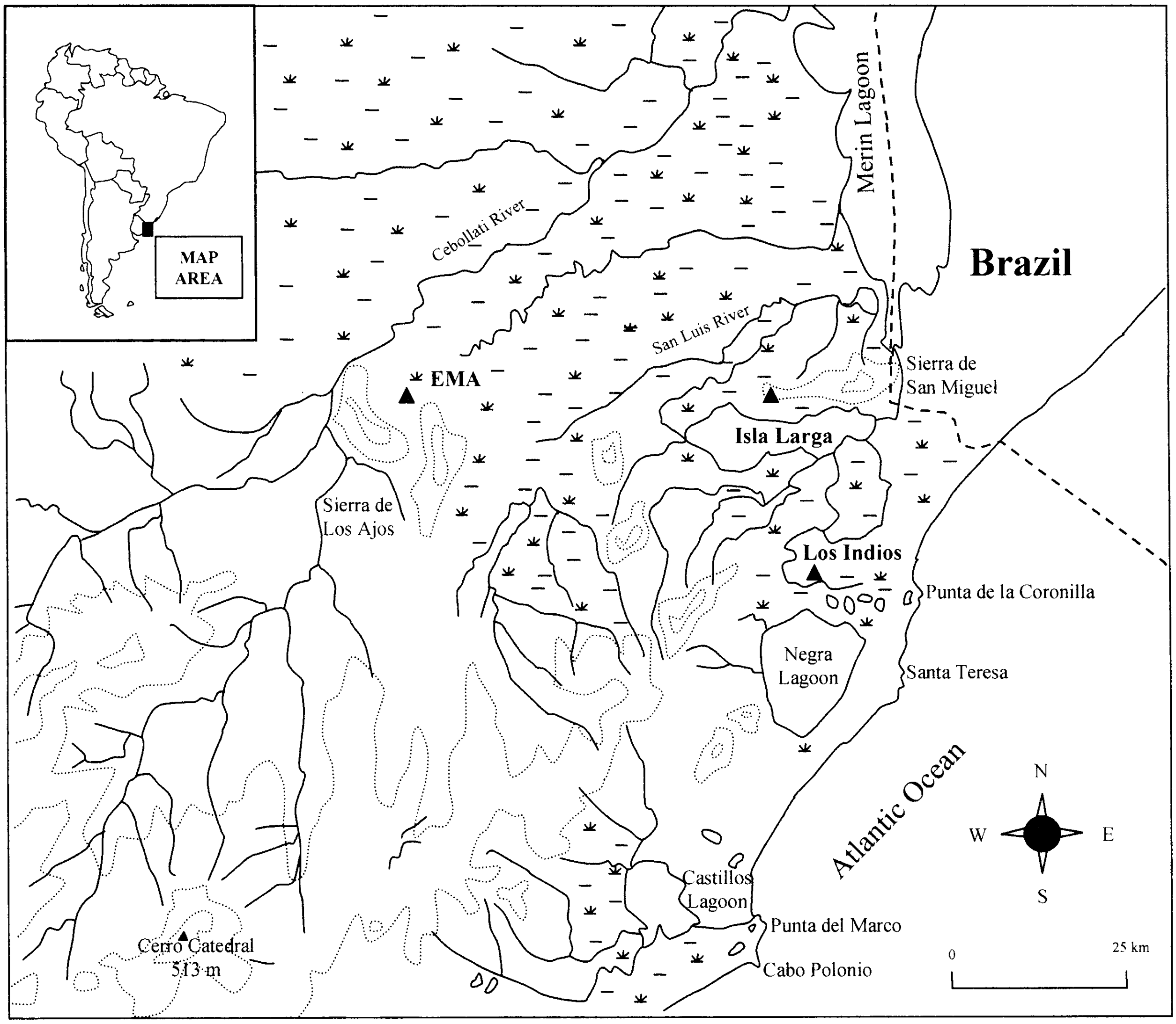
Until quite recently, wetland environments have provided a critical loci for prehistoric and historic native groups. Wetlands represent one of the most environmentally diverse habitats of the world supporting a great variety of flora and fauna (Williams 1990). They provide important plant, animal, bird, and fish resources to hunter-gatherers who exploited them as part of the seasonal economic round (Janetski and Madsen 1990; Nicholas 1998). They also represent an ideal context for the adoption and intensification of agriculture (Sherrat 1980; Pohl *et al.* 1996; Siemens 1999). In addition, wetlands provide greater stability reducing risk during periods of environmental deterioration since they provide a stable source of water supply. While most articles in the present volume show how the excellent preservation of perishables in wet sites give us extraordinary insights into prehistoric peoples adapted to wetland environments, this article constitutes an example that illustrates how newly developed analytical techniques, in particular starch grain and phytolith analyses, allow us to gain a better understanding of human-environment interaction in this unique setting when preservation is not so spectacular.

The dynamic interactions between human populations and the changing environment have played a major role in the development of Early Formative societies in the Americas during the Mid-Holocene (i.e., Brown and Vierra 1983; Carr and Gibson 1997). Research shows that cultural complexity has emerged under extremely different environmental settings based on coastal (Moseley 1992; Stothert 1985, 1992; Gaspar 1998; Blasi *et al.* 1999) and inland (Roosevelt 1980; Dillehay *et al.* 1989; Heckenberger 1998; Pearsall 1999) economies, the majority of which relied on both domesticated and wild resources to different degrees (Piperno and Pearsall 1998). In this respect, wetland areas have provided one of the richest environmental settings where the earliest mound-building cultures of lowland South America developed among populations of complex hunter-gatherers during the Mid-Holocene.

In order to understand the rise of these early complex societies, it is crucial to comprehend the role that wild and domesticated plant resources played in their economies. Unfortunately, poor preservation of macrobotanical plant remains in seasonally humid environments has hampered researchers in the wetlands of southeastern Uruguay, as well as in other part of lowland South America (i.e., Piperno 1995; Pearsall 1995; Piperno and Pearsall 1998), from assessing the scope, extent, and importance that domesticated plants may have played in the emergence of these Early Formative societies. Likewise, cultural practices in the processing of food and refuse disposal can also obstruct the recovery and reconnaissance of plant remains and its subsequent interpretation. For example, plants of economic importance in lowland areas such as tubers are notorious for their failure to enter the record of carbonized remains. These plants are generally processed outside houses and heaped unburned in trash middens and therefore, are absent from the macrobotanical record (Heckenberger 1998) leaving no fossil or charred remains. In the seasonal wetland sites of southeastern Uruguay, only the "tougher" charred remains like palm kernels survive burial and recovery.

To address these shortcomings in the study of the role that domesticated plants played in the economy of the Early Formative societies of southeastern Uruguay which developed 4000 yr BP in the southern sector of the Merin Lagoon basin (Bracco, Cabrera, and Lopez 1996), we have conducted starch grain and phytolith analyses from three sites in the region. The results of this study suggest that populations of hunter-gatherers, adapting to a changing Mid-Holocene environment adopted maize, squash, beans, and possibly domesticated tubers as part of their diet.



Map 6.1. Regional map of southeastern Uruguay.

The study region

The mound-building cultures known as the Vieria Tradition in the context of South American prehistory, developed ca 4000 yr BP in southeastern Uruguay (Bracco, Cabrera and Lopez 1996). The study area corresponds to the temperate sub-humid grasslands, which extend along the eastern Atlantic coast of South America from latitudes S 38° to 28° and are known as the Río de la Plata grasslands (Leon 1992) (Map 6.1). The area of southeastern Uruguay and Brazil along the Atlantic coast comprises a coastal plain (Delaney 1965) characterized by slight elevations (maximum 200 masl), generated by the Late Pleistocene and Holocene marine oscillations (Delaney 1965; Jackson 1984; González 1989; Bracco 1992; Montaña and Bossi 1995; Tomazelli and Wilwock 1996).

The area of study, the southern sector of the Merin Lagoon basin, locally known as Bañados de Rocha, is distinguished by coastal wetlands encompassing four freshwater lagoons connected to the ocean by streams. These lagoons appear in the form of a series of microbasins connecting the ocean with the lagoons, adjacent wetlands, plains, and hills, creating a patchwork of closely packed environmental zones. Bordering these lagoons, half-million hectares of wetlands have been recognized as one of the most environmentally diverse habitats of the world (Ramsar Convention 1984), supporting a great variety of flora and fauna and including at least 120 species of water birds, 80 species of fish, and 30 species of amphibians (Probides 1997). These wetlands are characterized by low-energy meandering streams, which together with the backwater lakes and marshes impounded behind its natural levees and terraces create an extremely rich environment. The vegetation of the area is mainly characterized by prairie grasses and palm forests of *Butia capitata* in the elevated plains (10–15 masl), scrubland and hydrophytic vegetation in the wetlands, and riparian forest along the primary water courses. At present, drainage carried out by the rice-growing companies in the area has resulted in the loss of more than a quarter of the wetlands, causing the destruction of indigenous flora and fauna as well as many archaeological sites.

The archaeological record of the southern sector of the Merin Lagoon basin is characterized by the conspicuous and numerous presence of earthmounds and earthworks. Since the region encompasses a great number of sites spread over a large region and distributed over a wide span of time, the different characteristics pertaining to different sites are probably the result of temporal and regional variations. Notwithstanding, the settlement patterns are clearly associated with different features of the environment. In this regard, in the wetland floodplains, clusters of mounds are generally located over the levees and terraces of the streams showing a linear pattern. These sites are smaller in size, standing less than a meter above the water level and therefore subject to periodic flooding. In contrast, in the flattened spurs and knolls of the hills overlooking the wetlands, the sites are bigger in size reaching up to 50 ha in some cases, bearing a greater number and diversity of mounds. These sites are located 5 to 10 meters above the water level, secure from flooding, and allow for immediate access to the rich-resource wetland area (Bracco, Cabrera, and Lopez 1996; Iriarte 1999) (see EMA site, Figure 6.1).

Early archaeological work in the 1960's aimed at developing a chronological framework for the yet unstudied archaeological region of the Mid-Atlantic coast of southeastern Brazil and Uruguay by applying Ford's ceramic seriation (Ford 1962; Meggers and Evans 1969) and lithic typologies (Schmidtz 1967, 1973; Schmidtz and Brochado 1967; Prieto *et al.* 1970; Schmidtz and Baeza 1982; Brochado 1984; Cope 1992; Rodriguez 1992; Schmidtz *et al.* 1992) which divided the Early Formative societies of the area in two broad cultural traditions. The first one, the preceramic Tradition, known as Umbu Tradition antecedes the ceramic Vieira Tradition and is characterized by the presence of bifacial stemmed stone projectile points. The Umbu Tradition spreads over the states of Rio Grande do Sul, Santa Catarina, and Parana, encompassing 400 sites grouped in 17 phases in Rio Grande do Sul, Brazil (Schmitz 1987). In the State of Rio Grande do Sul, this tradition is represented by three phases: Patos Phase in Camaqua, Lagoa Phase in Rio Grande, and Chui Phase in Santa Victoria do Palmar (Schmitz *et al.* 1992, Cope 1992). Radiocarbon dates obtained for Lagoa Phase, range from 485±85 A.D. and 70±150 A.D. (Schmitz 1973). Ceramics begin to appear in the Brazilian region in the first century A.D. and correspond to Vieira Tradition (Schmitz 1963, 1976). The ceramic sequence shows a clear evolution in time. The early phase is denominated Totorama (0–200 A.D.) and is characterized by wide and shallow wares with fine walls and coarse temper. The Vieira Tradition is subdivided into Vieira I (200–900 A.D), II (900–1110/1300 A.D), and III (1300 A.D.). The most recent phases, Vieira II and III are characterized by deeper and bigger wares with a more uniform manufacture, bearing some decoration in the external walls, such as basket and finger impressions. Vieira III starts at 1300 A.D. and includes the arrival of the Tupi-Guarani groups in the region until the total disappearance of the indigenous groups. On-going research in the southern sector of the Merin Lagoon basin since 1985 by the CRALM (Archaeological Salvage Program of the Merin Lagoon basin) in Uruguay has continued to amplify and redefine the chronological sequence. In the southern sector of the Lagoon Merin basin, the preceramic Umbu component has been dated back to the second millennium B.C., and the appearance of the ceramic Vieira tradition components has also been pushed back to the first millennium A.D. (Bracco, Cabrera and Lopez 1996).

Results of research

We have isolated starch grains and phytoliths from soil sediments corresponding to features and profile walls of three adjacent sites in the southern sector of the Merin Lagoon basin: (1) Los Indios; (2) Isla Larga; and (3) Estancia Mal Abrigo (Figure 6.1).

The extraction of starch grains from sediments was done following the technique which is being developed by Piperno and Holst at the Smithsonian Tropical Research Institute. Starch grain microscopically-based morphological identification of taxa was based on the reference collection of more than 100 species of economic importance accumulated by Piperno and Holst (1998) at the Smithsonian Institution of Tropical Research in Panama. As Table 6.1 shows we have identified the presence of starch grains characteristic of maize (*Zea mays*), beans (*Phaseolus spp.*), and possibly tubers pertaining to the genera Canna and Calathea. These results must be considered preliminary and qualitative (Figure 6.1). Phytolith analysis was carried out at the Smithsonian Institution of Tropical Research using standard methods (Piperno 1988, 1993).

Based on present knowledge of maize starch grain

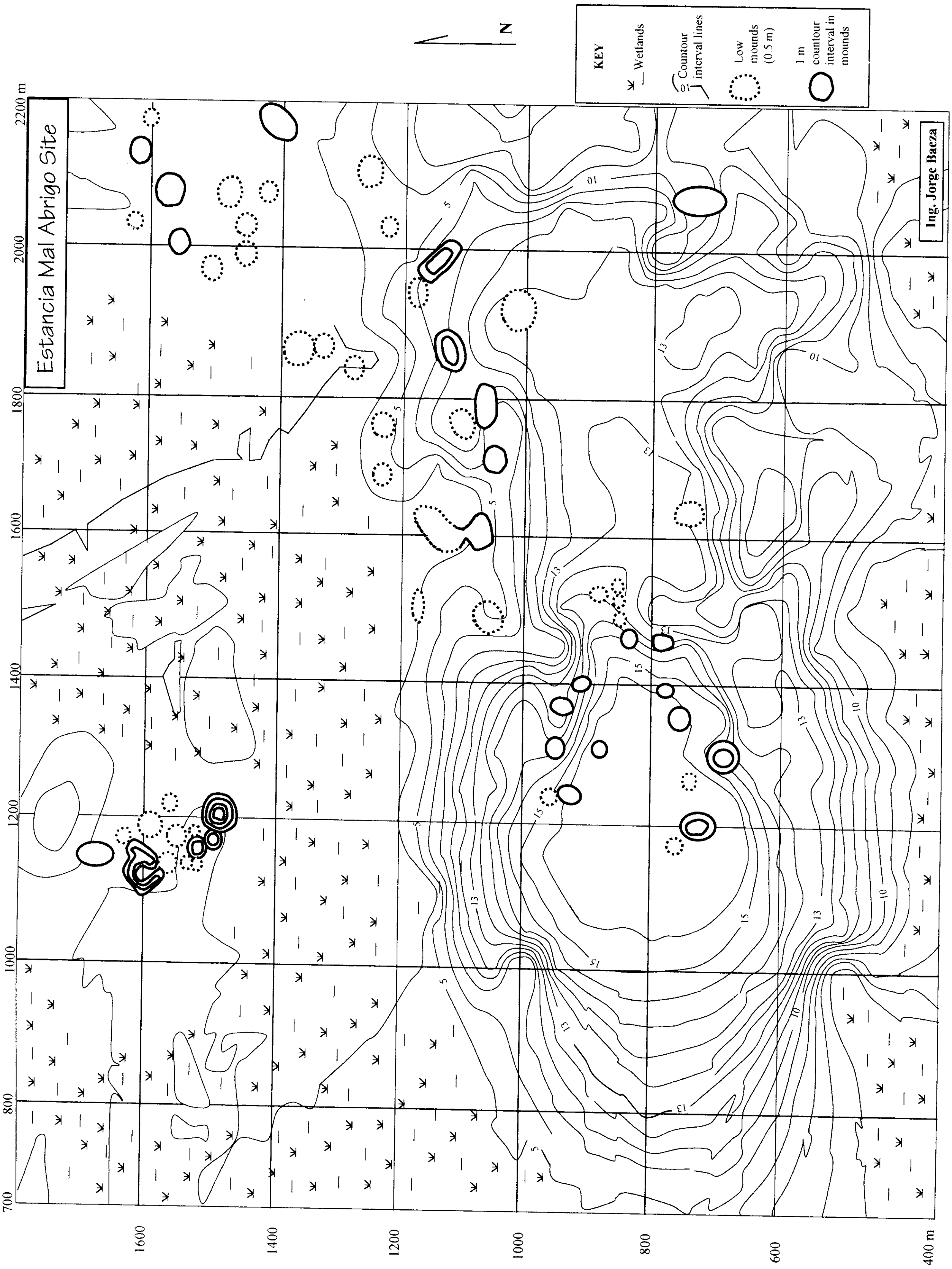


Figure 6.1. Estancia Mal Abrigo site.

Table 6.1. Results of starch grain analysis.

Site	Excavation	Level	C14 dates	Type of starch grain	N	Mean (μ)	Probable Species
EMA	II	(0.5-0.6 m)		Graminae (isolated)	12	21×18	*Zea mays*
		(0.2-0.3 m)		Graminae	1	16×16	*Zea mays*
Los Indios	I	(1.85-1.90 m)	2,800±70	Graminae (isolated)	6	14×13	*Zea mays*
	II	(1.20-1.30 cm)	1,170±60	Graminae (isolated)	42	18×16	*Zea mays*
				Graminae (aggregated)		20×17	*Zea mays*
				Leguminosae (isolated)	6	20×15	*Phaseolus spp.*
		(0.45-0.55 m)		Graminae (isolated)	18	16×13	*Zea mays*
				Graminae (aggregated)		18×18	*Zea mays*
Isla Larga	III	(0.8-0.85 m)	1,190±80	Graminae (isolated)	9	18×15	*Zea mays*
				Marantacea	1	28×16	*Calathea spp.*
		(1.90-1.95 m)	3,050±90	Graminae (isolated)	14	19×16	*Zea mays*
				Graminae (aggregated)		21×15	*Zea mays*
				Leguminoseae (isolated)	3	27×29	*Phaseolus sp.*
		(max. 2.58 m)	3,660±120	Graminae (isolated)	18	16×15	*Zea mays*
				Graminae (aggregated)		13×12	*Zea mays*
				Cannacea	2	44×26	*Canna spp.*

morphology and size, we have isolated more than 120 starch grains morphologically similar to maize from all the components of the three sites analyzed (Figure 6.2). Maize starch grains are bigger than wild grasses bearing a mean size over 14μ and presenting diagnostic shape and micro-morphological features. They can be simple or compound, spherical or may present irregular depressions and pressure facets. They often possess a distinct and continuous double border and very characteristic radiating fissures and indentations. This evidence suggests that maize was adopted at least 3,600 yr BP and continued to be cultivated until the historic period. Since the reference collection of modern maize is still small, it is premature to suggest the presence of a particular race or type of maize in this archaeological sample (Figure 6.2 and 6.3).

Single starch grains from sites Los Indios (6 grains) and Isla Larga (3 grains) compare favorably with starch grains of *Phaseoulus spp.* (Figure 6.4), although positive specific identification at the specie level cannot be made at this time. Starch of legumes, and in particular Phaseolus grains are simple, oval or kidney shape and evidently laminated. They present a large, ragged mesial fissure that extends the length of the grain. In addition, to maize and beans we have identified starch grains from plant tubers corresponding to Canna (*Cannaceae*) (Figure 6.5), and Calathea (*Maranthaceae*) (Figure 6.6). Canna starch grains occur as simple, elliptical, broad ovoid to shellshaped grains possessing prominent lamellae. The hilum is very distinct, eccentric, and slightly to the right or left of the longitudinal axis. When turned, the grains are flat. In addition to these characteristics, the grains are very big, up to 80μ. Calathea starch grains are simple, shell shaped or elongated. Grains are laminated, some lamellae more evident than others. The hilum is small, fairly distinct and eccentric. Grains are flat when turned and frequently the proximal end is narrower than the distal end.

On-going preliminary phytolith analysis has already identified the presence of domesticated squash (*Cucurbita spp.*) phytoliths. Cucurbita phytoliths are solid, regular spheres whose surfaces are scalloped in a deep and consistent fashion (Figure 6.7). All the Cucurbita phytoliths identified in the three sites studied exceeds the range of length and thickness characteristic of wild species (Piperno and Pearsall 1998). The domesticated species of squash likely present are *C. moschata* or *C. maxima*, or possibly even both. Palm phytoliths with their characteristic spherical spinoluse morphology were also identified in all the components of all the sites (Figure 6.8). This research has also identified cross-shape type 1 maize leaf phytolith, but more research is needed to properly measure and quantify the sample for positive identification.

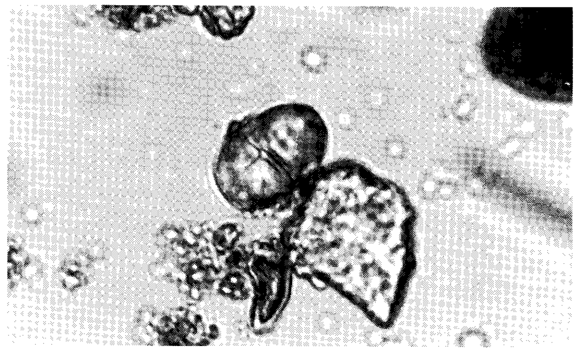


Figure 6.2. Maize starch grain from site Estancia Mal Abrigo. Exc II (50–60 cm). 360x. The grain measures 20 microns by 14 microns.

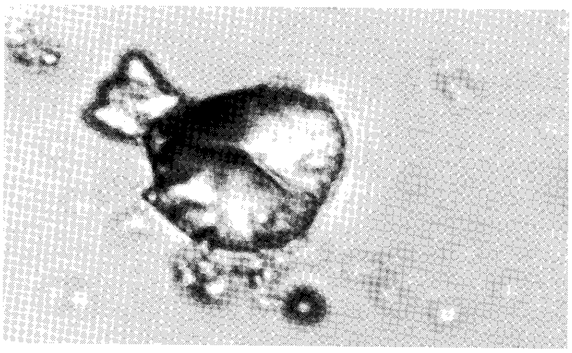


Figure 6.3. Maize starch grain from Isla Larga (max 2.85 m). 360x. The grain measures 20 microns by 20 microns.

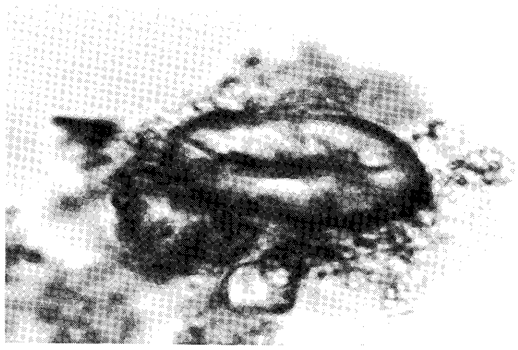


Figure 6.4. Starch grain of a Legume possible Phaseolus sp. from site Los Indios Exc III (1,20–1,30 m). 360x. The grain measures 32 microns by 20 microns.

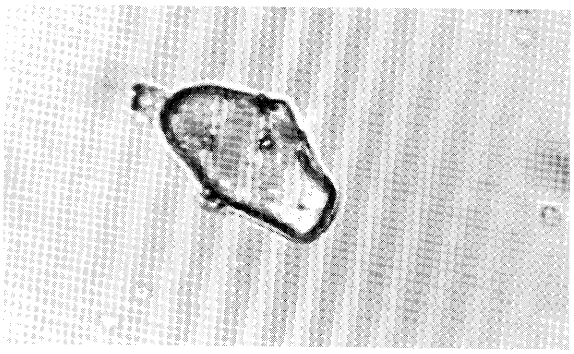


Figure 6.5. Calathea starch grain from site Isla Larga (0.80–0.85 m). 360x. The grain measures 28 microns by 16 microns.

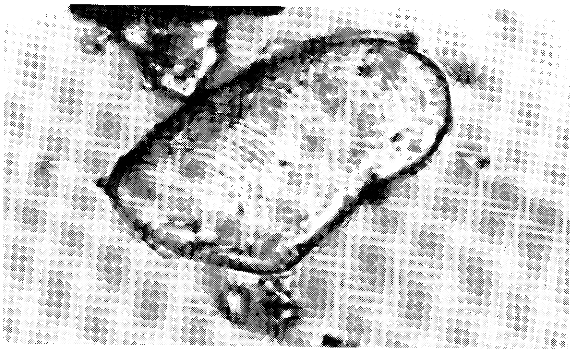


Figure 6.6. Starch grain of Canna sp. from Isla Larga (max. 2.85 m). 360x. The grain measures 58 microns by 36 microns.

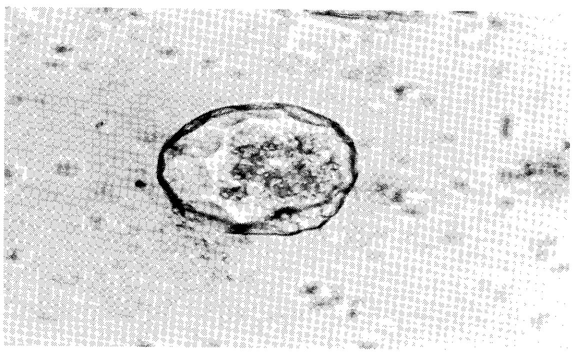


Figure 6.7. Cucurbita phytolith possibly C. moschata from site Estancia Mal Abrigo (40–50 cm). 40x. The phytolith measures 72 by 55 microns.

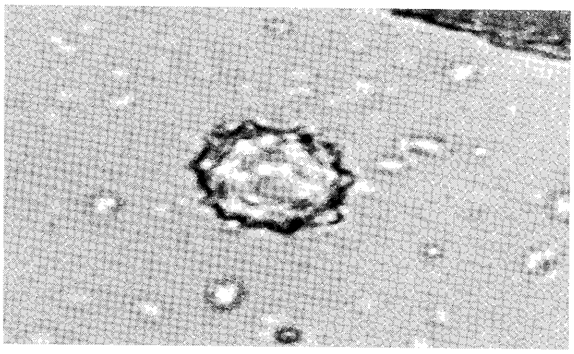


Figure 6.8. Circular spinolose palmae phytolith from site Isla Larga Exc. III (0.80–0.85 cm). x 40.

The Isla Larga site, CG14E01, is a multi-mound site located on the western extreme of the Sierra de San Miguel surrounded by the margins of the wetlands of San Miguel (Banado de San Miguel). Excavation III in the central part of the largest mound contains the longest continuous occupation of the site dating from 3600 yr BP to the historic period. This burial dome-shaped mound is roughly circular with a diameter of 40 m and 3.8 m high. It contains a wide variety of burials, including Tupi Guarani funerary urns associated with the contact period including venetian glass beads dating to the second half of the XVI century (Cabrera *et al.* 1996). Starch grain and phytolith evidence suggest that horticulture was practiced in this site since its earliest occupation. Starch grains from maize (*Zea mays*), and probably a domesticated specie of the genera Canna where recovered from sediments corresponding to the earliest component of the site (3600 yr BP) associated with a hearth containing deer bones and cutting lithic tools, which evidence the first episode of construction of the mound (Cabrera et al. 1996). Starch grains of maize and beans (*Phaseolus spp.*) were isolated from the 3000 yr BP component of the site, and starch grains of maize and Calathea were also recovered from the 1000 yr BP component. In addition, to the starch grains recovered, squash (*Cucurbita spp.*) and palm (possibly *Butia capitata*) phytolith were recovered from all these three levels analyzed of this excavation.

Los Indios site is a multi-mound, multi-component site located over a tongue-shaped spur surrounded by the margins of the wetlands of the Maravillas (Banado de las Maravillas). Its occupation dates between 5000 yr BP to the period of contact. Los Indios site comprises four mounds, two of which are connected through a ramp and facing a third one creating a central open space. The fourth is a burial mound, where so far thirteen burials have been recovered, and is located on the top of a knoll overlooking the other mounds (Lopez 1996).

Maize starch grains were recovered from the oldest occupation of Mound III (Excavation I, levels 1.85–1.90) dating to 2.800 yr BP. Starch grains of maize and beans (*Phaseolus spp.*) where isolated from the level dated to 1170 yr BP (Excavation III, level 1.20–1.30).

The EMA site is a multi-mound complex comprising 50 ha bearing more that 70 mounds located over a flat spur of the Sierra de los Ajos, which projects into the extensive wetlands of India Muerta. It represents the major concentration of mounds in the wetlands of India Muerta and like other multi-mound complexes in this area, the majority of the mounds are low flat circular mounds between 0.5–1.5 m in height, with a diameter ranging between 15 and 30 m. Starch grains and phytolith analyses were carried out from profiled walls of Excavation II on a accretional mound constituted by the vertical accumulation of midden refuse. Starch grains of maize were recovered from the all the ceramic levels of Excavation II.

Discussion and Final Considerations

Although the interpretations we offer must be considered preliminary, the starch grain and phytolith data sets are strong enough to produce useful interpretations and suggest clear directions for future research. Previous models based on faunal and bone isotope analyses (Lopez and Bracco 1992, 1994; Bracco *et al.* 1996) conducted in various sites in the region have interpreted these societies as complex hunter-gatherers living in a rich and abundant environment in cultural complexity. Faunal analysis (Chagas 1995; Pintos and Gianotti 1995; Pintos 1996) evidenced the consumption of a wide range of terrestrial and riverine resources, including terrestrial mammals (*Blastocerus dichotomus*, *Ozotocerus bezoarticus*, *Mazama guazubira*, *Hydrochoerus hydrochaeris*, *Myocastor coypus*, among many other less represented species), marine mammals (*Arctocephalus australis*), fish, and birds (*Rhea americana*, among others), demonstrating that these groups obtained a large part of their diet from naturally available resources with an emphasis on deer (Pintos 1996). This information was further corroborated by C^{13} isotope analysis of bone collagen from skeletal remains, which indicated that the diet of these groups was predominantly based on terrestrial resources with a low incidence of maize and/or marine resources (Bracco *et al.* 1993, 1996). While these studies have significantly increased our understanding of the economy of the Early Formative societies of southeastern Uruguay, they are not without their own limitations. In the first place, bone isotope data is most useful for assessing the status of maize as a staple crop, consumed on a regular basis. In addition, the studies of C^{13} isotopes based on bone collagen fraction need to be complemented with the analysis of the bone apatite carbonate fraction to provide a more proportional assessment of their dietary regimes since 1) the bone apatite carbonate fraction provides a more accurate record of the carbon isotope composition of the diet, 2) it is less susceptible to diagenic alteration, and more importantly, 3) apatite carbonate is more sensitive for detecting and measuring maize consumption (Norr 1995). Therefore, the contribution of maize to the economy of the Early Formative societies of southeastern Uruguay is still to be determined with future research.

The results of this study complement and provide new data suggesting that the emergence of Early Formative societies in southeastern Uruguay took place within the context of a mixed economy combining hunting, fishing, and gathering with small-scale horticulture of maize, beans, squash, and possibly domesticated tubers. These groups probably engaged in wetland cultivation during the dryseason when the water table was at its lowest, employing a system similar to flood-recessional agriculture (Sherrat 1980; Pohl *et al.* 1996; Siemens 1999). Explaining the processes responsible for encouraging the adoption of these cultigens during the Mid-Holocene in the wetlands of Uruguay are undoubtedly complex and varied and require the combined articulation of paleoenvironmental and archaeological data sets. In this respect, the application and development of the methods reported here should make possible direct investigation of the plant food component of the diet of the Early Formative societies of southeastern Uruguay in sites where preserved plant remains are rarely found as macrofossils. Future studies will concentrate on expanding our reference collection of modern plants and studying close wild relatives of the major domesticated crops in the area.

Acknowledgments

This research would not have been possible without the generous support of Dr. Dolores Piperno from the Smithsonian Tropical Research Institution (STRI) in Panama, who provided Jose Iriarte with training in phytolith analysis, and the Research Challenge Fellowship of the University of Kentucky. Fieldwork in Isla Larga, Los Indios and Estancia Mal Abrigo has been supported by the Comisión Nacional de Arqueología, Ministerio de Educación y Cultura, Uruguay. We would like to thank Dr. Tom Dillehay for his continuous support and encouragement. Thanks are also extended to Digna Matias for offering valuable laboratory support at the STRI and Ing. Jorge Baeza from the Facultad de Humanidades y Ciencias de la Educación-Universidad de la República, Uruguay for his enormous help during the first stage of the Estancia Mal Abrigo Archaeology Project.

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