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# MID-HOLOCENE EMERGENT COMPLEXITY AND LANDSCAPE TRANSFORMATION: THE SOCIAL CONSTRUCTION OF EARLY FORMATIVE COMMUNITIES IN URUGUAY, LA PLATA BASIN

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ABSTRACT OF DISSERTATION

José Iriarte

The Graduate School  
University of Kentucky

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ABSTRACT OF DISSERTATION

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of  
Philosophy in the College of Arts and Science at the University of Kentucky

By  
José Iriarte

Lexington, Kentucky

Director: Dr. Thomas Dillehay, Department of Anthropology

Lexington, Kentucky

2003

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## ABSTRACT OF DISSERTATION

### MID-HOLOCENE EMERGENT COMPLEXITY AND LANDSCAPE TRANSFORMATION: THE SOCIAL CONSTRUCTION OF EARLY FORMATIVE COMMUNITIES IN URUGUAY, LA PLATA BASIN

This dissertation is a multidisciplinary study combining both archaeological and paleoecological data to examine the rise of early Formative societies in Uruguay, La Plata Basin. It is contextualized within broader anthropological concerns related to the emergence of cultural complexity, the significance of ritual and public architecture in intermediate-level societies, and the role of human-environment interactions during the mid-Holocene. This investigation generated the first Late Quaternary paleoclimatic record, based on pollen and phytolith analyses, documenting that the mid-Holocene (ca. 6,620 to ca. 4,040 bp) was a period of environmental flux and increased aridity. It describes the occupational history of the Los Ajos site from the creation of a household-based community integrating a centralized communal space during the Preceramic Mound Component (ca. 4,120 – 3,000- 2,500 bp) to the Ceramic Mound Component (ca. 3,000 2,500 bp to the Contact Period), where Los Ajos acquired a strong public ritual character through the formalization and spatial segregation of its mounded architecture. During the Ceramic Mound Period, the site exhibited both internal stratification (inner versus outer precincts) and dual asymmetrical architecture in its central sector, which suggest the emergence

of incipient social differentiation. This study also marks the earliest occurrence of at least two domesticated crops in the region: corn (*Zea mays*) and squash (*Cucurbita* spp.), showing that the early Formative societies adopted a mixed economy shortly after 4,120 bp. Collectively, these results challenge the long-standing view that the La Plata Basin was a marginal area by evidencing an early and idiosyncratic emergence of social complexity never before registered in this region of South America.

KEYWORDS: Archaeology, Uruguay, Mid-Holocene, Emergent Complexity, Phytoliths

José Iriarte

11-04-2003

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DISSERTATION

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University of Kentucky  
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To my father, José María Iriarte Oyarbide, whose passion for life has shown me that the only secret of happiness is to have “una buena ilusión en la vida” and more importantly, “echar pa'lante, siempre pa'lante”.

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## **Chapter 1**

### **Introduction: Research Objectives and Theoretical Context**

#### **Introduction**

##### **The Problem of Classificatory Approaches and the Variability of Early Formative Societies in the Americas**

Questions regarding the emergence of cultural complexity among intermediate-level societies have become a topic of deepened theoretical concern (Arnold 1996; Blake 1999; Brumfiel and Fox 1994; Chapman 2003; Clark 2000; Enrenreich et al. 1995; Fowles 2002; Hayden 2001; Parkinson 2002; Price and Feinman 1995). Contemporary reevaluations of progressivist or neo-evolutionary typological frameworks recognize that there is more social variability among intermediate-level societies than previous concepts of cultural complexity had accounted for. They assert that a degree of social inequality exists even in the most egalitarian societies (Cashdan 1980; Collier and Rosaldo 1981; Flanagan 1989; Painter and McGuire 1991), that the origins of agriculture are not intrinsically related to the emergence of cultural complexity (Arnold 1996; Koyama and Thomas 1981; Price and Brown 1985; Price and Gebauer 1995; Upham 1990), and that there is more social variability among early Formative societies than previous neo-evolutionary concepts of cultural complexity had accounted for (Blanton et al. 1996; Drennan 1991; Nelson 1995; O'Shea and Baker 1996; Saitta 1997). These reconceptualizations demonstrate that the different properties of cultural complexity, including inequality, differentiation, increased scale and integration, and their correspondent list of archaeological correlates (Creamer and Haas 1985; Peebles and Kus 1977) do not necessarily covary from one stage of cultural evolution to the other, nor do they all need to be present in every intermediate-level society.

Given the heterogeneity that early Formative societies in South America exhibit in terms of economic, social, and political aspects, traditional classificatory concepts of non-stratified societies have been unable to explain the degrees and kinds of variation that these societies displayed across the Americas. Research shows that cultural complexity has emerged under extremely different environmental settings based on coastal (DeBlasis et al. 1998; Gaspar 1998; Moseley 1985; Stothert 1985, 1992) and inland (e.g., Dillehay et al. 1989a; Heckenberger 1998;

Pearsall 1999; Roosevelt 1999) economies, the majority of which relied on both domesticated and wild resources to different degrees (Piperno and Pearsall 1998a). Moreover, different studies indicate that the dynamic interactions between human populations and their changing physical environments played a major role in the development of complex societies during the mid-Holocene (e.g., Aldenderfer 1999; Bray 1995; Brown 1985; Damp 1984b; Sandweiss et al. 1999; Santoro and Núñez 1987; Stothert 1985, 1992). Early Formative cultures also show attributes of cultural complexity in various social and political contexts. This can be expressed in highly elaborate mortuary paraphernalia (e.g., Early Paracas [Paul 1990]), large-scale monument constructions with no evidence of hereditary status differentiation (e.g., Late Preceramic Peru [Burger 1995, Quilter 1991]), large-scale transformations of lowland landscapes (e.g., Llanos de Mojos of eastern Bolivia [Dougherty and Calandra 1984; Erickson 1995, 2000a, 2000b]), hierarchical settlement patterns (e.g., Llanos de Barinas in Venezuela [Spencer and Redmond 1992]), elaborate art ceramic styles (Marajoara [Roosevelt 1991, 1999]), the early appearance of ceremonial spaces (e.g., Real Alto, Ecuador [Damp 1984; Lathrap et al. 1977; Zeidler 1984], Zaña Valley, Peru [Dillehay et al. 1989a, 1997], and complex regional settlement systems (Upper Xingu [Heckenberger 1996; Heckenberger et al. 2003]). Consequently, in light of the heterogeneous nature of early Formative societies, which display mixed cultural traits and bear an incomplete list of diagnostic indicators of complexity, classificatory approaches to variation have proven problematic. Under this framework, researchers have been confronted with the dilemma of forcing some cultures into rigid oppositional categories of complex or simple societies thus neglecting to explore and explain the economic, social, and political variation that these pre-Hispanic cultures exhibited.

### **The Lowlands of South America: Marginalized Archaeological Cultures?**

A related problem associated with the use of rigid oppositional analytical categories to classify early Formative societies in the South American lowlands has been the perception of “marginal cultures” that has been applied to define these societies (e.g., Steward 1964; Steward and Faron 1959). These conceptualizations often underscored the notion that these peripheral areas were deficient versions of cultures closer to civilization centers in the Andes or Mesoamerica. Implicit in these assumptions is the perception that these “simpler” cultures were

“held back” or somehow had “failed to achieve” the higher levels of complexity accomplished by Andean and Mesoamerican chiefdoms and states as well as the notion that these cultures were isolated, static, unchanging or developing at a slow pace. Yet, some areas, like the La Plata Basin were simply unknown because little work had been carried out in it in addition to the existence of vast sectors, which remained largely unexplored.

This “marginalized” perception contributed little to generate new research to study the historical trajectory of these cultures (e.g., Rivera 1999; Wüst 1998). For example, traditional conceptualizations of progressive cultural evolution applied to the study of the early Formative cultures of the neotropical lowlands of South America during the mid-Holocene period create similar challenges (DeBoer et al. 1996; Heckenberger et al. 1999; Neves 1999; Roosevelt 1999; Viveiro de Castros 1996; Whitehead 1996). Another example is the “Sambaquies” shell-mound culture complex, which developed in extremely rich estuarine environments along the tropical Atlantic coast of Brazil between 6,000 and 2,000 bp. The aggregation of sites in some extremely productive areas; the monumental scale of some shell-middens, reaching up 30 m in height; the differences in mortuary practices reflected in associated burial paraphernalia; and craft specialization represented in the production and distribution of stone and bone sculptures may reflect certain degrees of social inequalities and incipient hierarchies (DeBlasis et al. 1998; Gaspar 1998; Fish et al. 2000). New isotope data carried out on shell also indicates that some of these sites were occupied year-round, showing a greater degree of human permanence than previously thought (Massi 1999).

Likewise, new studies carried out in Central Brazil suggest the aggregation of populations in complex systems of village organization (Wüst 1994, 1998; Wüst and Barreto 1999) characterized by large, circular villages, which appeared around 2,000 bp. Interestingly, the data gathered from this area shows “...that social complexity emerged in ways that differ from the classic site-hierarchy models based on Mesoamerican and Andean examples” (Wüst and Barreto 1999:19). In addition, recent fieldwork carried out along the archaeologically unexplored middle Paraguay River has documented the presence of mound complexes with Preceramic component dates of ca. 4,400 bp (Schmitz et al. 1998). Last but not least, the previous and on-going investigations of Dillehay (1986, 1990, 1992a, 1995a) in prehistoric, historic and contemporary Mapuche in south-central Chile have documented the presence of

loosely integrated chiefdoms exhibiting elaborated public architecture integrated in regional ceremonial landscapes.

The degree of social differentiation and inequality that the societies of the early Formative period reached and the particular developmental sequences that the shell-mound complexes of coastal Brazil, the circular villages of Central Brazil, and the mound-building cultures of the middle Paraguay River followed are yet to be determined. Regardless of how complex these societies were, how permanent their settlements were, and how much they relied on cultigens (all important questions by themselves), what stands out about these recent studies is that they are showing the existence of more diverse, autonomous, specific complex developments in this area, which were previously thought of as marginal when compared to the cultural developments in the Andes or Mesoamerica (e.g., Steward 1964; Steward and Faron 1959).

### **The Emergence of Early Formative Societies in the La Plata Basin**

Similarly, in the La Plata Basin in the southern cone of South America as well as in other large river systems of the world (e.g., Mississippi River in U.S. [Gibson 1994; Saunders et al. 1997], Orinoco and Amazonia in South America [Heckenberger 2003; Roosevelt 1991, 1999], Danube River in Europe [Handsman 1991]), recent fieldwork and reanalyses of prior fieldwork are beginning to reveal a long sequence of complex cultural developments.

The early Formative cultures that developed during the mid-Holocene along the La Plata Basin in southeastern South America pose similar challenges to traditional conceptions of complexity and the perception of the archaeological cultures of the region as marginal. This “marginalized” view has been even more pervasive in the Pampas’ grasslands of southeastern South America. While the tropical forest lowlands and Central Brazil have traditionally “...been portrayed by ethnographers and archaeologists as passive receptacles of time-lagged cultural influences (Carneiro 1995; Lathrap 1970; Meggers 1972:162; Roosevelt 1991a, 1991c:1624)” (Wüst and Barreto 1999: 4), Patagonia and the Pampas’ grasslands of the southern cone have been depicted as inhabited by simple hunter-gatherers that did not experience significant changes since the end of the Pleistocene but a better adaptation to their environments (Orquera 1987). This may well be true for Patagonia and the southern part of the Pampas. However, a different

picture is beginning to emerge along the La Plata Basin. In this study, I present the results of a multidisciplinary study combining both novel archaeological and paleoecological data indicating that the southeastern sector of this vast fluvial system was a focal point of early and idiosyncratic emergent complexity (Figure 1.1).

The pre-Hispanic cultures locally referred to as “Constructores de Cerritos” (mound-building cultures) in Uruguay and the Vieira Tradition in southern Brazil developed along the rivers and wetlands of southeastern Uruguay and southern Brazil (Figure 1.1) around 4,190 bp (radiocarbon years before present). The “Constructores de Cerritos” is divided into two main periods: a Preceramic Mound Period, which begins around 4,120 bp and ends with the appearance of ceramics in the region around 3,000 bp and a Ceramic Mound Period, which extends from around 3,000 bp to the contact period in the seventeenth century.

In the early 1990s, Uruguayan archaeologists (Bracco 1992a; Bracco et al. 2000a; López and Bracco 1992; see also Dillehay 1993, 1995b) began to seriously call into question the view that these societies were marginal hunter-gatherers. Complementing this previous and on-going research, the new results presented in this study document for the first time that the mid-Holocene was a period of environmental flux and increased aridity and that the Preceramic Mound Period (around 4,000 bp) was a time of significant cultural development that led to the emergence of early Formative societies in the region.

Beginning at this time, the region witnessed the appearance of large, numerous, spatially complex mound complexes concentrated on the hills and flattened spurs overlooking extensive freshwater wetlands. The community-focused archaeological investigations carried out at the study site, Los Ajos, reveal a long and complex occupational history. It shows that from the beginnings of the Preceramic Mound Component, Los Ajos inhabitants began to live in a circular village partitioning the site into a number of functionally discrete areas. During this time, Los Ajos witnessed the creation of an open plaza area flanked by accretional, circular, dome-shaped residential mounds closely arranged in a circular format. This initial stage of village formation evidences the incorporation and centralization of a clearly demarcated communal space into the overall geometric village layout. Significantly, starting shortly after the beginning of the Preceramic Mound Period, Los Ajos phytolith and starch grain data mark the earliest occurrence of at least two domesticated crops in the region: *Zea mays* and *Cucurbita* spp. This data indicates



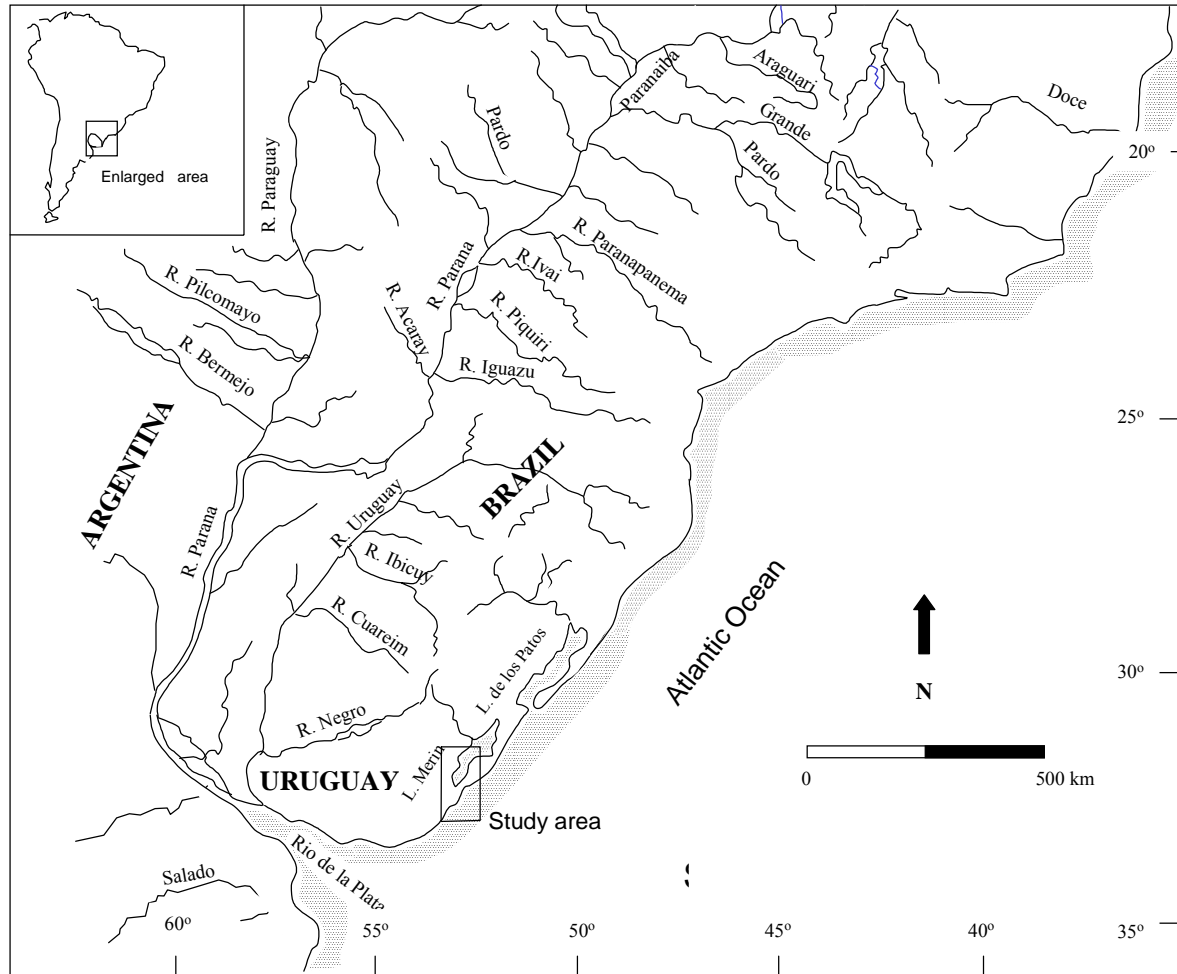


Figure 1.1. Map of Southeastern South America

that the use of domesticated plants was a more important aspect of subsistence long before previously recognized temporal and cultural placements suggest (Schmitz et al. 1991; Willey 1971) showing that these early Formative societies developed in the context of a mixed economy.

Within an area of 10 km<sup>2</sup>, nine other large sites in addition to Los Ajos exhibit varied and complex mounded architecture geometrically arranged in circular, elliptical, and horseshoe formats have been documented in settings not subjected to seasonal flooding (Bracco 1993, Bracco et al. 1999). At least two of them, which have been investigated to a certain extent (Puntas de San Luis and Estancia Mal Abrigo), contain deep, well-developed Preceramic Mound deposits. Puntas de San Luis contains 15 mounds, which are spread over 16 ha and arranged in a horseshoe format oriented N-S. The mounds are circular in shape, averaging 35 m in diameter and with varying heights between 1 and 4.2 meters (Bracco et al. 2000b). Five radiocarbon dates obtained from the excavation of the central part of three of the mounds at the site place it chronologically between ca. 1,360 and 3,750 bp (Bracco and Ures 1999; Bracco et al. 2000b). Estancia Mal Abrigo located only 4 km to the east of Los Ajos, spreads over 60 ha and consists of four major mound clusters displaying substantial settlement variability (Figure 2.5). Preliminary excavations at one of the mound clusters revealed the presence of well-developed Preceramic Mound deposits. The mound site Isla Larga also contains Preceramic Mound deposits dating to 3,660 bp (Cabrera 2000). Numerous smaller mound sites and isolated mounds also occur in the wetland floodplains positioned on top of the most prominent levees following the courses of streams, thus, displaying a linear or curvilinear pattern. It cannot be determined at the moment if all these sites were occupied simultaneously, but the presence of Preceramic Components in the ones investigated to date suggest the presence of a complex and probably integrated regional settlement system since early Preceramic Mound Period times.

Throughout the Ceramic Mound Period, Los Ajos experienced several transformations. This period witnessed the appearance of differential mounded architecture and the segregation of space into a formal inner precinct and a vast outer area of domestic debris. The overall shape of the mounds located in the central sector of the site changed through intentional remodeling through filling episodes with gravel. In the case of Mound Gamma, this activity converted the 0.6-0.8 m tall, circular, dome-shaped mound into a larger, quadrangular, 1.40 m tall, flat-topped, beveled-edged platform mound. The widespread presence of partial burials in mound contexts

also marks an innovative cultural practice. By the Ceramic Mound Period, Los Ajos exhibited a formal inner precinct comprising seven flat-topped mounds distributed around a central cleared plaza area and a less formal peripheral area containing five low circular mounds, three elongated mounds, the presence of two crescent-shaped rises, and a vast off-mound area of continuous domestic debris spreading ca. 12 ha. Collectively, this evidence indicates an early development of social complexity never before registered in this area of South America.

This new picture of the La Plata Basin prehistory clashes with traditional notions of the area as marginal showing that the southern sector of the Laguna Merin Basin was a locus of early emergent complexity. However, trying to fit the early Formative cultures of southeastern Uruguay into rigid societal types raises problems because not all the attributes traditionally associated with complex societies are present. The absence of other distinctive traits of cultural complexity and personal ranking such as the presence of exotic exchange goods, prestige technologies, descent-based social differentiation, or a clear hierarchical settlement patterns is striking. The data presented in this study show that these societies varied in ways that conventional analytic categories do not explain. The “Constructores de Cerritos” constitutes a unique case study to investigate the processes responsible for triggering a different expression of cultural complexity, one that can throw light on the multidimensional and diverse nature of early Formative societies in the Americas. Paraphrasing Nelson (1995), one of the major aims of this study is to begin to understand not just how complex these societies are, but more importantly, how these societies are complex. In the next section of this chapter, I offer a synthesis of the relevant alternative approaches that have evolved as a response to these rigid theoretical schemes in order to provide alternative explanatory frameworks that help us investigate the historical trajectory of the early complex societies in the La Plata Basin. Next, I argue why a community-focused archaeological investigation is pertinent at timely to examine the emergence and transformation of early Formative communities at Los Ajos.

After that, I narrow the focus to the study area by briefly reviewing the history of the archaeological investigations in the southern sector of the Laguna Merin Basin that have generated the more specific research questions pursued in this study. Finally, I conclude the chapter with a succinct description of the content of the different chapters that form the core of this study.

## **Rethinking the Rise and Dynamic Variability of Intermediate-Level Societies**

### **Introduction**

Over the past three decades, archaeology has experienced a fundamental rethinking of traditional notions of the emergence and the internal workings of intermediate-level societies, which emphasize previous unappreciated distinctions of age, gender, and prestige (Flanagan 1989; McGuire 1983; Paynter 1989; Paynter and McGuire 1991). In response to these criticisms, in recent years, archaeologists have begun to look beyond neo-evolutionary frameworks that stress functionally-oriented ecological and economic explanations, turning to considerations of ideology, power, and factional competition while adopting a more historically based approach (e.g., Chapman 2003; Clark 2000; Dietler 2001; Pauketat 2001; Parkinson 2002; Yaeger and Canuto 2000). These perspectives depart from oppositional views of simple/egalitarian versus complex/hierarchical by using other concepts such as actor-based perspectives (e.g., Clark and Blake 1994), heterarchy (Crumley 1987), situationalism, network and corporate strategies (Blanton et al. 1996), communalism (Saitta 1997), and a more flexible concept of tribal societies as defined by Parkinson (2002). Many of these new approaches are concentrating on more particular historical developments (e.g., Pauketat 2001), incorporating the concepts of practice (Bourdieu 1977) and structure (Giddens 1979) to inform their interpretations of specific historical trajectories. These new advances are the focus of the next section.

Recently, Parkinson (2002) and Fowles (2002) have revived the concept of tribe, separating it from its original conceptualization as an evolutionary stage. In doing so, these authors highlight the wide range of economic, social, and political variability that intermediate-level societies exhibit both in prehistory and in the ethnographic present. Furthermore, by focusing on both the organizational variability and the history of a society, they move away from comparing types to an emphasis on comparing historical trajectories. Because at this point a more precise characterization of the social formations characteristic of the early Formative in the region must await much more detailed archaeological analysis, it seems appropriate to embrace a broad characterization of intermediate-level societies like the one proposed by Parkinson (2002) and Fowles (2002) for a number of reasons. Notably, (a) it accommodates the organizational variability that intermediate-level societies display in terms of economic, social, and political

aspects; (b) it recognizes that a society can be organized at a variety of levels, acknowledging the possibility of alternating between “band-level” and “tribal” social organizations as well as the possibility that these societies may display a set of political strategies both egalitarian and hierarchical over time; and (c) it allows us to separate complexity from hierarchy, permitting us to explore the variety of fluid “lateral” mechanisms that structure and organize intermediate-level societies, such as kinship, ideology, and others. To paraphrase Nelson (1995:599), this flexible interpretative framework helps us explore not just how complex these societies are, but more importantly, how these societies are complex. Last but not least, this conceptual approach is aimed at providing a comparative framework to facilitate comparisons among different historical trajectories of emergent complexity across the Americas. Examining these themes is the focus of the next section.

### **New Approaches to Traditional Conceptualizations of Emergent Complexity**

As it should be readily apparent to the reader, these perspectives share several commonalities. However, for the sake of convenience and with the purpose of summarizing the more relevant points raised by each approach, I have grouped them into actor-based perspectives, heterarchy, situationalism, corporate and network strategies, Marxist perspectives, practice and structure concepts, and a more flexible and historical approach to intermediate-level societies.

*Actor-based perspectives* assert that social power is constructed in significantly different ways by aspiring political actors involving competitive strategizing, which may include feasting (e.g., Clark and Blake 1994; Dietler 2001; Hayden 1995, 2001), the practice of extensive or intensive agriculture (e.g., Drennan 1995; Gilman 1991), participation in long-distance exchange and craft-production of luxury goods (e.g., Helms 1994), warfare (e.g., Carneiro 1998; Redmond 1994, 1999), the appropriation of the means of expressing ideological knowledge (e.g., Aldenderfer 1993; Drennan 1976; Earle 1991), and/or the combination of many of the above strategies (e.g., Spencer and Redmond 1994). While these studies have greatly advanced our understanding of the role of individual agents in the emergence of complexity, they have been equally unsatisfying for their narrow focus on individual aggrandizement. Further, Weissner (2002:234-235) has criticized these agent-oriented approaches for equating egalitarianism with organizational simplicity, downplaying the role of resistance within communal formations (see

also Lee 1990). Similarly, Blanton and his collaborators (1996:2) also have pointed out that these perspectives “take a behavioral approach to faction building that only takes into account exclusionary power strategies neglecting corporate strategies”. Accordingly, these authors have expanded the arena of “political behavioral theory of social change” to two different strategies: corporate and exclusionary strategies.

Comparable to descriptions of accumulators (Hayden 1990) and aggrandizers (Clark and Blake 1994), network strategies are associated with individualistic, personalized, and centralized forms of leadership. Power and wealth are concentrated in a few persons who take advantage of their network of personal connections to expand their power and authority. In this respect, network strategies generate leadership and social power through individual connections among leaders of other communities. In contrast, as summarized by Feinman and his colleagues (2000:453), in corporate strategies “... economic resources are more dispersed, leadership is less personalized and ostentatious displays and individual aggrandizement are less apt to be found. Instead, communal ritual, public construction, large cooperative labor tasks, shared power, social segments that are woven together through broad integrative ritual and ideological means, and suppressed economic differentiation are emphasized”. In corporate strategies, leaders draw power from the collective, and therefore, are less dependent on individual prestige created through relationships with non-local leaders from other communities. The concept of corporate strategies is similar to Johnson’s (1982) sequential hierarchy, Renfrew’s (1974) group-oriented chiefdoms, and Saitta’s (1997) communal social formation (see below). Thinking in terms of corporate strategies is particularly relevant to interpret the early Formative societies of southeastern Uruguay, which lack any evidence of personal ranking such as differential burial treatment, economic accumulation, or prestige goods, but are characterized by the rather permanent occupation of large and complex mound sites, practiced a mixed economy, and incorporated clearly demarcated public/ritual spaces through the formalization and spatial segregation of space at Los Ajos.

Despite the formal design of a community village in the early Formative societies of southeastern Uruguay and the elaboration of public architecture, the lack of archaeological correlates for personal ranking is outstanding. Absent are differential mortuary patterns, specialized craft production, exotic/prestige goods, and/or corporate architecture that may require a body of authority to mobilize and organize large labor pools. This suggests that the power

aspirations of individual political actors may not have been successful. It seems that any venture at individual aggrandizement was neutralized by rituals aimed at reinforcing kinship ties through communal rites. These mechanisms may have effectively limited and undermined the degree of political control that the early Formative group leaders could have maintained over their communities. The archaeological evidence shows that agent-based competitive strategizing activities, such as feasting (e.g., Clark and Blake 1994; Dietler 2001; Hayden 1995, 2001), long-distance exchange (e.g., Helms 1994), or warfare (e.g., Carneiro 1998; Redmond 1994, 1999) did not crystallize in the early Formative societies of southeastern Uruguay or at least it was not archaeologically conspicuous. During the CMC, it is possible that part of the population appropriated the means of ideology. Consequently, it is best to conceptualize these early Formative societies as group-oriented (Renfrew 1974), corporate (Blanton et al. 1996), communal social formations (Saitta 1997), which may have resisted individual aggrandizers in their path to power (e.g., Lee 1990; Weissner 2002) (see below).

*Heterarchy* is another concept that has emerged as an alternative to dichotomous views of complexity. Crumley (1987: 158; 1995:3) has defined heterarchy “as the relation of elements to one another when they are unranked or when they possess the potential of being ranked in a number of different ways.” The concept of heterarchy is, to borrow the phrase from Levi-Strauss, “good to think” about intermediate-level societies because it separates complexity conceptually from hierarchy and forces us to look at “lateral”, “horizontal” complexity, which is so essential to understand these societies. As noted by Henderson (1998:23): “Heterarchy is not just short-term hierarchy and fleeting social inequality, nor is it the opposite of hierarchy. Heterarchy exists in the dynamic. When applied to intermediate-level societies, heterarchy is complexity that speaks to the fluid and situational nature of these societies' social and political structure.” Similarly, heterarchy is able to accommodate inequality and ranking within a situational framework, without necessarily implying permanence or institutionalization.

Although heterarchy is an extremely useful concept to explore community relations at a regional level, in southeastern Uruguay, we still lack an appropriate regional database to effectively apply this concept. However, as stressed by Dillehay (1995b), I think it will continue to be a crucial interpretative framework as new regional data becomes available. As will be described in the following chapters, although most of the multi-mound sites present the recursive geometrical circular, elliptical, and horseshoe layouts, there is considerable variability in site

plan, location, and the shape of the mounds. With future research, if mounds proved contemporaneous, this may imply heterarchical relations among them; the nature of which need to await more archaeological investigations.

A close companion to heterarchy is *situationalism*. One of the most important characteristics of intermediate-level societies is the central role that kinship plays as an organizing principle and the corresponding fluid and situational nature of economic, social, and political relationships. As Sahlins (1968) noted, in tribal societies, kinship determines that the structure of the relationship between individuals or groups is fluid, contextual, and situational. For example, a community may engage in exchange with certain peer neighbors, cooperate in defense with others, and may still seek others for marriage or ceremonial events. One aspect in which we can perceive the situational nature of intermediate-level societies is in the fluctuating nature of leadership. The study of Redmond (2002) provides a good example in this respect. Her study shows how the Jivaro could be perceived as chiefdoms ruled by powerful war leaders during war times as well as how this same society could be seen as decentralized and egalitarian during peaceful times. This example also illustrates how intermediate-level societies should be examined as comprising a set of both egalitarian and hierarchical societies over time. Another aspect that shows the organizational variability of intermediate-level societies is that many of them are situational in terms of their social organization. For example, many intermediate-level societies such as the Plains Indians of Teton Dakota (Oliver 1968), the Gê of Central Brazil (Gross 1979), and the Shawnee of the Southeastern U.S. (Henderson 1998), among many other ethnographic and archaeological examples, exhibit a dual pattern of dispersion into small family units and aggregation in large villages throughout the year, which demand that society should be organized at different levels at these different moments. In this regard, these groups alternate between a “band-level” social organization and a “tribal-level” one, which are governed by situational leaders.

*Marxist perspectives* of communal relations among lineage-based segmentary societies also have been important in highlighting the structural contradictions and asymmetries in power that exist among age sets, genders, families or households, and lineage segments (Mellaisoux 1978; Saitta 1988) within a background of mutual relations of alliances, exchanges, and obligations which bring together communities as a cohesive whole. These approaches have played a crucial role in challenging simplistic oppositional views of simple/egalitarian versus



complex/hierarchical societies by exposing the internal conflicts and contradictions that are “embedded” in intermediate-level societies. As illustrated by Handsman (1991:342) for the Mesolithic in Yugoslavia “The web of everyday life in this Mesolithic society was woven as much from relations of power, inequality, and hierarchy as it was from principles of kinship, underproduction, and communalism.” In a similar vein, Bender (1985, 1990) has explored how, in many cases, internal social dynamics may have triggered subsistence and technological changes. In fact, the archaeological evidence from some regions suggests that population growth and technological innovation often follow social change (e.g., Bender 1985; Blanton et al. 1993; Hayden 1998). In addition, a renewed emphasis on communal approaches (McGuire and Saitta 1996; Saitta 1997; Saitta and Keene 1991) continues to explore how leadership is played out in societies that held communal ownership of resources and appropriate social labor collectively. These authors have concentrated on the study of how inequalities and leadership “subsumed” to the commune are expressed in these societies where rank is not present and the use of power is limited by kinship and civil obligations.

Due to the type of more static spatial data that archaeologists deal with, the concepts of structure and practice could be made more useful by examining the concept of “locale” proposed by Giddens (1979). He has emphasized the role of locales, that is, the places created and known through common experiences, symbols, and meanings in the process of social production and reproduction. The creation of locales, that is, the construction of social space, reflects the manner in which social interaction takes place. In this regard, by examining the locales we can learn how space was conceived and what types of social relations were objectified in their construction. As noted by Tilley (1994:11): “Spatial experience is not innocent and neutral, but invested with power relating to age, gender, social position, and relationships with others. Because space is differentially understood and experienced, it forms a contradictory and conflict-ridden medium through which individuals are acted and acted upon.”

For example, the type of circular formal layout of Los Ajos during the Preceramic Mound Component give us a sense of closure, completion, boundedness, and unity that has been interpreted by many archaeologists as representing egalitarian societies (e.g., Grøn 1991; Gross 1979). However, traditional ethnographic studies (e.g., Levi-Strauss 1963) as well as several contemporary ethnographic investigations on the social and political organization of Central Brazil (Crocker 1979; Turner 1996) and Amazonian groups (Heckenberger 1996) have revealed

how circular/plaza villages also carry the seeds of social differentiation. These studies have thrown light on the inherent structural contradictions embedded in circular/plaza villages along the lines of gender, age, and other social dimensions highlighting the hierarchical oppositions (e.g., center/periphery, sacred/domestic, public/profane, and male/female) objectified in circular plaza/village layouts. These latter aspects will be evidenced in the formalization and spatial segregation that Los Ajos experienced during the Ceramic Mound Period.

The study of the rise and variation of intermediate-level societies may also benefit greatly from the notions of *structure* and *practice*, as originally formulated by social theorists Bourdieu (1977) and Giddens (1979). Structure may be defined as a set of rules and resources for action. It is the medium through which action is produced both enabling and constraining it. The relationship between structure and practice is complex and dialectical. Structure also is a production of action and is created, reproduced, and changed through the meaningful action of agents. On the one hand, as emphasized by Bourdieu's (1977) concept of *habitus*, people are constrained by their dispositions and perceived options for behavior. On the other hand, through actions individuals consciously develop strategies for manipulating traditions and structures, and in the process they both reproduce and transform them. Thus, as Pauketat (2001) remarks, traditions can be both constraints on and mediums for social change. Where these practices persisted long enough to be visible archaeologically as community and regional settlement patterns, they reflect traditions and structures.

As will be demonstrated throughout this study, the changes that Los Ajos experienced in site layout, which materialized transformations in social relationships among the early Formative groups that inhabited this region, were not radical. The basic configuration of the village remained largely unaltered. The transformation of the circular/plaza village occurred as a re-elaboration of the previous layout, which maintained the resilient central cleared plaza area, evidencing this continuing negotiation between the inertia of resilient structures and emerging innovative practices.

### **Theoretical Orientation of this Study**

To summarize, based on (a) the organizational variability that intermediate-level societies exhibit in the economic, social, and political realms, which are manifested in the diversity of expressions that the early Formative societies of the Americas display and (b) in the absence of a

more precise depiction of the social formations characteristic of the early Formative period in the mid-Atlantic region, it seems appropriate to embrace a broad characterization of intermediate-level societies to study the rise and dynamics of early Formative cultures in southeastern Uruguay. This perspective is useful for the following reasons: (a) it does not equate complexity with hierarchy, (b) it can accommodate conceptions that view unequal power as neither ranked nor hierarchical, (c) it stresses the role of individual agents, age, and gender and give more weight to historically contingent factors, and (d) it emphasizes the fluidity and organizational variability of intermediate-level societies.

These concepts are crucial to study societies where authority was only weakly developed, situational, deliberately hidden, or communal/collective as opposed to individual. Moreover, the conceptualization of the early Formative societies of southeastern Uruguay as communal societies may allow us to explore how leadership is “subsumed” to the commune and unmasked in power relations that are concealed within a “communal ethos” (Handsman 1991; Turner 1996). Last but not least, situationalism both in cultural and social terms, which may allow us to look at “horizontal”, “lateral” complexity, but also with regards to historical and environmental situationalism is crucial to interpret intermediate-level societies.

While all the above perspectives help us think about the emergence of complexity in more productive ways, they also present several challenges for the archaeologists. First, as noted by Henderson (1998:20) “For tribal societies, the lack of stratification and the fluid, non-hierarchical, and situational nature of tribal social and political relationships mean that archaeological correlates are more equivocal and difficult to recognize because of the constantly varying structure of the society itself.” Second, as stressed by Blanton (1998: 149) when discussing corporate-based societies, these new conceptualizations present analytical challenges, owing both to the conceptual difficulties and the deficiency of information, resulting from the excessive attention given to hierarchy and centralization. Consequently, only additional archaeological work will help unravel the different kinds and variations of these societies. As Saitta and Keene (1990:143) emphasize “ ...given the fact that the dynamics of tribal societies are always understood as conditioned by specific sets of ecological and historical circumstances to advance in our understanding of each particular context/situation, we must turn to the particular archaeological record.” The next section is dedicated to the study of community organization.

## **The Study of Community Organization**

Within this larger theoretical framework, the implementation of community-focused archaeological investigations in Los Ajos is pertinent and timely. The formal design of the early Formative community at Los Ajos, which incorporates clearly demarcated public and domestic spaces, is indicative of recognized social interactions beyond the household level (Johnson and Earle 1987; Kolb and Snead 1997). Moreover, Los Ajos' formal layout lends itself to the study of its internal spatial organization and therefore, to the study of the origin, maintenance, and transformation of community organization through time and space. As will be described below in detail, Mounds Gamma, Delta, and Alfa share several similarities: (a) they present a Preceramic Mound Component with similar stratigraphies, (b) dates from the lowermost PMC levels of Alfa and Gamma could be considered broadly contemporaneous, and (c) spatially, these three mounds are closely arranged around a central plaza area. All these joint characteristics lend support to the idea that Los Ajos was, from very early PMC times, a household-based community.

Following Kolb and Snead (1997:611), I do not consider the study of community organization as an alternative for social-organization categories such as tribal societies or local groups, but rather, I think that community-focused studies "... provides a particular type of socio-spatial setting against which such theoretical concepts can be examined." As argued by Yaeger and Canuto (2000:11): "The consistent practices or interactions between community members within the same spatial location create archaeologically recognizable material patterns in spatially restricted locations which structure and reflect these interactions. Accordingly, the data obtained through community-focused archaeological investigations can provide insights into the dynamics of identity, social organization, and socioeconomic integration that unfolded at Los Ajos. My approach concentrates on revealing how people construct and use space by focusing on how people create communities through their relationships. Therefore, this community-focused archaeological investigation will allow us to depart from more conservative and homogeneous functionalist views of communities, encouraging a more historically based, in-depth exploration of the diversity and complexity of the communities that originated and transformed Los Ajos.

## **Research Objectives: Towards an Understanding of the “Constructores de Cerritos” in Southeastern Uruguay**

Before introducing the research questions pursued in this study, I briefly review the previous archaeological investigations carried out in the area in order to highlight the main theoretical and methodological problems of these investigations and point out how they have informed my study. This strategy helps me place my research site, Los Ajos, within its temporal and cultural contexts.

Archaeologists in southern Brazil and in Uruguay have long differed in their interpretations and evaluations of the degree of cultural complexity of the “Constructores de Cerritos” in Uruguay and the Vieira Tradition in Brazil (compare, for example, Brochado 1984; Copé 1991; Schmitz 1976; Schmitz et al. 1991 with López and Bracco 1992, 1994; Bracco et al. 2000a)<sup>1</sup>. During the 1960s and 1970s, the Programa Nacional de Pesquisas Arqueológicas (PRONAPA-National Program of Archaeological Investigations) of Brazil was 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 (Prieto et al. 1970; Schmitz 1967, 1973; Schmitz and Brochado 1981; Schmitz et al. 1991). Accordingly, the PRONAPA methodology focused on obtaining representative ceramic samples from limited test units, mainly placed in the center of the mounds, in order to obtain maximum vertical depth and surface collections. This allowed investigators to assess the chronological relationships among ceramic phases, but limited their ability to obtain spatial horizontal relationships in order to infer the internal site structure. Based on radiocarbon dates obtained from sites in the Rio Grande region, PRONAPA researchers place the beginnings of the Ceramic Mound Period (The Vieira Tradition) about 2,500 bp and estimate the age of the Preceramic Mound Period (a continuation of the Umbu Tradition) around 4,000 bp (Schmitz and Brochado 1972). PRONAPA archaeologists (Schmitz 1976; Schmitz et al. 1991; Copé 1991) interpreted mound sites as domestic units, being the result of successive, short-term occupations by hunter-gatherer-fishers that moved seasonally to exploit the rich local environments of this region. These researchers viewed continuity between the

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<sup>1</sup> It should be kept in mind that the mid-Atlantic area encompasses a great number of sites, which are spread out over a large region and distributed over a wide span of time. Therefore, the different characteristics pertaining to the different sites are probably the result of temporal and regional variations.

Archaic Umbu tradition of generalized hunter-gatherers and the Preceramic Mound Period occupations. Furthermore, they envisioned continuity during the Ceramic Mound Period (the Vieira Tradition) and through the historic record with the Charrúa and Minuano, the horse-equipped hunter-gatherers, who these researchers maintain, populated the region in historic times (Becker 1980; 1993). It is hardly surprising that this interpretation fitted comfortably with the long-held assumption that this region was inhabited by marginal, stagnant, small groups of simple, egalitarian, highly mobile hunter-gatherers (Meggers and Evans 1977; Steward 1946, Steward and Faron 1959).

During the mid-1980s, the Comisión de Rescate Arqueológico de la Cuenca de la Laguna Merín (CRALM-Archaeological Salvage Program of the Laguna Merin basin) in Uruguay began systematic archaeological fieldwork in the context of salvage archaeology, as a result of the drainage of the wetlands in this basin by rice-growing companies. The CRALM constituted a new and refreshing approach to the study of these mound-building groups both on methodological and theoretical grounds. Methodologically, the most important step was to recognize the earthen structures as part of a broader archaeological site, comprising other topographical features, including ridges (“*microrelieves*”) and flat off-mound areas. This opened the way for the investigation of spatial relations among artifacts and their properties (e.g., Bracco and Nadal 1991) between these different areas. Regardless of these advances, CRALM emphasis continued to be directed at excavating the central part of the most prominent mounds at small mound sites.

The investigations of the CRALM in small mound sites in the wetlands of the Laguna Merin basin and the Sierra de San Miguel produced the first absolute radiocarbon dates for Uruguay, which placed the beginning of the “Constructores de Cerritos” around 2,500 bp (Bracco 1992). The complex and numerous arrays of multiple burials these sites yielded, led CRALM researchers to interpret mounds as burial/ceremonial in nature. Based on this initial information, López and Bracco (1992, 1994) developed a model, which typified these societies as complex hunter-gatherers that adapted to a hospitable wetland environment that fostered cultural complexity. López and Bracco’s (1992, 1994) interpretation was mainly based on the fact that they considered all of the earthen structures as burial/ceremonial in nature and the fact that mound sites were circumscribed by extensive wetlands. The rich and resource-abundant wetlands were deemed capable of sustaining large populations in the absence of food-production

strategies. Their model was mainly influenced by several conceptual advances on hunter-gatherers' lifeways (Price and Brown 1985), the hypothesis of Binford (1971) and Tainter (1978), which related the elaboration of mortuary practices to distinct social status, and the interpretation of formal cemeteries as territorial markers to claim and protect corporate lineal inheritance of rich but restricted resources (Charles and Buisktra 1983; Dyson-Hudson 1978; Goldstein 1980; Saxe 1970). In this regard, they interpreted mounds as burial/ceremonial constructions that were built through distinct construction events, using refuse, sediment extracted from surrounding soils, and the addition of other materials such as gravel.

Methodologically, this model led them to focus on mound construction techniques (López 1992; Bracco et al. 2000b), mound design (Bracco et al. 2000b; López 2000; López and Gianotti 1996; López and Pintos 2000), and analysis of mortuary practices (Bracco and Pintos 1999; Cabrera 1999; Femenías and Sans 2000; Femenías et al. 1996, 1989; López and Bracco 1992). Although their research recognized variability in the size and shape of mounds and the presence of an extensive off-mound area associated with the mounds, their excavations tended to overlook the importance of doing work to articulate the mound and off-mound contexts to reveal community organization.

In the early 1990s, Bracco (1993) expanded the region of investigation and carried out a survey on the eastern sector of the Sierra de los Ajos. As a result of this survey, Bracco (1993) noted that the area presented the largest concentration of mounds in the region and possibly, in the mid-Atlantic coast area. He also pointed out that this area contained large, numerous, spatially elaborate mound complexes. During this preliminary project, he mapped the mound clusters, which are placed on top of hills and flattened spurs projecting into the wetlands of India Muerta in the eastern end of Sierra de los Ajos (see for example Colina da Monte, Figure 2.4). In 1993, Bracco (1993) produced a detailed topographical map of the central sector of Los Ajos (Figure 4.1-3), excavated the central part of Mounds Alfa and Betha, and placed opportunistic test units in off-mound areas at the site. The excavation at Los Ajos resulted in the production of a suite of five radiocarbon dates from the lower component of Mound Alfa, dating between ca. 3,550 and 3,950 bp (see Table 4.4; Bracco 1993), which extended the beginnings of the "Constructores de Cerritos" back to around 4,000 bp.

Although Bracco (1993) did not report his excavations at Los Ajos in detail, he noted the marked differences that exist between the small paired-mound sites, initially excavated by the

CRALM in Sierra de San Miguel, and the large, spatially elaborate, and formally laid out mound complexes in the upper interior wetlands of India Muerta. Compared to prior investigations, he stressed the rare presence of burials and the low frequency of artifacts recovered from the central part of the mounds. Although he did not suggest a possible function or any particular use for these mounds, he indicated, in light of this new data, the need to revise the burial nature of all the mounds in the region and emphasized the value of carrying out more intensive excavations in the off-mound areas (Bracco 1993). These new investigations clearly revealed the importance of these sites to elucidate the development of early Formative societies because they (a) contain the oldest and best-developed Preceramic Mound Component in the area and (b) present the greatest internal complexity and structural elaboration in the region.

Despite these advances, some important questions crucial to understanding the nature of Los Ajos, and by extension the large multi-mound sites in the area, remain unanswered. For example, what do these large, formally laid out multi-mound sites, encompassing tens of mounds and covering dozens of hectares, represent? Are they well-planned villages, vacant ceremonial centers, or do they represent villages that include public/ceremonial spaces? What are the formation processes and uses of these mounds? Are they residential, burial, or ceremonial in nature? Given the fact that Los Ajos was occupied over a period of ca. 3500 years, what was the occupational history of the site? More importantly, what was the nature and dynamics of the societies that built these complex mound sites? What are the deeper social and cultural realities that these material realities objectify? What does the appearance of differential mounded architecture during the Ceramic Mound Period mean?

From 1995 to 1996, the archaeology of the region received new impetus with two important events. First, Tom Dillehay taught a course on the “Early Formative Cultures of the Americas” at the Universidad de la República in 1995. Second, the Comisión Nacional de Arqueología (Ministerio de Educación y Cultura) organized the “Symposio Internacional de Tierras Bajas” (“International Symposium of the Lowlands”) in 1996, where both national and foreign scholars presented their research and discussed the emergence of cultural complexity in the lowlands across the Americas (Durán and Bracco 2000). This symposium created a large comparative framework, which enhanced our understanding of the emergence of mound-building cultures in the region. During the different discussions on the early Formative cultures of southeastern Uruguay, the questions mentioned above were examined. In particular, the



following question was raised on numerous occasions, if all these earthen structures are ceremonial, where are the domestic sites of these populations that support such an apparent large-scale ceremonialism? Particularly stimulating was Dillehay's suggestion (1995b:6) that "... most mound sites, characterized by the presence of several mounds, may be a planned aspect of a village settlement understood as an expression in material form of key symbolic elements in the cosmology and social organization of the society that built and used them." This question became even more important when trying to explain the large mound complexes located in the freshwater, upper wetlands of India Muerta, which bear formal and recurrent circular and horseshoe spatial arrangements, indicating the development of planned communities (Dillehay 1995b).

In order to address these questions, this study is designed as a multi-disciplinary project to investigate early Formative community organization at the Los Ajos site in the wetlands of India Muerta, Rocha Province, and southeastern Uruguay during the mid-Holocene. It focuses on the Los Ajos mound complex with an excavation program specifically tailored to reveal settlement structure and shed light on the emergence and dynamics of early Formative societies in the region (Figure 1.2). The selection of Los Ajos to study community organization was based on the following criteria. First, the circular, semicircular, and horseshoe cluster of mounds represents one of the most recurrent spatial groupings of mounds within multi-mound sites in the region (Bracco et al. 2000a; Iriarte et al. 2001). Therefore, if we unravel the community layout at Los Ajos, we can begin to understand the settlement structure and function of multi-mound sites in southeastern Uruguay. Second, Los Ajos is one of the largest and most formally laid out multi-mound sites in the southern sector of the Laguna Merin Basin, constituting an ideal setting to test different scenarios (e.g., well-planned village, vacant ceremonial center, among others) about the uses and the nature of the occupation at this site. Seven flat-topped, beveled-edged mounds are closely arranged in a horseshoe format whose base is located on the northeast and opens to the west. A circular and an elongated dome-shaped mound in the opposite southwestern sector enclose a central cleared plaza area. Also, there are a variety of architectural and topographical features, including five circular and three elongated dome-shaped mounds, two crescent-shaped rises encircling the central sector of the site, and several borrow areas (Figure 4.3, 4.4a). In short, Los Ajos' formal layout lends itself to the study of its internal spatial organization and therefore, to the study of the origin, maintenance, and transformation of community organization through

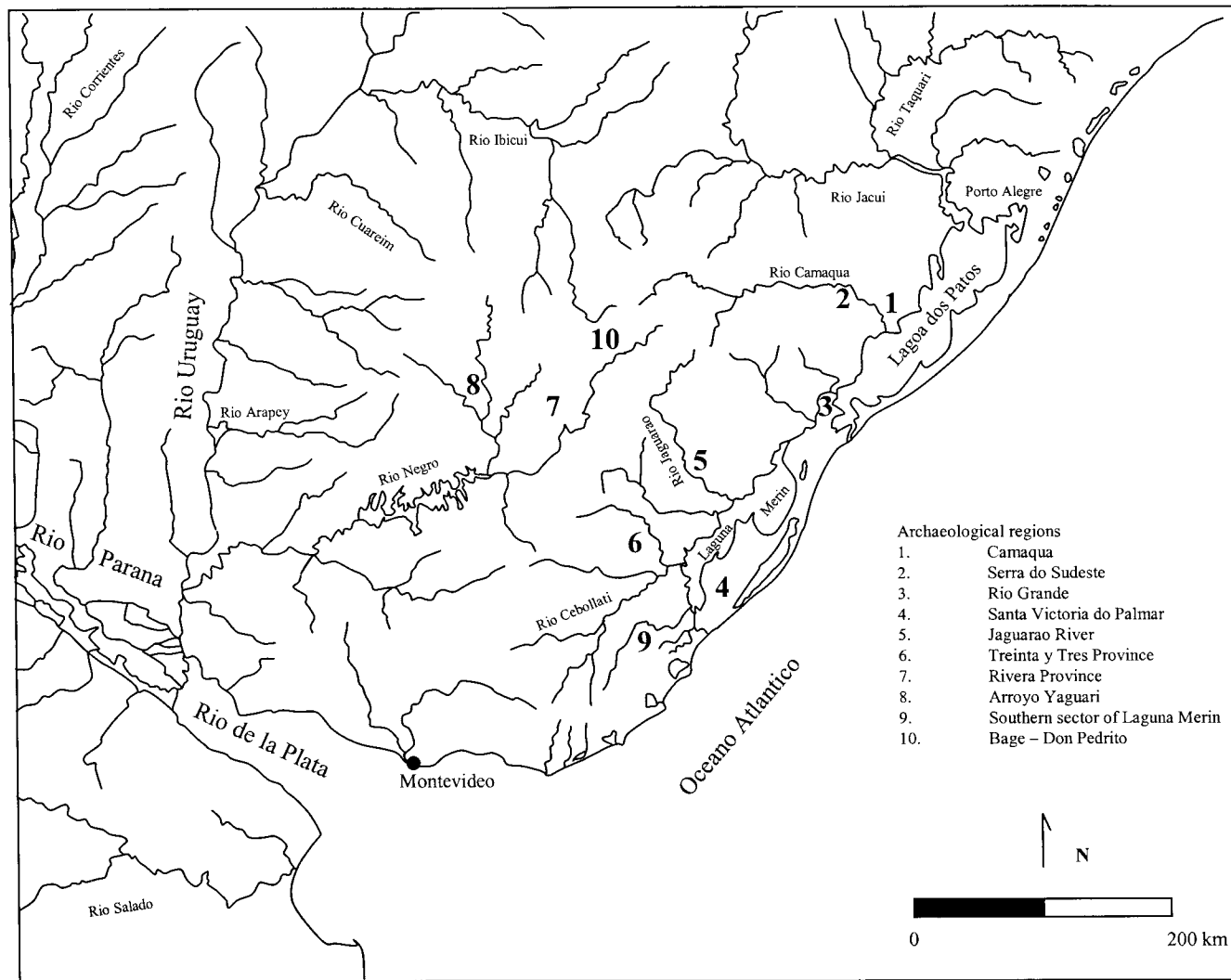


Figure 1.2. Location of archaeological regions studied in the Mid-South Atlantic.

time and space. Third, Bracco's (1993) prior work at the site revealed its multi-component nature, bearing both Preceramic and Ceramic Mound components, the former beginning at approximately 4,000 bp. Furthermore, Los Ajos has the oldest and best-dated Preceramic Mound Component in the region, consisting of a suite of five radiocarbon dates from the basal layer of Mound Alpha, ranging from ca. 3950 to 3550 bp. Last but not least, given the large size and complexity of multi-mound sites in the region, the relatively small size of Los Ajos presented the potential to yield valuable information on community patterns within the time and labor constraints of a one-year project.

To reveal the internal spatial structure at Los Ajos, field research concentrated on two complementary excavation strategies. On the one hand, the shallow deposits of the off-mound areas were targeted through a systematic sampling strategy of fifty seven small test units (1.5 x 1.5m). On the other hand, the deep mound deposits were excavated by placing a block excavation in Mound Gamma (7 x 5 m) and through selected trench transects to articulate the mound and the off-mound areas (10 x 1 m and 40 x 2 m).

Complementing the archaeological work, this investigation is designed to study the role that human-environment interactions played in the rise of early Formative cultures in the region. The approach pursued in this study follows contemporary landscape perspectives (Feinman 1999), which recognize that human-environment interactions are dynamic, historically contingent, and socially mediated. While acknowledging that environments are neither pristine nor independent entities unaffected by past human actions, landscape approaches recognize that the analysis of the environment is critical to comprehend both culture and society. Furthermore, the development of new paleoenvironmental techniques to reconstruct past landscapes is greatly enhancing our understanding of human-environment interactions. For example, paleoecological data from "off-site" contexts, such as lakes and wetlands, which contain identifiable microscopic prints of both global and local climatic changes and vegetation disturbance by humans coupled with archaeological "on-site" data, are helping archaeologists to comprehend the complex interplay between changes in the physical environment and the cultural responses to them. The application of new techniques such as phytolith and starch grains analyses also are allowing archaeologists to overcome the tyranny of poor-preservation biases, permitting us to explore, in more depth, the use, manipulation, domestication, and adoption of plants by past peoples (e.g., Deham 2003; Mindzie et al 2001; Piperno and Pearsall 1998a). The multidisciplinary,

collaborative nature of this work fosters an integrated view of human-environment interactions in southeastern Uruguay during the mid-Holocene. This was achieved by integrating different bodies of paleoclimatic data generated by the paleoecological methods of core-drilling and the combined pollen and phytolith records from a sediment core obtained from the wetlands of India Muerta.

This study explores the rise of early Formative societies in southeastern Uruguay as seen through Los Ajos, from the start of the process of early village formation during the Preceramic Mound Component ca. 4,190 bp, to the transformation of the circular village during the Ceramic Mound Component, ca. 3,000-2,500 bp. Particular emphasis is given to the investigation of the social construction of space within the process of early village formation, the appearance of public spaces, and the diversity of mounded architecture. Additionally, with the data generated through this multidisciplinary study, I give particular attention to human-environment interactions that unfolded in the midst of unstable and transforming mid-Holocene landscapes. Overall, this study is contextualized within broader anthropological concerns related to the emergence, dynamics, and organizational variability of intermediate-level societies.

### **Organization of this Study**

This study begins at a broader scale of analysis in Chapter 2, which offers a brief historical overview of the archaeological investigations carried out in the mid-Atlantic area, including the different techniques, methods, and theoretical approaches employed by researchers working in the area and their interpretations of the archaeological record, in order to provide a context for the research design of this study. Special emphasis is given to the debates that focus on the nature of these archaeological cultures, which have generated the main research questions pursued in this study. This strategy allows the author to show how his research design builds up from and complements the work carried out to date in the region.

Chapter 3 begins with a succinct overview of the general geographical setting of southeastern South America. Then, the study area, the southern sector of the Laguna Merin, is presented along with the characteristics of its modern climate, vegetation, fauna, geomorphology, and soils as well as a consideration of the importance of wetlands resources. Appendix 1 lists the plant inventory for the region, which was carried out by project botanist Lic.

Eduardo Alonso (Facultad de Química, Universidad de la República, Uruguay). Then the environmental history of the region is presented focusing on the reconstruction of the climate based on a combined pollen and phytolith record from a sediment core extracted from the wetlands of India Muerta (Appendix 2). With this baseline information, the concluding section examines human-environment interactions during the mid-Holocene.

Chapter 4 outlines the community-focused archaeological investigations conducted at Los Ajos in the wetlands of India Muerta. It concentrates on my own archaeological research at the site, which consisted of a block excavation in one mound, Mound Gamma, two trench transects bisecting mound and off-mound areas, and the placement of 57 test units within a systematic interval transect sampling strategy in off-mound areas at the site. This chapter provides the stratigraphic and chronological context for the more detailed description of the artifacts that are presented in Chapters 5, 6, and 7.

Chapter 5 focuses on the analyses of the lithic debitage and the tools recovered at Los Ajos. Oscar Marozzi (Facultad de Humanidades y Ciencias de la Educación, Universidad de la República) carried out the análisis of debitage and the author carried out the análisis of the tools. Appendix 4 describes the use-wear analysis of selected stone tools conducted by Dr. Tom. D. Dillehay. Once the results of the lithic analysis are presented, the concluding section of the chapter discusses lithic assemblage variability in relation to the changes in settlement and subsistence that took place between the Preceramic Archaic and the Preceramic Mound components and how they are correlated with the development of early Formative societies.

Chapter 6 offers an overview of the early Formative economy at Los Ajos. It combines the botanical analysis carried out by the author and the faunal analysis by Lic. Andres Rinderknecht (Museo de Historia Natural, Uruguay). Additional information was obtained by applying paleobotanical analyses, including the implementation of a flotation program as well as phytolith and starch grain analyses from selected archaeological sediments and the residues of four plant-processing tools. I conclude this chapter with a short summary and consideration of the wider implications of the phytolith and starch grain data for the characterization of the subsistence of the early Formative societies and the early dispersal of cultigens into southeastern South America.

Chapter 7 presents the ceramic assemblage analysis recovered at Los Ajos. Appendixes 3 and 6 highlight both the lithic and ceramic data coding forms, respectively.

Chapter 8 investigates community patterns at Los Ajos through the study of artifact density trends, the distribution of anthropogenically altered soils, and artifact assemblage composition in the different sectors of the site. The results of soil chemistry analyses are fundamental to interpret the formation processes of the deposits at the site, which are offered in Appendix 7.

Chapter 9 synthesizes the research at Los Ajos, integrating both archaeological and paleoenvironmental data to explore how this evidence can illuminate the nature of these early Formative societies and their responses to the changing mid-Holocene landscapes. Within a more interpretative framework, it describes the historical trajectory of the early Formative societies of southeastern Uruguay, which are framed as intermediate-level societies. Particular emphasis is given to the transforming environment of the mid-Holocene, the process of early village formation, the appearance and formalization of public ritual spaces, and the formation of tribal societies as seen through the changes in layout that Los Ajos experienced. After that, it summarizes the implications of the data obtained from this study in terms of the culture-history for southeastern South America, its environmental history, the early adoption and dispersal of cultigens into southeastern South America, and the conceptualization of the emergence and dynamics of intermediate-level societies. Finally, I conclude this chapter with some guiding questions for future research in the area.

## Notes

1. Before I proceed, two remarks are necessary. First, in this study, I use the term intermediate level societies to refer to the whole spectrum of societies that fall between bands and states (Gregg 1991). Other researchers have characterized these societies as small-scale, sedentary (though not necessarily year-round), non-hierarchical societies (Gregg 1991: xvii-xviii), “middle-range” (Feinman and Nietzel 1984; Upham 1990), “transegalitarian” (Clark and Blake 1994; Owens and Hayden 1997), and “communal” (McGuire and Saitta 1996; Saitta 1997). Second, the term “Formative” is used throughout the Americas to denote a number of aspects of pre-Hispanic cultures, notably, the process of becoming more sedentary, the domestication or adoption of domesticated plants, and the appearance of more marked social differentiation (Blake 1999; Willey and Phillips 1958). The concept of early Formative is used here for

convenience. It is not used as a chronological concept, but as a tool to provide a comparative framework in order to investigate and compare different historical trajectories of emergent complexity across the Americas. As it will become clear below, I believe this concept is useful if it is employed broadly and used to emphasize major organizational changes in social, political, and economic organization that occurred in intermediate-level societies displaying high organizational variability and not simply to focus on the appearance or disappearance of specific archaeological correlates.

## **Chapter 2**

### **Historical Overview of the Archaeological Investigations in the Mid-South Atlantic Area**

#### **Introduction**

This section offers a historical synthesis of the investigations carried out at the mound building cultures of Uruguay, locally referred to as “Constructores de Cerritos” and the Vieira Tradition in Brazil, both of which developed along the Atlantic coast of southeastern South America during the mid-Holocene, ca. 4,190 bp (radiocarbon years before present). This portion of the mid-South Atlantic coast encompasses a broad geographical area (Figure 1.1 and 1.2). In Brazil, it is limited by the Jacui River to the north and the Ibicui River to the west. In Uruguay, it is bordered by the Rocha Province and the Middle Negro River to the south and includes the provinces of Treinta y Tres, Cerro Largo, Rivera, and Tacuarembó (Figure 1.2). In the course of this study, the author will refer to this vast and diverse geographical area as the mid-South Atlantic coast. Within this broader area, I will describe regions, localities, and archaeological sites within localities. In most cases, these denominations do not follow a physiographical criterion but are based on archaeological investigations.

The purpose of this historical synthesis is to: (a) offer background information about the archaeological investigations carried out in the study area in order to provide a context for the research design, (b) highlight both the natural and cultural diversity that the mid-South Atlantic area exhibits, and (c) illustrate the different theoretical approaches, methods, interpretations, and techniques employed by archaeologists working in the area. Special emphasis will be given to the debates that focus on the nature of these archaeological cultures, which in turn, have generated the main research questions pursued in this study. This will allow the author to show how the research design of this project builds up from and complements the work carried out to this date in the region.



## **History of Archaeological Investigations**

The history of archaeological investigations in the study area is divided into four chronological periods, according to the development of distinct methodological and theoretical approaches. These include: (1) the investigations carried out by the Programa Nacional de Pesquisas Arqueológicas (hereafter PRONAPA) in southern Brazil from the mid-1960s to the 1980s, (2) the CRALM research program in Uruguay from the mid-1980s until the early 1990s, (3) the post-CRALM archaeological investigations in Uruguay from the early 1990s until 1995, and (4) the more recent investigations in Uruguay from 1996 to the present. After a description of the archaeology, I conclude each section with a summary and evaluation of the relevance of the research carried out by these programs in light of my own research questions.

### **Programa Nacional de Pesquisas Arqueológicas (PRONAPA) in Southern Brazil: Mid-1960s-1980s**

Serious archaeological work in the area began in the late 1960s with the implementation of the Programa Nacional de Pesquisas Arqueológicas (PRONAPA-National Program of Archaeological Investigations). This was a joint research effort that brought together eleven universities and museums from different states in Brazil, the Conselho Nacional de Investigações, Patrimônio Artístico y Cultural de la Nación, and the Smithsonian Institution (U.S.A). The main mission of the PRONAPA was to establish a baseline chronological framework for the still largely unexplored prehistory of Brazil, which eventually would allow archaeologists to tackle more processual research questions such as human-environment interactions, diffusion, migration, and intergroup contacts among other topics (Brochado et al. 1969). When evaluating the PRONAPA, it must be remembered that at that time, the PRONAPA was an ambitious undertaking which tried to explore and study Brazil's 8,500,000 km<sup>2</sup> territory with only a small handful of archaeologists.

Field procedures mainly included producing site inventories through reconnaissance, mapping, limited stratigraphic cuts, and surface collection techniques. As stated by Massi (1999: 29), the PRONAPA

“...established a cultural-historical approach, which defines archaeological cultures using the phase and tradition terminology that evolved from the Midwestern Taxonomic Method used in the United States (McKern 1939), and later systematized by Willey and Phillips (1958). This terminology is based on artifact typology and on the formation of components, foci, phase, and tradition according to shared artifact characteristics, and their defined spatial and temporal distribution. This approach is more descriptive than explanatory, although it infers diffusion and migration to explain cultural changes.”<sup>2</sup>

In order to build ceramic chronologies, archaeologists relied on the application of Ford’s (1962) ceramic seriation (Brochado et al. 1969; Meggers and Evans 1969), aided by a few radiocarbon dates. With the application of Ford’s (1962; Meggers and Evans 1969) seriation method, the emphasis of the program was put on ceramics, since they considered ceramics to be “...relatively more abundant and subjected to more rapid changes than other artifact types, thus, ceramics are particularly useful for establishing relative chronological sequences and tracing cultural diffusion” (Brochado et al. 1969:4).

The initial approach of the archaeological investigations carried out in southern Brazil is well illustrated in the following observation by Schmitz’s statement (1980: 76): “In general terms, archaeologists from Rio Grande do Sul were concerned with extremely simple archaeological approaches and basic techniques (...) more attention was paid to surface collected materials than stratified ones and when excavations were carried out, they had to do more with the succession of materials and structures than with their association with space and time”.

The preceramic and ceramic-bearing mounds<sup>3</sup> occurring in the mid-South Atlantic coast were interpreted as the Vieira Tradition. This tradition was defined by Brochado et al. (1969) in an effort to bring together all the ceramic archaeological phases of the groups of hunters, gatherers, and fishers found in the Rio Grande do Sul state of Brazil and eastern Uruguay. Two main aspects characterized this tradition: (a) the site-type constituted by artificial earthen

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<sup>2</sup> All translations from Portuguese and Spanish are mine.

<sup>3</sup> Unless specified or discussed in detail, in this study, the author will generally refer to “mounds” as all earthen structures without implying any particular function or use of them.

structures, referred to “aterros” or “comorros” in Brazil and to “Cerritos” in Uruguay, and (b) the ceramics found in them, which were grouped under the Vieira Tradition.

As will be described below, the great diversity of mounds with regards to size, shape, location, chronology, material culture, and more importantly, the patterns of mound aggregation in complexes displaying formal and recurrent spatial arrangements, precluded researchers from speaking of an all-encompassing uniform “mound” site-type. Furthermore, as will be noted later, many of the debates on the nature of these mounds and on the societies that built them, lose sight of the differences among them and treat them as a uniform homogenous phenomenon, without noting that these differences may be representing both temporal and regional variations.

To introduce the reader to the archaeological record of the region, I will provide a brief description of the earthen structures and their chronological sequence. First, mounds are artificially constructed earthen structures with a circular, elliptical, oblong or quadrangular base, which ranges in diameter between 15 and 150 m, though they frequently fall between 20 and 50 m and between 0.3 to 7 m in height. Second, mounds can be found located in various topographical positions from 0 to 160 masl (meters above sea level) and on different geofoms like fossil sand dunes, marine terraces, lake margins, levees, flat knolls, and on top of prominent hills. Third, mounds can be isolated, form small clusters of 2 to 5 mounds, or aggregate in large mound complexes, such as the Estancia Mal Abrigo site, which occupies an area of 60 ha and contains 77 mounds (Figure 2.5). Fourth, mounds can be uni- or multi-component only bearing preceramic or ceramic components, or containing both components. In southern Brazil, the preceramic component of these mounds has been generally affiliated with the Umbu Tradition and the ceramic-bearing phase has been associated with the Vieira Tradition. In the next section, I give a summary description of aspects of the Umbu and the Vieira traditions. More detailed descriptions of the phases of these traditions are provided when describing each particular region in detail. Figure 2.1 presents the chronological scheme for the mid-South Atlantic area. A summary of all the archaeological phases and traditions defined by the PRONAPA for southeastern South America can be found in Rodriguez (1992).

Major Periods	Dates rcybp	Southeastern Brazil			Uruguay
		Camaqua	Rio Grande	S. Victoria do Palmar	Southern sector of Laguna Merin basin
Historic					Ceramic Mound Period
Early Formative	500	Vieira III Phase - Tupi - Guarani			
	700	Vieira II Phase			
	1,100	Vieira I Phase			
	1,800	Totorama Phase			
	2,000	VIEIRA TRADITION			
2,500					
	3,000	Lagoa Phase	Patos Phase	Chui Phase	Preceramic Mound Period
Archaic Preceramic	4,000	UMBU TRADITION			Preceramic Archaic Period

Figure 2.1. Chronological Chart of Southeastern Brazil and Uruguay

### ***Umbu Tradition***

In southern Brazil, the Preceramic Mound Period has been ascribed to three phases affiliated with the Umbu Tradition (Lagoa, Patos and Chui) (Figure 2.1). The Umbu Tradition is represented by 24 phases and isolated sites that spread over the states of Sao Paulo, Paraná, Santa Catarina, and Rio Grande do Sul. Several preceramic sites of Uruguay and the Argentine provinces of Misiones and Corrientes also have been affiliated with the Umbu Tradition by Schmitz (1980, 1987).

The older Umbu phase, known as the Uruguay Phase, marked the beginning of the Umbu Tradition, which is dated between ca. 10,400 and 9,575 bp (Schmitz 1980:112, 1987). Notwithstanding, the proliferation of Umbu sites is correlated with the onset of the Optimum Climatic changes, a period marked by high temperatures and humidity, around 7,000 bp (Ribeiro 1990; Schmitz 1987). The Umbu Tradition sites are generally located in the present-day inter-phase among grasslands and the subtropical Araucaria forest of the Brazilian Highland Plateau, the seasonal tropical forest of the southern escarpment of the highland plateau, and the gallery forests along the major rivers and streams that crosscut the grasslands.

The chipped stone industry of this tradition consists of utilized flakes, unifacially retouched flake tools such as scrapers and denticulates, and bifaces. Bifacial tools are mainly represented by stemmed, barbed, triangular projectile points, and bifacial knives. Pecked, ground, and polished tools include: palm nut breakers (“rompe-cocos”, “quebra-coquinhos”), mortars (“morteros”), manos, milling stone bases (“piedras de moler”), long cylindrical manos, grinders (“moletas”), and bola stones. Polished hand-axes (“machados”) made in basalt and diorite also are predominant.

The faunal assemblages are typified by a variety of small and large mammal species, including different species of deer, peccary (*Tayassu* spp.), “coati” (*Nasua nasua*), “paca” (*Agouti paca*), howler monkey (*Alouatta pigra*), otter (*Myocastor coypus*), “jaguaritica” (*Felis* sp.), and different species of armadillo (*Dasyopus* spp. and *Euphractus* spp.) among other less represented species. Schmitz (1980, 1987) concludes that these faunal assemblages indicate that the Umbu Tradition groups practiced a generalized hunting strategy mainly centered on small and medium-size mammals complemented by fishing, shell-fishing, and the gathering of palm nuts. However, certain areas show the intensive exploitation of more specific resources.

For example, the exploitation of fish and shell-fish along the shorelines of the Lagoa dos Patos in Rio Grande (Lagoa Phase) and on the exploitation of fish and deer in the interior wetlands in Santa Victoria do Palmar (Chui Phase) (Schmitz 1976; Schorr 1985) (see Figure 1.2).

### ***Vieira Tradition***

Unlike the Umbu Tradition, which spread over a large area of southeastern South America, the Vieira Tradition is restricted to the mid-South Atlantic coast. The coiled ceramics of the Vieira Tradition are characterized by their simplicity, homogeneity, and utilitarian nature. In general, vessel forms are simple and open (10-34 cm in diameter) with generally flat bases. The height of the pots is often half their diameter and the walls are usually vertical or extroverted. Vieira ceramics are mainly fine or coarse sand tempered and exhibit limited oxidation of the core. They occasionally display some decoration in the form of punctuations, finger-punching, and basket impressions and the surface finishing is customarily smoothing.

In the next sections, I provide a succinct description of the archaeological investigations carried out in different regions in Rio Grande do Sul by PRONAPA and the Instituto Anchieta de Pesquisas. This description follows a geographical order from north to south, starting in Camaqua, Brazil and ending in the province of Treinta y Tres, Uruguay. This is a vast geographical expanse that encompasses a large variety of environments. In each region, special attention is given to the physiographical particularities, the cultural sequence, and the interpretations made by archaeologists working in the region. It should be noted, however, that the quantity and quality of the information differs from region to region since archaeological investigations carried out in these areas have been done with different purposes and intensities.

### ***Camaqua***

The Camaqua region is located approximately between 30° 10' and 31° S and 52° 30' and 52° W. It is characterized by an extensive marsh area resulting from the damming of a large alluvial basin on the Serra do Sudeste created by Late Quaternary marine terraces. This extremely diverse region is characterized by the close juxtaposition of Lagoa dos Patos, extensive marshes, upland prairies, mixed forests, and deciduous tropical forests that grow on the escarpment of Serra do Sudeste.

Between 1968 and 1971, Schmitz, Brochado, Becker, Nahue, Valente, and Schorr surveyed the left margin of the Camaqua River, locating 95 mound sites in the wetlands locally known as Banhado do Colegio, 8 archaeological sites in sand dunes, and 19 archaeological sites in the Serra do Sudeste (Schmitz et al. 1970). The majority of the mound sites are associated with wetland areas and they are rare both in Lagoa dos Patos' shoreline and in the upper Pleistocene terrace. In this regard, a visual inspection of the archaeological map of the region (Ruthschilling 1989: 25, Figure 2.2) indicates that mounds are more numerous and aggregated in the upper, interior freshwater wetlands. The surveyors described the mounds of the region as mostly circular to oval, with diameters between 15 and 50 m, and with varying heights, from 0.5 to 2.5 m. Nonetheless, no detailed stratigraphic description was provided by the excavators, which described the mounds as composed "... mainly of earth, small lenses of ash, mammal bones, and rarely, charred palm-nuts" (Brochado 1984:191).

Based on the test units placed on selected mounds, Schmitz and his colleagues (1970) proposed the following cultural sequence for the area. He recognized a preceramic phase corresponding to the Umbu Tradition denominated the Patos Phase and a ceramic phase corresponding to the Vieira Tradition named Lagoa Phase. Patos Phase artifacts mainly include small, crude, stemmed and barbed arrow points (see Brochado 1974: Figure 8), denticulates, utilized flakes, and rarely scrapers. As in the Rio Grande region (described below), the majority of the tools are made from water-worn pebbles. Analysis of the lithic artifacts by Ruthschilling (1989) shows how direct percussion was employed to reduce large pebbles (>20 cm in diameter) of quartzite, basalt, and quartz. With regards to quartz, direct percussion was utilized to manufacture crude projectile points whereas, bipolar flaking was used to reduce smaller cobbles (<10 cm in diameter) of quartz, quartzite, and granite. At the archaeological sites of this region, bone and shell artifacts are rare.

In contrast to other Vieira Tradition phases, the ceramics from Camaqua are more diverse than those corresponding to other ceramic phases in southern Brazil. In

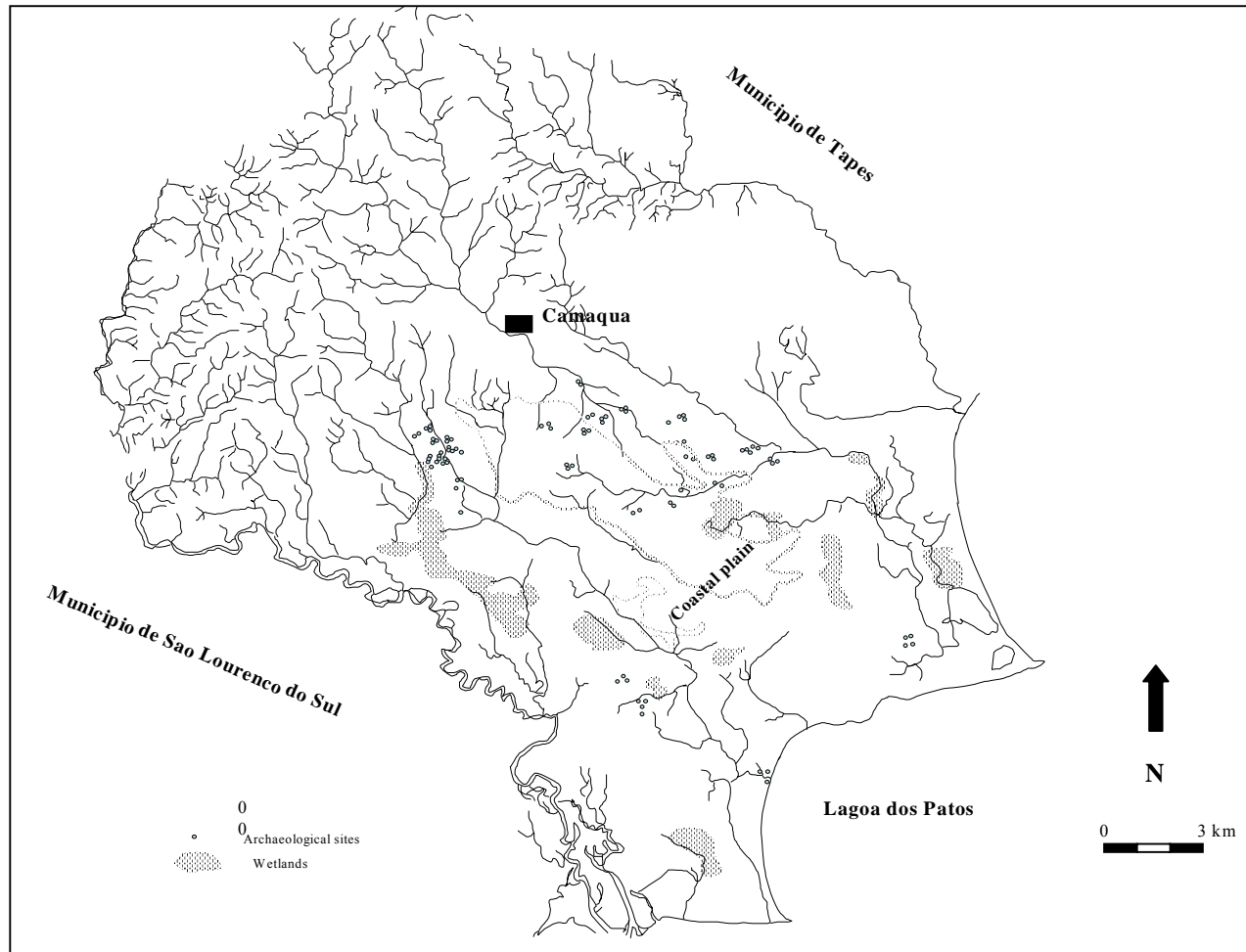


Figure 2.2. Archaeological Map of Camaqua Region (after Rutschilling 1989: Map 3).



addition to the red or white slipped Vieira ceramics, these sites also present Guarani-like and Taquara-like ceramics. As described by Brochado (1984: 191):

“The Guarani-related sherds are coarse sand tempered and show flattened corrugations and nail incisions, red slip, and red-on-white- paintings. Sherds resembling the Taquara ceramics of the Pedra Caboclo Tradition also are found in these mounds, which show the characteristic fine sand temper and closely arranged nail incisions and punctuations, and perhaps net-impressions (Schmitz et al. 1967; Schmitz et al. 1968; Schmitz and Becker 1970:4; Schmitz et al. 1970b:507; Schmitz and Brochado 1972). These ceramics indicate extensive interaction with the Ge related inhabitants of the adjacent uplands.”

Brochado (1974:45, 1984) argues that the adoption of pottery by the Patos Phase preceramic populations in this region appears to have occurred relatively late, around A.D. 1000; the period when the Guarani came into the region, which coincided with the Vieira II Phase. It should be noted that although these authors acknowledged the presence of mound clusters in this region, no detailed description of their spatial arrangements is offered.

### *Serra do Sudeste*

In the low-lying bottoms of a small closed valley in the southern escarpment of the crystalline shield of Rio Grande do Sul, Serra do Sudeste, Brochado (1974, 1984) identified the presence of ten small, shallow middens, ranging from 5 to 30 meters in diameter, at an elevation between 200-400 masl. He assigned the artifacts recovered from these sites to the Piratini Phase (Brochado 1974:84) and suggested that these sites are related to mound sites in the northern end of the Lagoa dos Patos in Camaqua, which I described above. The lithic materials included a few end scrapers, denticulates, and flakes and ceramics, which were “... tempered with fine sand, - are plain, or show obliterated coils, flattened corrugations, finger punchings, or closely arranged punctuations. Vessels appear to have been small.” (Brochado 1984:192). It must be noted that sites related to the Humaita Tradition also have been recorded along the escarpment of the Serra do Sudeste, where a deciduous tropical forest occurs. Although these sites are probably contemporaneous with the Vieira Tradition phases, they however, have been assigned to the Humaita Tradition.

### ***Rio Grande Province***

The Rio Grande Province is the area within Rio Grande do Sul that has been subjected to more intensive archaeological and environmental studies. This region includes the southern sector of Lagoa dos Patos, the place where it empties into the Atlantic Ocean. In the state of Rio Grande do Sul, the Atlantic Coast is characterized by rectilinear sand beaches without rocky points. Separating the beach from the Lagoa dos Patos and the Lagoa Mangureira are extensive mobile sand dunes fields, reaching nearly 15 m in height. Further inland to the east of these lakes are barrier-lagoon systems composed of Late Quaternary marine terraces, small lagoons, and ancient tidal plains.

In order to understand the prehistoric occupation in this region, it is necessary to understand the marked seasonality of its resources. Faunal and floral resources in this region are particularly abundant between late spring-summer-early autumn. Lagoa dos Patos and its interconnected systems of lagoons and tidal plains represent an extremely unstable ecosystem subjected to flooding during the winter. This phenomenon produces great variability in the salinity of the water, hampering the proliferation of shellfish, which are particularly sensitive to these changes. Despite this, these brackish water environments support rich populations of micro-fauna (diatoms and plankton), which attract a wide variety of marine fishes that use the lake to feed and spawn. Among the most important fishes that migrate from the ocean into the lake are catfish (*Bagre* sp.) (reaching up to 30 kg), which enters Lagoa dos Patos in August-September and leaves three months later; corvine (*Micropogon* sp.), which enters in September-October and leaves in December-January, and the Miraguaiha (*Pogonias* sp.) (reaching 60 to 80 kg in its adult state), which is more abundant during the months of September-October-November. Crustaceans like “siri” (*Callinectes sapidus*) and shrimp (*Penaeus paulensis*) proliferate in the lake during the summer and diminish in the early fall.

In addition, a diverse number of Antarctic bird species also migrate to this area to reproduce drawn by this cornucopia of marine resources during the spring and summer months. Likewise, terrestrial mammals are an important resource in the area. Particularly abundant are small and medium-size mammals, including a variety of rats and mice (*Cavia* sp., *Oryzomys* sp., *Holochilus* sp., among others), armadillo (*Dasypus* sp. and *Euphractus* sp.), capybara (*Hydrochaeris hydrochaeris*), and nutria (*Myocastor coypus*).

Plant resources are important in this region too. Most plants ripen during the late spring-summer-early fall period. The most significant plants are palm groves of *Butia capitata* and *Syagrus romanzoffiana*. Other important wild plant resources are fig tree (*Ficus* sp.), pineapple (*Ananas* sp.), and maracuja (*Passiflora coerulea*).

Overall, the presence of a diversity of fishes, birds, and crustaceans in an abundant and predictable fashion during the late spring-summer-early autumn period coupled with the ripening of several fruits and palm nuts, make this region an attractive seasonal location for pre-Hispanic populations. It is hardly surprising that the modern city of Rio Grande is one of the most important fishing ports in Brazil and that the major aggregation of archaeological sites in this region occurs at the entrance of the Lagoa dos Patos in the Rio Grande municipality.

In contrast to the spring and summer seasons, the only food resource available during the fall and winter is the “taihna” (*Mugil* sp.) fish; the only fish species migrating into the Lagoa dos Patos at this time of the year. As will be seen below, the absence of taihna fish in the faunal assemblage of coastal sites supports the hypothesis of a seasonal occupation in this subregion.

I will now turn to the description of the archaeological investigations carried out in the area. Between 1965 and 1972, Schmitz, Brochado, Becker, Nahue, Valente, and Schorr conducted a reconnaissance of the area, between 31° 45' and 32° 30' and 52° and 52° 40' W, bounded by the Atlantic Ocean, the west margin of Lagoa dos Patos, and the San Gonzalo Canal in addition to some rivers that flow from the Serra do Sudeste. The surveyed area is located approximately. They carried out surface collections at 40 sites, including mounds and surface sites, with the latter found on sand dunes.

The mound sites are mainly isolated, but sometimes appear in small clusters. They are circular and elongated in shape with a diameter that ranges between 15 and 100 m and heights that range between 0.5 and 2.5 m. Mound sites are located on the present shoreline of Lagoa dos Patos, on the Mid-Holocene marine terraces, and on levees and terraces of streams flowing into the lake. However, most of the sites are clustered around the entrance of Lagoa dos Patos, where it connects to the Atlantic Ocean; a place characterized by the abundance of fish resources.

The cultural sequence for this area was defined by Schmitz (1976). Table 2.1 displays the radiocarbon dates obtained for this region. The chronological sequence for the area was based on dates obtained from this region, which then were used to relatively date other phases of Rio Grande do Sul. The oldest component is represented by the preceramic component affiliated with

the Umbu Tradition, known as Lagoa Phase, lasted between ca. 600 B.C. and A.D. 100. However, given the fact that these dates belong to the end of this phase, Schmitz and Brochado (1972:4) estimated an age of ca. 2000 B.C. for the beginning of the Lagoa Phase. It must be remembered though that this is the only preceramic phase that has been dated in the area. The other phases (i.e., Patos and Chui phases) have been only relatively dated using these dates as chronological markers. In retrospect, thirty years later, and with the added advantage of new dates for the Preceramic Mound Period in the wetlands of India Muerta, Uruguay ca 4,190 bp (Bracco 1993; Bracco and Ures 1999), we must recognize that Brochado and Schmitz (1972) were correct in their estimation of the age of the early Preceramic Mound occupation in the area. The lithic industry of the preceramic component of these sites is rare and atypical. It was manufactured using the only raw materials available in the area, which includes water-worn pebbles brought by inflowing streams. Most of the lithic artifacts are characterized by unmodified cortical and primary flakes, mostly made of quartz and quartzite. The rest of the assemblage is composed of diabase and granite. Occasionally, some flakes were unifacially retouched into grossly manufactured scrapers. Unlike the lithic artifacts, bone tools are abundant. The most common are boat-shaped and double points made from long bones of mammals and sectioned bird or mammal bones, borers, and small points that could be parts of composite hooks. The lack of stone projectile points was interpreted by Schmitz (1976) as the result of the low emphasis that these populations gave to hunting scarce mammals in this region. The faunal analysis of Schorr (1985) evidenced the dominance of aquatic resources, mainly composed of fish remains (40 to 90%) and followed by birds, crustaceans, shells, and small mammals. According to Schmitz (1976) and Schmitz and his colleagues (1991), this phase corresponds to hunting-gathering groups that have an economy focused mainly on fishing and was complemented with the hunting and gathering of birds, crustaceans, small mammals, and wild fruits.

Table 2.1. Radiocarbon Dates from Rio Grande do Sul

Tradition	Phase	Site	Level/Context	masl	Lab. Number	Radiocarbon	
						bp	Source
Umbu	Lagoa	RS RG 21	30-40 cm	1.34	SI-1006	2,435± 85	Schmitz 1976
Umbu	Lagoa	RS RG 01	40-50 cm	2.97	SI-1194	2,160± 80	Schmitz 1976
Umbu	Lagoa		30-40 cm	2.97	SI-1193	2,000±120	Schmitz 1976
Umbu	Lagoa	RS RG 49	40-60 cm	3.06	SI-1008	2,020±50	Schmitz 1976
Vieira		RS RG 48	80-100 cm	0.64	SI-1007	1,335±45	Schmitz 1976
		RS RG 01	40-50 cm	1.33	SI-1192	1,080±90	Schmitz 1976
		RS RG 04	20-40 cm	1.5- 2.0	SI-1105	845±75	Schmitz 1976
		RS RG 01	10-20 cm	0.35	SI-1191	200±80	Schmitz 1976

After the preceramic Lagoa Phase, ceramics were adopted in this region, representing three successive ceramic traditions. The oldest is the Vieira Tradition, which includes two phases: the Totorama Phase and the Vieira Phase. The Totorama Phase was identified in a few mounds in the area and was radiocarbon dated between 1 and 100 B.C. Schmitz and Brochado (1972) estimated that it began about 300 B.C. and lasted until the beginning of the succeeding Vieira Phase, dated around A.D. 1. The Totorama Phase ceramics are similar to the ceramics described below for Vieira I, but the former are fine-sand tempered. The succeeding Vieira Phase was chronologically placed between A.D. 1 and A.D. 1750. The Vieira ceramics are similar to the ones described earlier. One of the main differences between other phases is that the use of coarse temper appears to increase over time. This is a pattern that also has been observed at sites in the area, for example in Uruguay at site CH2D01 (Bracco 1992b) (Figure 2.3) and in our ceramic analysis of Mound Gamma at Los Ajos (see Chapter 7).

Brochado (1984: 188-9) also described the presence of "...surface finishings or pseudo-decorative techniques such as obliterated coils, scrapings, and slight finger-punching ("digitada")" for this phase. Notwithstanding, some analysts have doubts about the intentional stylistic purpose of making a finger-punching "decoration" on vessels. Brochado (1984:189) and Prous (1992: 300), argue that finger-punching could be the result of using a paddle-and-anvil technique in vessel manufacture.

Vieira ceramics has been divided into three phases. First, the Vieira I Phase ceramics, between A.D. 1 and 1000, are almost completely plain and only present some finger-punching on the pots, which was likely the result of using the paddle-and-anvil technique in vessel manufacture. Second, the Vieira II Phase ceramics, between A.D. 1000 and 1300, is characterized by punctuations, nail incisions or spatula impressions, corrugations, and basket impressions forming bands near the rim. Based on the study of basket impressions on ceramics, Schmitz (1976) identified different weaving techniques, including simple "enrolado", "bifurcado con costura" and "armadura vertical", and three non-identified styles. The presence of this type of decoration has been interpreted as evidence for the influence of other groups. Punctuations, nail incisions, spatula impressions, and corrugations are viewed as the influence of Tupi-Guarani groups. Tupi-Guarani ceramics appear in the region from A.D. 1000 onwards and are distributed on the upper Pleistocene terraces in the area. Basket impressions are believed to come from the Taquara pottery of the uplands where these ceramics have been dated to A.D. 50-200 onwards.



Figure 2.3. Regional Archaeological Map of the Southern Sector of the Laguna Merin Basin.

Finally, the Vieira III ceramic phase, between A.D. 1300 and 1700, is mainly represented by open sites and has been attributed to Charrua-Minuano groups that occupied the coast when the Portuguese colonizers first settled the area at the beginning of the sixteen century (Brochado 1974; Schmitz and Brochado 1972).

An important aspect of this chronological sequence is that it has been correlated with successively lower levels of receding lake levels (Nahue 1971, 1973; Nahue et al. 1968). In the Rio Grande sector of the Lagoa dos Patos, Schmitz and his colleagues (1991: 226) described three marine terraces located inland from the present-day of the Lagoa dos Patos shoreline. The two terraces closer to the lake shorelines are Holocene in age and are referred to as A and B. The third terrace, C, is located to the west of terrace B, and is Pleistocene in age.

Schmitz (1976) and Schmitz and his colleagues (1991) documented the earliest preceramic sites on the older Holocene terrace B. On the margin of terrace B, he also recognized a Vieira I Phase ceramic occupation. A later Vieira II Phase occupation was found on terrace A. These authors interpreted this evidence as a gradual colonization towards the modern shoreline of the Lagoa dos Patos, as the waters from the Holocene marine high-stands receded, making this environment more stable and suitable for human occupation.

Based on the analysis of faunal remains, Schorr (1985) argued that the regression of the lake broadened the area of freshwater wetlands, creating a favorable habitat for the proliferation of numerous species of migratory birds, small mammals, and deer. The faunal record obtained from sites located in the B upper marine terrace (*idem*) reflects an increase in the exploitation of terrestrial species by human populations

Later in time, Tupi-Guarani ceramics appeared, in particular, in the deciduous tropical forests that occupy the escarpment of the Serra do Sudeste and in the Pleistocene terraces the region, after A.D. 1000. In Rio Grande, this period corresponds to the Camaqua Phase. The presence of Tupi-Guarani ceramics in this area is interpreted by Schmitz and his collaborators (1991:233) as the presence of "... intense contact and a possible symbiosis" between the Vieira Tradition and these groups.

The presence of clusters of post-molds in two sites in this region was crucial evidence to interpret these earthen structures as occupational middens. In the preceramic component of site RS-RG-50 (80-100 cm deep), 17 post-molds were defined in an area of approximately 2.0 x 1.7 m in a 2x2 test unit (Schmitz 1976: 68). In the ceramic site RS-RG-28 (60-80 cm deep), 6 post-



molds were defined enclosing an area of ca. 1.40 x 1.0 m in a 2x2 m test unit. These features were defined in the lower strata of the mounds constituted by a light color sand substrate. Unfortunately, the excavators did not expand the excavation units to expose the entire distribution of post-molds. As the refuse midden accumulated, the mottled, multicolored dark sediments precluded archaeologists from identifying post-molds in the upper strata of these mounds. As we will see later, this aspect of the archaeological record has been pervasive in mound excavations across the area. Coupled with the presence of post-molds, the presence of homogenous horizontal layers of artifacts, ecofacts, and hearths have led Schmitz (1976) and Schmitz and his collaborators (1991) to propose that these sites are residential in nature. When all the archaeological and environmental data are combined, Schmitz interpreted the mound sites of the Rio Grande region as seasonal camps of hunter-gatherers who lived on the abundance of fishes, crustaceans, and birds available at the mouth of the Lagoa dos Patos during the spring and summer seasons.

### ***Santa Victoria do Palmar***

Between 1967 and 1972, Schmitz, Becker, Nahue, and La Salvia surveyed the area identifying a total of 150 sites; 46 of which were mounds located in the wetlands that border the Laguna Mangueira and the terraces of the Provedores and Rei rivers, both of which flow into the Laguna Merin. The region surveyed is located between 32° 45' and 33° 20' and between 52° 30' and 53° 20' W. This region is characterized by extensive wetlands containing patches of large extensions of palm forests and prairies on the higher parts of the landscape. Schmitz and his colleagues (1991) observed that fish is not abundant here. Instead, populations of large mammals, in particular, deer are more abundant.

In Santa Victoria do Palmar, mounds are generally arranged in clusters of 2 to 8 mounds, although some are isolated. They tend to be circular in shape, with sizes ranging between 25 and 50 m in diameter and heights between 0.5 and 2.5 m. Although no radiocarbon dates have been obtained from sites in this region, Schmitz and his colleagues (1991) defined two major phases of occupation based on test units excavated in selected mounds. The older phase is preceramic and was named the Chui Phase, which is part of the Umbu Tradition. The more recent ceramic phase belongs to the Vieira Tradition and referred to as the Cerritos Phase (Schmitz 1967; Schmitz and Baeza 1982; Schmitz and Brochado 1972, 1981).

As in the Lagoa dos Patos region of Rio Grande, the preceramic sites of the Chui Phase are located on the upper marine terraces farthest away from the present-day shoreline of the Laguna Merin. The ceramic Cerritos Phase sites are found on the more recent marine terraces and on the present-day shorelines of the Laguna Merin. The first preceramic level in sites located on Arroyo Chui contains the remains of a marine-adapted fish “Miraguaia” (*Pongil* sp.). This evidence suggests that Arroyo Chui was a stream connected to the ocean, which explains the presence of this species of fish inland.

Although no radiocarbon dates were obtained from these sites, the excavators placed the beginning of the Cerritos Phase at 300 B.C. Cerritos Phase ceramics are fine or coarse sand tempered. Vessel shapes and dimensions are the same as those of the Palo Blanco Tradition (Brochado 1984) and many of them exhibit suspension holes near the rim. The majority of the ceramics are plain, but a minority is decorated with rows of punctuations near the rim. The faunal remains recovered from these sites are predominantly terrestrial species, mainly made up of deer (Schorr 1985). Schmitz and his colleagues (1991) interpreted these sites as the result of successive seasonal short-term occupations of hunter-gatherers exploiting local resources.

### ***Headwaters of the Negro, Ibicui, and Vacacay Rivers***

In the northern Uruguayan province of Rivera, Omar Santos (1965, 1967) recorded approximately 100 mound sites on the northern margin of Negro River, in Rivera Province, Uruguay. The mound sites display a linear pattern and are located along the shorelines of channels and lagoons adjacent to Negro River. Although the author did not provide a clear definition of the Preceramic Mound occupations in the region, Brazilian archaeologists who analyzed the ceramic collections assigned them to the Vieira Tradition.

In Brazil, reconnaissance surveys on the headwaters of Negro River at Bage, the headwaters of Ibicui River at Don Pedrito, and the headwaters of Vacacai River at Sao Gabriel identified clusters of mounds on the low-lying, frequently flooded marshy areas of small lakes contiguous to major river courses (Santos 1967: 8; Schmitz and Becker 1970:10). As summarized by Brochado (1984:193): “On Negro River headwaters, the mounds are clustered in groups. They are oval and measure from 7 to 8 m in diameter and range between 0.5 and 2.5 m in height. The mounds are made of soil, ash, and animal bones. Lithic artifacts are frequently found everywhere in the area and include stemmed and barbed arrow points, scrapers, knives,

flakes, and grooved bola stones. Vessels are thick, plain, and have holes near the rim”. Unfortunately, as in other regions, although PRONAPA researchers acknowledged the presence of mound clusters, they did not study the spatial arrangements of mounds in detail. On the headwaters of Ibicui and Vacacai rivers “... the mounds also are oval and have the same dimensions. While some are 0.5 m in height, others are 8 m tall. As in the previous case, many of them were built on the foot-hills, far above the floodplain.” (idem.).

### ***Jaguarao River Valley***

Initial reconnaissance work was carried out by Schmitz, Copé, Basile Becker, and Verardi in the Jaguarao River in Herval do Sul identified 64 mounds located on frequently flooded grasslands on the margins of small lagoons and on the Jaguarao River. A more intensive and systematic survey work was undertaken by Copé (1991) who surveyed 800 km<sup>2</sup> on the left margin (Brazilian side) of the Jaguarao River. She located 81 mound sites, where 54 are preceramic, 12 are multi-component, and one only has ceramic materials. The majority of the sites in this area are positioned on the upper sector of rivers and streams and frequently on flat knolls overlooking wetlands and streams. Using the quadrant method, Copé (1991) statistically demonstrated that the sites revealed a clustered pattern. She documented mound clusters exhibiting 7 to 19 mounds. She also observed that the major aggregation of sites occurs in flat knolls on the upper sectors of the landscape. Similarly, she identified relationships among the arrangement, dimension, and location of sites on the landscape. Mounds located on the low-lying wetland areas are smaller in size but higher. Mounds occupying higher topographical positions, such as knolls, are larger in size but lower in height. This pattern also has been documented by Bracco and his collaborators (1999) in the wetlands of India Muerta, Uruguay. In describing the mounds of the region, Copé (1991) found that most of the mound sites are circular in shape and only a few are elliptical and oval. In general, the mounds are small in size with diameters between 25 and 100 m. The majority of the sites contain a deep preceramic occupation that usually represents two thirds of the mound profile. Once again and regrettably, Copé (1991) did not describe the spatial arrangement of the mounds in the multi-mound sites and continued to use the mound as the unit of analysis. Although no radiocarbon dates were obtained from these sites, the lithic artifacts collected from the preceramic components have been attributed to the Umbu Tradition and the ceramic ones to the Vieira Tradition. The ceramics are fine and medium sand

tempered. Most of the pots are simple in shape and include open vessels (0 to 90<sup>0</sup> inclinations of the walls) with a diameter at the opening mouth between 10 and 32 cm. As in the Ceibos Phase (see below) and the Cerritos Phase, only a few sherds exhibit decoration such as punctuations. This decoration is similar to the Ceibos Phase punctuated “style” of the neighboring Treinta y Tres Province in Uruguay (see below). In the entire area, only 12 Tupi-guarani sherds were found. It is interesting to note that these ceramics are tempered and manufactured similarly to the Vieira Phase ceramic. However, the corrugated decoration of the sherds made Copé (1991) associates them with the Tupi-Guarani Corrugated Sub-Tradition.

Copé (1991:206) interpreted these mound sites as the result of multi-purpose domestic sites, representing short-term winter occupations of mobile hunter-gatherers who spent the remaining part of the year fishing, collecting crustaceans, and hunting birds and small mammals nearby lakes, close to the Atlantic coast. This interpretation is based on the small size of sites, shallow archaeological deposits, artifact content, and ethnographic analogies with the historic Charrua and Minuano groups. She interpreted the lithic artifacts as the result of tool manufacture, food processing, and hunting and collecting activities. Drawing on ethnohistorical analogy with the historic Charrua and Minuano groups, she asserts (1991:206): “Another reason to interpret them (the mounds) as domestic units is provided by ethnohistory. It shows the constant movement of the entire family group, transporting with them their easily dismantlable dwellings. The dwelling of the Charrua and Minuano groups is called *toldos* ... Each *toldo* can accommodate a family of 5 persons (...). The space inside the *toldo* is used for sleeping and as shelter and is never used during the day. The hearth is built outside the domestic space (Basile Becker 1982:116).” In this regard, Copé (idem) envisioned mound sites as a village resembling the ones of the historically-known and profoundly transformed Charrua and Minuano groups. The problems associated with establishing linkages between the historic and prehistoric pasts to interpret the lifeways of pre-Hispanic populations will be reviewed below.

### ***Treinta y Tres Province, Uruguay***

The Treinta y Tres Province in Uruguay is located immediately to the north of the Rocha Province. During the 1960s, Uruguayan amateur archaeologists Prieto, Arbenoiz, de los Santos, and Vedisi carried out reconnaissance in the province of Treinta Tres and localized more than 350 mounds (Prieto et al. 1970). The materials collected and excavated from these sites were

analyzed with the technical support of Brazilian archaeologists from the Instituto Anchieta de Pesquisas, notably, Schmitz and Becker.

As in the neighboring Jaguarao River sub-region studied by Copé (1991), most of the mound sites are positioned on the upper sectors of streams and rivers and in groups of nearly 40 mounds in less than one km<sup>2</sup>. As in other regions studied by PRONAPA, insufficient attention was given to the description of the spatial arrangement of mounds. However, Prieto and his colleagues (1971) observed that most of the mound complexes contain a more prominent mound, usually situated on a higher topographical location at the site. These authors (op.cit.) suggested that the more prominent mounds were privileged observation points used to spot game.

The authors did not make any clear references to the presence of a preceramic phase in this region. The lithic artifacts from the ceramic-bearing components were similar to the ones found in the Brazilian municipality of Santa Victoria do Palmar. The ceramics from these sites have been referred to as the Ceibos Phase, which is affiliated with the Vieira Tradition. Brochado (1984:186) indicates that the Ceibo Phase ceramics are very similar to the Cerritos Phase ones, but the latter ones, bear deeper sub-globular or cylindrical pots as well as the presence of rare sherds displaying rows of finger punching (“digitada”) or punctuations referred to as Ceibos Punteada.

The ceramics were manufactured using the coil technique and were fine, medium, and coarse-sand tempered. The fine-sand tempered ceramics bear a more compact texture. Two vessel shapes were almost completely reconstructed. One is an open vessel of 22 cm in diameter and 18 cm in height. It is cylindrical in shape, with straight walls, a flat base, vertical rims, and rounded lips. The other vessel is an open vessel of 21 cm in diameter in the mouth, 24 cm in diameter in the body, and 20.5 cm in height. It is globular in shape, with convex walls and a base, slightly introverted rims, and rounded lips. The authors also identified plates and other cylindrical, globular, and semispherical forms. The wall thickness is predominantly 8 mm, but can range between 4 and 18 mm. Rims are generally irregular and could be directed or contracted. Lips are rounded, straight, or beveled. Another distinctive characteristic of the Ceibo Punteada ceramics is the geometrical punctuations near the rim.

### *Summary of the PRONAPA Program*

As noted previously, in evaluating the PRONAPA program in southeastern Brazil, it must be kept in mind that it constituted a pioneering effort designed to construct the first chronological scheme for this yet archaeologically unexplored vast region during the 1960s and 1970s. The work of the PRONAPA in Rio Grande do Sul had the following outcomes: (a) it represented the first reconnaissance of an archaeologically unknown region, (b) it generated the first chronological scheme for the area and provided us with the first systematic description of sites and artifacts in the region, and (c) it greatly broadened our understanding of past human-environment relations in this region of South America.

The most important goal of the PRONAPA program was to develop a chronological framework for the unstudied archaeological region of the mid-Atlantic coast of southeastern Brazil and Uruguay by applying Ford's ceramic seriation method (Ford 1962; Meggers and Evans 1969) and constructing lithic typologies (Schmitz 1967, 1973, 1978; Schmitz and Brochado 1972, 1981; Schmitz et al. 1991). Their field methodology focused on obtaining representative ceramic samples from limited test units, which were mainly placed in the center of mounds, in order to attain maximum vertical depth. Although this approach was useful to build chronological relationships between ceramic phases, it limited researchers' ability to obtain data about the spatial horizontal relationships among artifacts, crucial to infer the internal site structure.

In my view, the investigations of PRONAPA in southern Brazil gave rise to one of the most pervasive problems in the archaeology of this region; they reduced the unit of archaeological analysis and interpretation to the study of individual mounds rather than emphasize the study mound complexes. This, in turn, discouraged the investigation of community organization at these mounds. One of the contributing factors that may explain the absence of community-focused studies may simply be one of scale. Most archaeologists in the region are not used to studying large sites covering more than a dozen hectares. Also, there has been little, if any research in the region that could serve as an example on how to approach the study of large sites. As a result, often, the overall site structure was ignored, essentially removing the mounds from their contexts. In addition, in many cases, the mounds and their associated features were perceived as static features. Consequently, researchers often overlooked the architectural evolution and the complex occupational histories of these sites. As has been argued

before in this study, the diversity that the earthen structures exhibit in terms of size, shape, location, and more importantly, their patterns of aggregation in mound complexes, precluded researchers from taking an all-encompassing, uniform site-type “mound” approach as it was traditionally done.

Unfortunately, this conceptualization of the mounds has further hampered PRONAPA researchers from exploring other hypotheses. For example, little attention has been given to mound complexes as permanent, coeval, planned settlements, as I argue for Los Ajos. Although multi-mound sites are mentioned and plotted in large-scale maps in the publications of PRONAPA researchers and their collaborators (Figure 2.2 and 2.3), no site plans are described or presented, limiting our ability to evaluate the complexity of these sites. As this study will show later, exploring the hypothesis that mound complexes are the result of more permanent contemporaneous settlements, challenges the examination of the isolated mound as the unit of analysis and calls for the need to study community patterns. Moreover, as we will see below, when considering the multi-mound sites as an integrated whole, its formal community structure denotes a form of social organization that implies some degree of institutionalized social integration beyond the household level (e.g., Kolb and Snead 1997; Parkinson 2002; Yaeger and Canuto 2000).

PRONAPA archaeologists (Brochado 1984; Schmitz 1976; Schmitz et al. 1991) interpreted mound sites as domestic sites. Mounds were viewed as the result of successive, short-term occupations of hunters, gatherers, and fishers that moved seasonally to exploit locally rich environments. The domestic nature of the mounds was inferred based on the identification of post-molds, hearths, and the presence of domestic debris resulting from food preparation, tool manufacture, and maintenance, in conjunction with occasional findings of human burials.

These researchers (op.cit) saw continuity between the Archaic Umbu Tradition of generalized hunter-gatherers and the Preceramic Mound occupations, affiliating the latter with the Umbu Tradition. The adoption of ceramics around 2,500 bp is generally interpreted as a mere “addition” to the hunting and gathering way of life of these populations. In their view, there was continuity between the pre-Hispanic and the historic populations that inhabited this region. Furthermore, according to these authors (op.cit.), continuity follows through the historic record with the Charrúa and Minuano groups, the horse-equipped hunter-gatherers, who these researchers argue, populated the region during historic times. The Charrúa and Minuano groups

are seen as the descendants of the archaeologically-defined Vieira Tradition groups (around 2,500 bp until the Contact Period). Very often, these historic groups are projected deep into the past and used as direct ethnographic analogs to interpret the archaeological record (Copé 1991; Schmitz 1976; Schmitz et al. 1991). Similarly, the now revised conception of simple hunter-gatherers that grew out of the Man the Hunter Conference (Lee and Devore 1968) is usually employed by Schmitz (1976) and Schmitz and his colleagues (1991) to interpret the Vieira Tradition groups as highly mobile small bands. I argue instead, that it is inappropriate to extrapolate models from contemporaneous hunter-gatherers living in marginal areas of the world to interpret the pre-Hispanic societies that inhabited the rich and diverse environments of the mid-South Atlantic coast.

Similarly, PRONAPA researchers (e.g., Schmitz et al. 1991) associate the dispersal of agriculture into southeastern South America with the arrival of tropical agriculturalists who practiced slash and burn agriculture along the subtropical forests of the main river systems in the region, around 1,000 bp (Acosta y Lara 1970; Brochado 1984; Cabrera 1992; Schmitz et al. 1991). As will be discussed in detail below, the results of the paleobotanical investigations carried out in this study reveal (a) that the use of domesticated plants in the region was a more important aspect of subsistence than recognized temporal and cultural placements suggest, and (b) that the ancient use and manipulation of wetlands along lakes, rivers, and marshes' margins was a much more important and frequent activity than previously thought (i.e., Blake 1999; Pohl et al. 1996; Siemens 1999).

Another aspect that became clear with the investigations carried out in Uruguay during the early 1990s, was that in light of organizational subsistence and settlement transformations that the early Formative groups experienced, it was no longer possible to view continuity between the Archaic Umbu Tradition (10,400-2,500 bp) and the beginning of the Preceramic Mound Period (ca. 4,190 bp). The data generated by our study at Los Ajos in the wetlands of India Muerta, Uruguay, reveals that more intensive and permanent occupations took place on selected locations on the landscape of this region; triggering the process of early village formation, the appearance of more formal public-ceremonial spaces, and the adoption of a mixed economy. This new evidence further corroborates that we can no longer affiliate the Archaic



Umbu Tradition with the early Formative societies<sup>4</sup> that evolved in the wetlands of India Muerta, ca. 4,190 bp.

PRONAPA research emphasis on the environment improved our understanding of the dynamics between humans and the environment in this area. Notwithstanding, they continued to portray cultures as bounded to particular environments, limiting, with some exceptions (e.g., the arrival of the Tupi-Guarani around 1,000 bp), any considerations of the impact inter-regional interactions between groups may have played on the emergence of early Formative cultures in the area.

It is hardly surprising that this interpretation fitted comfortably with the long held assumption that this region was inhabited by marginal, small groups of simple, egalitarian, and highly mobile hunter-gatherers (Meggers and Evans 1977; Steward 1946, Steward and Faron 1959) when compared to the Andean and Mesoamerican chiefdoms and states. The negative impact that the concept of marginal cultures exerted in lowland South America has been reviewed in depth by both ethnographers (e.g., Maybury-Lewis 1979) and archaeologists (e.g., Rivera 1999; Wüst 1998). Suffice is to say here, that it has discouraged researchers from investigating these “marginal” cultures in their own right, often implying that these peripheral areas were deficient or declining versions of the cultures closer to civilization centers, notably, the Andean and Mesoamerican chiefdoms and states. Also, within this framework of “marginality”, cultures are generally viewed as isolated and static, devoid of any change or developing at a slow pace. I will return to these points in the final chapter of the dissertation.

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<sup>4</sup> In this study, the early Formative period in the southern sector of the Laguna Merin is represented by the Preceramic Mound and Ceramic Mound periods.

## **Comisión de Rescate Arqueológico de la Cuenca de la Laguna Merin (CRALM), Rocha Province, Uruguay: Mid-1980s and Early 1990s**

Systematic archaeological investigations in the southern sector of the Laguna Merín basin in Rocha Province, Uruguay began in 1986 with the creation of the Comisión de Rescate Arqueológico de la Cuenca de la Laguna Merín (CRALM-Archaeological Salvage Program of the Laguna Merin basin). The CRALM was a salvage archaeology program sponsored both by Uruguay's Ministry of Education and Culture and the National Museum of Anthropology. Their mission was to inventory and investigate the archaeological sites in the wetlands of San Miguel, Rocha Province threatened by modern agricultural developments, in particular, the drainage of the wetlands by large rice-growing companies.

From 1986 until 1989, the first generation of professional Uruguayan archaeologists, notably, Bracco, Cabrera, Curbelo, Femenías, Fusco, López, Martínez, and Toscano concentrated their research efforts on the wetlands of San Miguel. When describing the research carried out by the CRALM, I will give particular attention to the methodological advances and theoretical interpretations that grew out of these early investigations in this region.

### ***Early Archaeological Work in the Floodplains of San Miguel, Rocha Province***

The CRALM team targeted three archaeological sites located in the area between Arroyo San Miguel and Sierra de San Miguel. Two of them, CH1E01 and CH2D01, are located on top of the levees of two intermittent streams flowing into Arroyo de San Miguel. The third, CH1D01, is situated on top of Sierra de San Miguel.

The CRALM excavation program had a different methodological approach to the study of these sites compared to the one applied by the PRONAPA team. The former not only concentrated on the excavation of individual mounds, but also placed test units in the surrounding earthen structures made of ridges (“micro-relieves”) and flat areas. In their view, both the mound and off-mound areas are part of the same archaeological site.

### ***The CH1E01 Site***

The CH1E01 site consists of two dome-shaped mounds referred to as Mound A (44 m in diameter and 2.30 m in height) and Mound B (30 m in diameter and 0.5 m in height). The excavation of this site involved the placement of test units in the mounds' top surface and slope, and in the articulation of the mound's slope with the off-mound area. In addition to this, more than 20 opportunistic test units were excavated in the off-mound area. As a result, an off-mound area of 0.40-0.50 m deep, containing lithics and ceramic sherds and spreading more than 100 m away from the earthen structures was documented (Femenías et al. 1987).

Although no detailed descriptions of the stratigraphies of these mounds were offered, Femenías and his collaborators (1987) indicated that Mound A was multi-component, containing both a Preceramic and a Ceramic components whereas Mound B only presented a Ceramic component.

The base of the mounds had evidence of extensive burning indicated by charcoal, burned clay, and the presence of possible hearth structures associated with few lithic artifacts and faunal remains. The presence of marine shellfish remains (*Glycimeris longior*) and sea lion canines suggested the excavators that this site was related to the sites found on the Atlantic coast, 15-20 km south of this one (op.cit.).

### ***The CH2D01 Site***

The CH2D01 site is located 1.5 km north of the CH1D01 site. It is composed of two mounds positioned on the levee of an intermittent stream that flows into Arroyo de San Miguel. The mounds were referred to as A and B. Both of them are ca. 35 m in diameter and 1.4 and 1.2 m in height, respectively. The site presents an extensive off-mound area, characterized by low but prominent topographical features called ridges ("micro-relieves") and flat areas. The mound and off-mound areas of this site were subjected to more intensive excavations than the CH1D01 site. By applying a similar excavation program to the one employed at the CH1D01 site, CRALM archaeologists recognized that the site was not limited to the earthen structures. Cultural materials, reaching nearly 0.35 m in depth, also extended outside the mounds themselves, creating a larger site of approximately 2 ha. in size. At first, Mound A was interpreted as one sector of a broader site that exhibited different activity areas (Curbelo et al.

1989; López 1992). Later, the site and its activity areas were and continue to be subjected to various new interpretations by different CRALM archaeologists. Some of the main points of disagreement are related to the interpretation of the off-mound areas, mound formation processes, and the mortuary practices displayed in the mound. Although it is beyond the scope of this study to describe these arguments in detail, I will, however, provide a brief description of the site's stratigraphy, chronology, artifact, and ecofact analyses and the main interpretations that have been offered.

Five radiocarbon essays placed Mound A between ca. 2,090 and 340 bp. The matrix sediments of the mound have been interpreted as “transported primary contexts” (*sensu* Ashmore and Sharer 1979) (López 1992). This interpretation is based on the absence of any distinct spatial pattern among the excavated remains that may suggest the presence of a habitation floor. Thus, the excavators interpreted mound materials as the result of the use of domestic refuse from nearby habitation areas as filling material for the construction of the mound. The mound it was argued, grew up through discrete and separate construction stages, using refuse, sediments extracted from surrounding soils, and gravel brought from Sierra de San Miguel (700 m away from the site). More recently, some researchers have referred to this mound construction mode as “growth by layers” (Gianotti 2000; López 2001; López and Gianotti 1997, 2003) (see discussion below).

Within these allegedly mixed contexts, several features were identified, including hearths, ash lenses, and primary and secondary burials, representing more than 40 individuals (Femenías and Sans 2000; Femenías et al. 1996; Sans 1999). At the base of the mound, López (1992; 2001) defined a circular arrangement of post-molds associated with hearth structures and ash lenses spread over a large portion of the 3x3 excavation unit; resembling the RS-RG 28 and RS-RG 50 sites in southeastern Brazil. Unlike, Schmitz (1976) who interpreted the post-molds as flimsy remains of fishermen's dwellings occupying the Lagoa dos Patos' shoreline, López (1992:90) viewed this structure as the remains of “...ceremonial activity with a possible ritual function” because of its strong spatial association with human burials.

Burials were mainly found in the central part of the mound. Mortuary practices display great variation, including primary, secondary, and multiple burials. An example of the latter includes two adult male bundle burials associated with a third adult female primary burial in an

extended position. Also, three bundle burials representing two males and the third one containing two heads, one male and one female, were defined in this earthen structure.

Curbelo and Martinez's (1992) lithic analysis from Mound A revealed that lithic raw materials, such as grainy rhyolite, basalts, and quartz, which are of low quality, highly abundant in the geological context, and located at a short distance from the sites, produce: (a) expedient, minimally modified tools, bearing direct use of edges without secondary trimming; (b) comprise the great majority of tools and debitage assemblages (more than 90%); (c) bear terminal production (*sensu* Ericson 1984); and (d) are mainly reduced by direct and bipolar percussion. On the contrary, fine-grained lithic raw materials such as opal and fine-grained quartzite, among others minimally represented, which are of good quality but are limited in abundance in the geological record are: (a) minimally represented both in the tools and debitage assemblages (less than 10%); (b) bear a more elaborate technology with greater formal and sophisticated artifacts (preforms and bifacial projectile points) and debitage including bifacial thinning flakes; (c) display sequential production, that is, only the final stages of tool manufacture are represented at the site (bifacial thinning flakes), suggesting that core reduction and blank preparation was carried out elsewhere; and (d) exhibit pressure flaking.

The ceramic analysis of mounds A and B carried out by Bracco (1992b) and Bracco and his collaborators (1993) show that the ceramic assemblages recovered from this site are utilitarian, simple in manufacture, highly homogenous, and rarely exhibit decoration in the form of punctuations. In general, ceramics are characterized by a predominance of fine-sand tempered types (>80%), reduced firing, and smooth surface finishing (Bracco 1993; Bracco and Nadal 1991; Bracco et al. 1993). The general technological and morphological characteristics of the ceramics recovered from the site resemble the ones of the Vieira Tradition (Bracco 1992b). In Mound A, Bracco (1992b) found an increase in the percentage of coarse-sand-tempered ceramics with a decrease in fine-sand tempered ones between the dated contexts of ca. 2,090 and 340 bp. This pattern conforms well to the temporal trends also observed in southern Brazil (Schmitz 1976). In addition, Bracco and Nadal (1991) found a correlation between the high degree of fragmentation in ceramic sherds and the presence of burials pits. This evidence led the authors to suggest that this pattern was the result of the placement of interments in pits, which caused the perturbation of previous layers and consequently, a greater fragmentation of ceramic sherds.

The faunal analysis carried out by Pintos and Gianotti (1995) indicated that the faunal assemblage is rich in species, with deer as its predominant constituent (82%). Among the identified animals are Pampas Deer (*Ozotoceros bezoartius*), nutria (*Myocastor coypus*), mice (*Cavia* sp., *Cricetidae*), felids (*Feliidae*), edentates, opossum (*Didelphidae*), mollusks (*Pomacea canaliculata*, *Diplodon charruanus*, *D. paralelopedon*, *Glycymeris lomgidior*), “ñandú” (*Rhea Americana*), turtle (*Chelonia*), lizard (*Tupinambis texguixin*), and freshwater and marine fishes (*Teleostei and Selacii*).

These authors also observed that the faunal assemblage evidenced high processing rates as indicated by the elevated degree of fragmentation in bones, notably, deer bone. As in other inland sites, such as Isla Larga and Los Ajos (see below) where detailed faunal analyses have been carried out, a great proportion of the faunal assemblage of the CH2D01 site consists of splintered large bones of mammals showing cut marks and evidence of charring.

Pintos and Gianotti (1995) noted a differential sequence of processing in relation to the size of the prey. Although almost complete skeletons were recovered from small animals, only the long bones of large mammals were found at the site. This pattern suggested that large mammals were butchered elsewhere and only the meaty parts were brought to the site.

As will be discussed further in the faunal analysis section in Chapter 6, the sample analyzed in this study was recovered from a 1 cm<sup>2</sup> screen mesh. This methodological approach was strongly biased against the representation of small vertebrates, including small mammals, fishes, birds, reptiles, and amphibians, and in turn, over-represented the presence of large mammal bones.

Previous chemical analysis carried out on archaeological sediments obtained from Mound CH2D01 has served to clearly establish the anthropic nature of the mounds in the region (Durán 1989; Bracco and Nadal 1991). Studies on percentage of organic matter, phosphorous, and potassium showed the marked chemical enrichment that the mound sediments possessed, reaching levels 10 to 100 times higher than the background natural soils of the area.

The process of mound formation and its relationship with mortuary practices has been subjected to discussion at the CH2D01 site. Initially, López (1992) argued that the interments in the mound were placed deliberately in the central part of the mound, at the base of each layer and then covered up by capping episodes. Later, Femenías and his collaborators (1996) and Femenías and Sans (2000) indicated that individuals were interred in pits, disturbing previous

interments. This latter interpretation was also supported by Bracco and Nadal's (1991; see also Bracco 1992b) ceramic analysis, which correlated a high degree of fragmentation in ceramic sherds with the presence of burial pits.

Although the entire team of CRALM researchers agrees that the CH2D01 site was a burial mound, another point of discrepancy concerns the interpretation of mortuary practices at this mound. At first, CRALM researchers (Bracco et al. 2000a; Curbelo et al. 1989; López 1992) considered that the differences in burial goods displayed in the interments indicated that these groups represented a non-egalitarian society in transition to a hierarchical one (Bracco et al. 2000a). For Bracco and his collaborators (2000a), the differentiation in ascribed roles could be observed in mortuary practices, where the social position of an individual was based on the amount of grave goods and the location of the burial within the site (Bracco et al. 2000a). Later, Femenías and his collaborators (1996) and Femenías and Sans (2000) stated that they did not find significant differences in the material culture associated with the buried bodies, indicating that there were few differences in grave-goods. They also observed that burials were neither arranged in any discernible spatial pattern nor did the skeletons present any particular orientation (Femenías et al. 1996). Based on this evidence, the authors argued that status differences were not reflected in the mortuary practices at the CH2D01 site. In my opinion, the large number of burials and the lack of exotic artifacts argue against the restriction of high status differentiation to a few individuals. The mound was probably built as a corporate burial facility designed to reinforce kinship, clan or community ties rather than to mark the death of a single, important individual.

The interpretation of the off-mound areas also was a subject of considerable debate. As has been mentioned before, the excavators identified two different off-mound sectors, notably, ridges and flat zones. Relief zones have a clayey B horizon and a slightly developed buried A horizon on top of which there is an anthropic soil characterized by a loamy organic soil (Durán 1989), bearing high concentrations of lithic and ceramic materials. Flat zones do not present any relief and are constituted by a clayey B horizon and a slightly developed A horizon. These soils do not show any signs of chemical alterations and bear low frequencies of archaeological materials.

Originally, Curbelo and her colleagues (1989) interpreted the ridges as domestic, residential zones based on the presence of (a) a high concentration of refitting sherds, (b) high

diversity of lithic artifacts, representing different stages of manufacture, (c) plant grinding tools, (d) different types of ceramics, and (e) evidence of ceramic manufacture. Then, Bracco and Nadal (1991) concluded that the off-mound areas were trash disposal areas based on an intra-site spatial analysis of ceramic sherds distribution. They noted a higher density of ceramic sherds and a higher diversity of ceramics. Also, they observed an important number of sherds that were discarded because of poor manufacture.

While the CH2D01 site has generated multiple and sometimes opposing arguments about the interpretation of this site, one cannot deny its importance. The evidence obtained from this site served to firmly establish the anthropic nature of the mound, provided the first radiocarbon dates for the area, advanced our understanding of the subsistence, social, and mortuary practices of the “Constructores de Cerritos” for the Ceramic Mound Period, provided data crucial to develop López and Bracco’s (1992) model of complex hunter-gatherers, and gave the impetus for future projects in the area.

### ***Early Archaeological work in Sierra de San Miguel***

#### ***The CH1D01 Site***

The CH1D01 site is located on the upper part of Sierra de San Miguel and has two mounds. Only one mound, Mound A, which is 44 m in diameter and 1.20 m in height, was excavated. Based on Femenías and his colleagues’ (1987) brief description of the site, we know that the mound only has one Ceramic component and contained three burials representing two strongly flexed primary burials and a secondary one. In contrast to the CH1E01 and CH2D01 sites, which are located on the floodplain of this wetland, CH1D01 does not have any off-mound occupations.

#### ***Survey of the Laguna Negra Shoreline***

Reconnaissance surveys during the mid-1980s on the Laguna Negra’s shoreline identified several surface archaeological sites. These sites are well known to local collectors for the abundance of projectile points and plant grinding tools that they exhibit. These artifacts became highly visible in dunes and the shorelines of the lake that are intermittently exposed and covered



up by the wind and fluctuating levels of the lake (Bracco 1990). The survey located 7 surface sites and 3 stratified ones (López and Bracco 1992). The lithic and ceramic materials are clearly water-worn, exhibit wind patina, and have been clearly redeposited by the fluctuating levels of the lake. Due to the high number of projectile points recovered from these surface sites, López and Bracco (1992) suggested that these sites were places where people focused on the hunting of large terrestrial mammals.

### **Summary and Assessment of the CRALM Program**

The CRALM constituted a new and refreshing approach to the archaeology of the area on both methodological and theoretical grounds. Methodologically, one of the most important contributions was the recognition of earthen structures as part of a broader archaeological site, which comprise other topographical features such as ridges (“microrelieves”) and flat off-mound areas. This opened the way for the application of new techniques through the study of spatial relations among artifacts and their properties (e.g., Bracco and Nadal 1991). The CRALM also applied new techniques in the region, including creating of first Radiocarbon Laboratory in the country at the State University of Uruguay (Bracco 1990), and developing the analysis of trace elements (Bracco et al. 1989, 1995), bone isotopes (Bracco 1995; Bracco et al. 1987, 2000c), and phytoliths (Campos et al. 1993).

As has been mentioned earlier, CRALM excavations yielded complex and numerous arrays of multiple burials in the mounds, revealing a variety of mortuary practices. This led researchers to postulate that these earthen structures were burial mounds. The character of the off-mound areas has been and still is a subject of considerable debate. Some have interpreted them as domestic areas (Curbelo et al. 1989; López and Nadal 1997) and others as secondary refuse areas (Bracco and Nadal 1991).

As a result of the investigations carried out under the CRALM program, López and Bracco (1992, 1994) proposed that these societies were complex hunter-gatherers adapted to a rich wetland environment that fostered cultural complexity. This constituted a major breakthrough in the perception of the pre-Hispanic populations of the area, which were usually portrayed as

marginal, small bands of hunter-gatherers. This view contrasted with the previous interpretation of PRONAPA investigators.

López and Bracco's (op.cit.) interpretation was mainly based on two assumptions: (a) that all the earthen structures were burial/ceremonial in nature due to the recurrent presence of burials and the apparent lack of structures without use surfaces and (b) that mound sites were circumscribed by extensive wetlands that constituted rich and abundant resource habitats, capable of sustaining large populations. Several conceptual advances and new theories about hunter-gatherer's lifeways influenced their model. Firstly, the work of Price and Brown (1985) challenged the traditional stereotype of the simple hunter-gatherers that emerged from the Man the Hunter Conference (Lee and Devore 1968). These authors stressed the correlation between resource richness and abundance and the appearance of more sedentary hunter-gatherers characterized by social complexity, a higher degree of inequality, and larger populations. In particular, many of these studies showed how wetland and maritime economies (e.g., Brown 1985; Yesner 1980) were almost a precondition for the emergence of this type of complex hunter-gatherers. Secondly, the works of Binford (1971) and Tainter (1978), which associated social status with the sophistication and elaboration of mortuary practices had an effect on their interpretations of the complex arrangement of mortuary practices found at these sites. Thirdly, another influential approach was Saxe's (1970) and Goldstein's work (1980), which hypothesized that in food-producing societies, formal cemeteries are built to protect corporate lineal inheritance of crucial and restricted resources. This hypothesis was particularly applicable to the work of Charles and Buikstra (1983) that reframed and applied this hypothesis on hunter-gatherers inhabiting non-marginal areas rich in resources, such as the wetlands of the central Mississippi River drainage. The study of Dyson-Hudson (1978), which showed how hunter-gatherers defend and use territorial markers in regions where resources are abundant, predictable, and circumscribed, also influenced the view of these Uruguayan archaeologists.

Unlike PRONAPA researchers, who saw continuity between the archaeological Vieira Tradition and the historic Charrúa and Minuano indigenous groups, Cabrera (1992) pointed out that there was a rupture between these two periods. He argued that the apparent lack of correspondence between the archaeological and historic records is explained, partly, by the dramatic transformations that the Charrúa and Minuano groups experienced during the historic period. These transformations were due, in large part, to the dissemination of European diseases,

the Spanish military campaigns of extermination, and the pressures of Portuguese slave-hunters on indigenous populations, which severely reduced their numbers and forced them to significantly change their traditional lifeways. More recently, Cabrera (2000, 1992), Cabrera and Barreto (1996), Cabrera and Femenías (1991) and Bracco (1998) also have called into question the assumption that the Charrua and Minuano groups are the descendants of the archaeological mound-building groups. Their reexamination of chronicles and more recent analysis of new ethnohistorical documents indicate that the groups that inhabited the area, that is, the Tapuyas for Cabrera (2000) and the Guenoas for Bracco (1998), were more sedentary, lived in villages that were probably organized in tribal societies, and practiced a mixed economy, combining hunting and gathering wild resources with small-scale horticulture.

The aforementioned model of López and Bracco also led researchers working in the area to focus their research on mound construction techniques (López 1992; Bracco et al. 2000b), mound design (López 2000; López and Gianotti 2003; López and Pintos 2000), estimates of labor costs (López and Bracco 1992), and analysis of mortuary practices (Cabrera 1999; Femenías et al. 1987; Femenías et al. 1996; Femenías and Sans 2000; López and Bracco 1992; López and Gianotti 1997, 2003; Pintos and Bracco 1999) and bioanthropology (Sans 1999). As has already been mentioned above, in general terms, these studies shared the notion that mounds were built in distinct construction episodes by covering up burials with loads of sediment that mixed different types of sediments and refuse. According to these authors, these capping episodes resulted in the horizontally heterogeneous and vertical homogenous discrete layers reflected in the mound stratigraphy, referred to as “growth by layers” (Gianotti 2000; López 2001; López and Gianotti 1997, 2003). Implicitly or explicitly, the “growth by layer” model has generally implied that mounds required a large amount of labor in order to be constructed. For example, López (1998, 2000) and López and Gianotti (1997) has argued that the construction of some thick layers and interconnecting paths between mounds at Los Indios site would have required “... a large number of individuals as well as greater organization and direction of labor” (López 2000: 261).

The interpretation of the earthen structures by CRALM researchers as burial/ceremonial mounds and its implications in terms of the nature of the society that built them triggered a debate with PRONAPA archaeologists in the early 1990s. This discussion, however, was unproductive in advancing our understanding of other aspects of these early Formative societies

for the following reasons. First, both teams of archaeologists based their interpretations of these societies on a very limited set of archaeological data. They constructed models based on information from a few sites and then extrapolated them to the entire area. Their excavation efforts largely concentrated on the lower wetland areas of the region, which mainly exhibit the more recent mound sites, offering an incomplete picture of the beginning of the early Formative societies in the area. In the particular case of southeastern Uruguay, the sites excavated by the CRALM team in the wetlands of San Miguel are temporally restricted to the more recent Ceramic Mound Period occupations (López 2001). The more recent dates for the lower mound components date to ca. 2,530 bp, which correspond to the lower limit of the Ceramic Mound Period in the region. Arroyo San Miguel, where these sites are located, was directly connected to the Laguna Merin and consequently, was affected by the marine highstands that occurred between 5,000 and 3,000 bp. It is likely that this area was unstable and unattractive, if not impossible to settle well after the last marine highstand, around 3,000 bp. It comes to no surprise that the first substantial human occupation in the floodplains of Arroyo de San Miguel took place around 2,350 bp, as can be seen in the earliest levels of CH2D01 and CH1D01 sites.

Secondly, this debate was impoverished by the continued use of the individual mound as the unit of comparison, paying little attention to the manner in which several mounds are articulated within larger sites. For example, the mound sites located along Arroyo de San Miguel are not only temporally late, but do not exhibit the number of mounds and the structural elaboration of the sites found on the upper wetlands of India Muerta.

Thirdly, the current debates on the function of the earthen structures define them as either burial/ceremonial or domestic/residential in nature. This dichotomy has been an obstacle to advancing our understanding of the societies that built these mounds for two main reasons. The first one is strictly linked to how these societies have been defined and to what extent it is possible to separate the ceremonial/religious activities from the daily activities of middle-range societies in the archaeological record, since as Renfrew (1994:47) has pointed out "...they are too interwoven". The cross-cultural study of Adler and Wilshusen (1990:133) further illustrates the difficulty of separating these two dimensions. These authors contend that in tribal societies, the social integrative facilities, for example, a dance house, a plaza structure, or a mound, tend to remain generalized in use. In other words, these social integrative facilities "...serve as a context for both secular and ritual activities" (idem.).

The fourth aspect revolves around the issue of how the archaeological record should be interpreted for this particular region. Generally speaking, the literature of the New World makes a distinction between what is referred to as ceremonial, burial or temple mounds and mounded middens or residential mounds (e.g., Lindauer and Blitz 1997; Russo 1995). Ceremonial mounds are earthen structures that may contain burials, ceremonial objects, tombs, earthen platforms, and structures. They reflect construction episodes and shapes, which further indicate that the construction of the mound was intentional and purposeful for activities unrelated to or beyond the simple disposal of refuse and other mundane activities. Unlike ceremonial mounds, mounded middens or residential mounds are the incidental accumulation of midden refuse made of soil, shell, animal bone, and other cultural materials associated with daily maintenance activities. In addition, they may contain features such as the postmolds of domestic structures, hearths, tools, debris associated with food preparation and consumption, and storage pits. However, the distinction between ceremonial mounds and mounded middens becomes difficult when the traditional traits associated with either one of these mounds are found or when they are absent from a mounded feature. As this study will try to show, this is more often the case at various sites in southeastern Uruguay where burials were placed in a mounded midden and diagnostic ceremonial objects were absent.

This study also will demonstrate, that during the last part of the Preceramic Mound Period and throughout the Ceramic Mound Period, the earthen structures at the Los Ajos site served dual functions. They were both places for the living and places for the dead. Moreover, it is the contention of this study that some mounds were built in the context of a well-planned residential settlement, one that included both public and domestic spaces. As the data presented in Chapter 4 and discussed in more detail in Chapter 8 indicate, at the Los Ajos site, mounds not only fulfilled dual and intermingled residential/burial functions, but also were both unintentionally and purposely built and shaped during its long occupational history. During the Preceramic Mound Period, the gradual accretion of multiple overlapping residential occupations resulted in a dome-shape occupational midden used as a platform for residential purposes. At the end of the Preceramic Mound Period, we witnessed the appearance of the first burial. It was placed in the occupational midden on top of which a carefully arranged stone ring was laid out. During the Ceramic Mound Period, burials capped with gravel layers become more common. As a result of these intentional gravel filling episodes, the mound was enlarged and its dome-shape changed

into a more imposing quadrangular flat-top beveled edge mound. Artifact and ecofact analyses (Chapter 5, 6, 7) evidenced the domestic nature of these occupations at the site.

Planned trash disposal and the presence of thick, black soil and artifact-laden middens indicate substantial and prolonged occupation of the site. The regular shape of the mounds and their careful spatial arrangement articulated around a plaza area (characterized by low artifact densities and minimal soil alterations) evidenced that Los Ajos operated as an integrated whole, one that combined both public and residential areas, constituting a well-planned village. By extension, it will be suggested that many of the multi-mound sites in the wetlands of India Muerta that display this recurrent circular and horseshoe format arrangement of a mound enclosing a central plaza area are part of planned residential settlements.

One last aspect of the PRONAPA-CRALM debate that needs to be addressed focuses on how these cultures were interpreted. The researchers of these programs both failed to recognize the different environments this broad region encompasses and to assess the long temporal span through which these cultures developed. As I expect this chapter has made apparent, both the temporal span and the diversity of natural and archaeological expressions encompassed under the Umbu and the Vieira traditions in the mid-South Atlantic coast of South America made this discussion sterile.

To conclude, an important aspect that became evident by the early 1990s was that, given the major changes in subsistence and mobility that these groups experienced with the development of mound-building cultures in the region, it was no longer possible to view continuity between the Archaic Umbu Tradition and the beginning of the Preceramic Mound period. It is the contention of previous studies in Uruguay (Bracco et al. 2000a) and of this study in particular, that we can no longer affiliate the Archaic Umbu Tradition with the early Formative societies that emerged in the area ca. 4,190 bp.

## **Post-CRALM Research in Uruguay: From the Early 1990s to 1996**

Following the work of the CRALM program, three major projects were developed in different areas of the southern sector of the Laguna Merin basin, Rocha Province, under the supervision of former members of the CRALM. López started a project on the Atlantic coast titled “The Prehistory of the Atlantic Coast of Uruguay”. It was funded by the State University of Uruguay and the Institute of Ibero-American Cooperation-Embassy of Spain (I.C.I.-Instituto de Cooperación Iberoamericana). Cabrera, on the other hand, continued the work of the CRALM in the eastern sector of Sierra de San Miguel, under the sponsorship of Uruguay’s Heritage Council-Ministry of Education and Culture (Comisión Nacional del Patrimonio-Ministerio de Educación y Cultura). Bracco initiated a new project in the wetlands of India Muerta, which was jointly funded by the National Museum of Anthropology in Uruguay (Museo Nacional de Antropología) and the United Nations’ Biodiversity and Sustainable Development Program (PROBIDES-Programa de Biodiversidad y Desarrollo Sustentable).

### **The Atlantic Coast of Rocha Province**

Before I describe the archaeological investigations along the Atlantic coast of Rocha province, I will succinctly review the environmental characteristics and the resources available to humans on this sector of the landscape. In contrast to the uninterrupted, linear, sandy shorelines of Rio Grande do Sul, Brazil; the Atlantic coast of Uruguay is marked by the presence of rocky points and islands, located between beach arches. Both the rocky points as well as their close-by islands are inhabited by large colonies of pinnepeds (*Arctocephalus australis* and *Otaria flavescens*), which constitute one of the most important economic resources in conjunction with fish, shellfish, and crustaceans. On many rocky points and nearby rocky islands, such as the Cabo Polonio or Punta de Loberos sites (see Figure 2.3), sea lions represent a predictable, abundant, and localized resource that become particularly easy to hunt during the mating season in the summer (Vaz Ferreira and Ponce de Leon 1987). During this season, males fiercely defend their rocky territories and consequently, their dependence on the land is absolute. Experienced swimmers in the ocean, these marine mammals move very slowly on land, becoming easy prey for hunters (see Lanata and Winograd 1990; Schiavinni 1993).

As in the Rio Grande do Sul, Brazil, many fish species enter the brackish water lagoons that occasionally open to the ocean to feed and reproduce. Although less abundant when compared to the fish species available in Rio Grande do Sul, fish in the Atlantic Ocean of Rocha Province, Uruguay also makes up an abundant and predictable resource. In minor proportions, shellfish and crustaceans (crabs and shrimp) also could be collected during this time of year. As the faunal remains obtained from the archaeological sites on the Atlantic coast of Rocha province show, the human populations that inhabited this coastline may have opportunistically taken advantage of beached dolphins and whales (Chagas 1995).

The first systematic survey carried out in the locality of Cabo Polonio, documented the presence of several preceramic and ceramic sites (Baeza et al. 1973, 1974) in the sand dunes. Later, López and Bracco (1992) adopted the concept of “archaeological locality” to study this coastal site. This concept fits better the nature of the archaeological record in this area given the disturbed nature of the archaeological assemblages found in these mobile sand dunes. These archaeological localities constitute post-depositional mixed “aggregates” of artifacts rather than discrete archaeological sites. They identified six archaeological localities, notably, La Paloma, Cabo Polonio-Valizas, Punta del Diablo, Santa Teresa, Cerro Verde (Punta de Loberos) and Punta de la Coronilla from west to east, along the Atlantic coast of Rocha Province. They carried out intensive surveys in the localities of Cabo Polonio-Valizas and Santa Teresa-Punta de la Coronilla. An important outcome of this survey was the discovery of several buried paleosoils, which occur nearby rocky points and are associated with a high frequency of artifacts.

Excavations were carried out in Cabo Polonio, Punta de Loberos, and Punta de la Coronilla. In Cabo Polonio, López (1993, 1995, López et al. 1994) excavated a stratified site, composed of five sandy layers exhibiting different degrees of soil development and yielding an occupational sequence of ca. 4,360 bp. This was the first radiocarbon date for the Atlantic coast of Uruguay. More importantly, this date not only indicated that the Atlantic coast was occupied at least 4,630 bp, but that this coastal occupation was contemporaneous with the earliest occupations of the Preceramic Mound Period of the mounds in the wetlands of the Laguna Merin basin. One radiocarbon essay on shell found in a dark grey sand paleosol was obtained from a test excavation at Punta de la Coronilla, yielding a date of ca. 2,740 bp (López 1995).

In addition, López (1995) found a strong correlation between the amount of phosphorous and the frequency of artifacts at the Cabo Polonio site. Based on this evidence and the depth of



the “anthrosols” that occurred in these selected locations on the Atlantic coast, López (1995) suggested that their genesis is associated with a more intensive and redundant human occupation of these coastal locations than was previously thought.

Similar to the pattern found on the coastal sites in Rio Grande do Sul, Brazil (Schorr 1975), the faunal analysis carried out by Chagas (1995) showed that the faunal assemblages of the Atlantic coast sites in Rocha province, between ca. 4,630 and 610 bp, were dominated by marine resources, including marine mammals such as sea lions (Otariidae), Delphinidae (*Mysticeti* spp., *Truncatus* spp.), and whale, in addition to fish (*Pogonias cromis*) and terrestrial mammals. The earliest component has a predominance of marine mammals, which in later times, was complemented with terrestrial resources. The lithic analysis carried out by the author (Iriarte 1993, 2000; López and Iriarte 2000) in the Atlantic sites, found a similar differential technological treatment regardless of the quality and local availability of the various raw materials employed. While granite and quartz, which are local and abundant, received an expedient treatment; fine-grained, non-local raw materials, such as quartzite and opal, among others, exhibited a more curated technology. This pattern bears strong similarities with the one documented by Curbelo and Martínez (1992) at the CH2D01 site.

Based on this work, López (1995) distinguished two main types of coastal sites, namely, sites located on the rocky points and those located in the beach arches’ sand dunes. The former are larger, deeper, more stratified, and are usually associated with paleosoils. In comparison to the sites located in the sand dunes, the former presents relatively high densities of archaeological materials, bear non-portable artifacts such as large mortars and milling stone bases, and display a greater diversity of lithic tools, including bola stones, net sinkers, projectile points, mortars, manos, and milling stones bases. Interestingly, most of these tools are highly recycled and reused suggesting the redundant occupation of these sites. In sum, the lithic assemblages found at the sites located on the rocky points speak of a wide variety of activities, representing those that are expected at residential base camps. The faunal assemblages at these sites are both more numerous and diversified with respect to the sites found in the sand dunes. They include marine (pinnipeds, cetaceans, fishes, shellfish, and crustaceans) and terrestrial fauna (deer, small rodents, and birds).

In contrast, the sites in the sand dunes are smaller and highly scattered. Their lithic assemblages are mainly restricted to quartz flakes and their faunal assemblages to sea-lions and

shellfish. Comparisons among these sites led López (1995) to interpret them as ephemeral occupations related to some marine economic activities. In short, he hypothesized that the sites situated on rocky points represent a more intensive and redundant occupation whereas the sites located in the sand dunes represent ephemeral camps.

The similarity between the lithic artifacts (e.g., nut breaking stones, manos, milling stone bases, projectile points) and the Vieira-like ceramics found on the Atlantic coast sites have when compared to the artifact assemblage recovered from inland mounds and surface (Merin Lake and Negra Lake shores) sites, made several authors associate the Atlantic coast with the inland mound sites (Baeza et al. 1973, 1974; Hilbert 1991; López 1995; López and Bracco 1992; López and Iriarte 1995, 2000; López et al. 1994).

Hilbert (1991) analyzed surface collected sherds from the Atlantic sites of La Coronilla, Cabo Polonio, and Valizas gathered by Oliveras, which are curated at the National Museum of Anthropology (Museo Nacional de Antropología). The ceramics were described as simply manufactured and sand or crushed quartz tempered. Globular and sub-globular vessel forms are predominant, with a mean diameter at the mouth opening of 20 cm, and generally present simple rims with only a few vessels with expanded rim profiles. Hilbert (1991) ascribed these ceramics as pertaining to the Vieira Tradition.

More recently, López and Iriarte (2000) suggested the possibility that these sites represented the seasonal exploitation of marine resources during the summer, acknowledging that more research is needed to determine if these sites are summer residential base camps, or if they represent logistical parties anchored inland, which visit the coast to take advantage of these abundant and seasonal resources. In contrast, Bracco and his collaborators (2000c) have suggested that populations inhabiting the Atlantic coast of Uruguay were different groups from those that built the mounds in the interior wetlands. This hypothesis is based on the comparison between the C13 bone isotope record of 23 individuals dated to the Ceramic Mound Period from inland mound sites and one skeleton recovered by an amateur archaeologist in the coastal town of Punta del Este, Maldonado Province, a site located 200 km away from the study region. Their analysis indicates that the Ceramic Mound groups from the inland mound sites did not rely extensively on marine resources and therefore, suggest that the groups that inhabited the Atlantic coast were a totally different group from the one inhabiting the interior wetlands. At present, due to (a) the similarities in material culture and contemporaneity between the sites in the Atlantic

coast and the mound sites in the interior wetlands and (b) the lack of bone isotope studies from human skeletal remains from the Atlantic coast of Rocha Province, it is reasonable to state that the Ceramic Mound Period groups did not rely intensively on marine resources.

### **Wetlands of India Muerta – The Los Ajos Site**

Serious archaeological investigations at the Los Ajos site began in 1993 with a joint project between Uruguay's National Museum of Anthropology (Museo Nacional de Antropología) and the United Nation's Biodiversity and Sustainable Development Program (PROBIDES- Programa de Biodiversidad y Desarrollo Sustentable) under the direction of Bracco. Between 1991 and 1992, Bracco and Nadal surveyed the northern sector of Sierra de los Ajos, including the Colina Da Monte (Figure 2.4) and Los Ajos sites (Figure 4.1-3), and produced preliminary maps of the mound complexes located in the northeastern sector of Sierra de los Ajos. As a result of this survey, Bracco (1993) noted: (a) the area presents the major concentration of mounds in the region and possibly in the mid-South Atlantic coastal area, (b) mound clusters are placed on top of hills and flattened spurs projecting into wetland areas in the northern end of the Sierra de los Ajos, and (c) the major density of mounds and largest multi-mound sites occur on the flat knolls that overlook the extensive wetland areas.

In 1993, Bracco excavated Los Ajos and produced a detailed topographical map of the central sector of the site (Figures 4.1-3). In describing the circular arrangement of mounds at Los Ajos, he noticed that the larger mounds (both in diameter and height) are positioned delimiting an open "plaza" area. As will be seen below, in Chapter 5, the closely spaced mounds that encircle the plaza area also are characterized by flat tops, beveled edges, and fairly quadrangular bases and tops. Bracco's (1993) excavation of this site consisted of a block excavation (9x4 m) in Mound Alfa, test units of 2x2 m in Mound Betha, and opportunistic test units in the off-mound areas of the site. From these excavations, only a brief preliminary report was written for PROBIDES (Bracco 1993), from which the information summarized below was obtained.

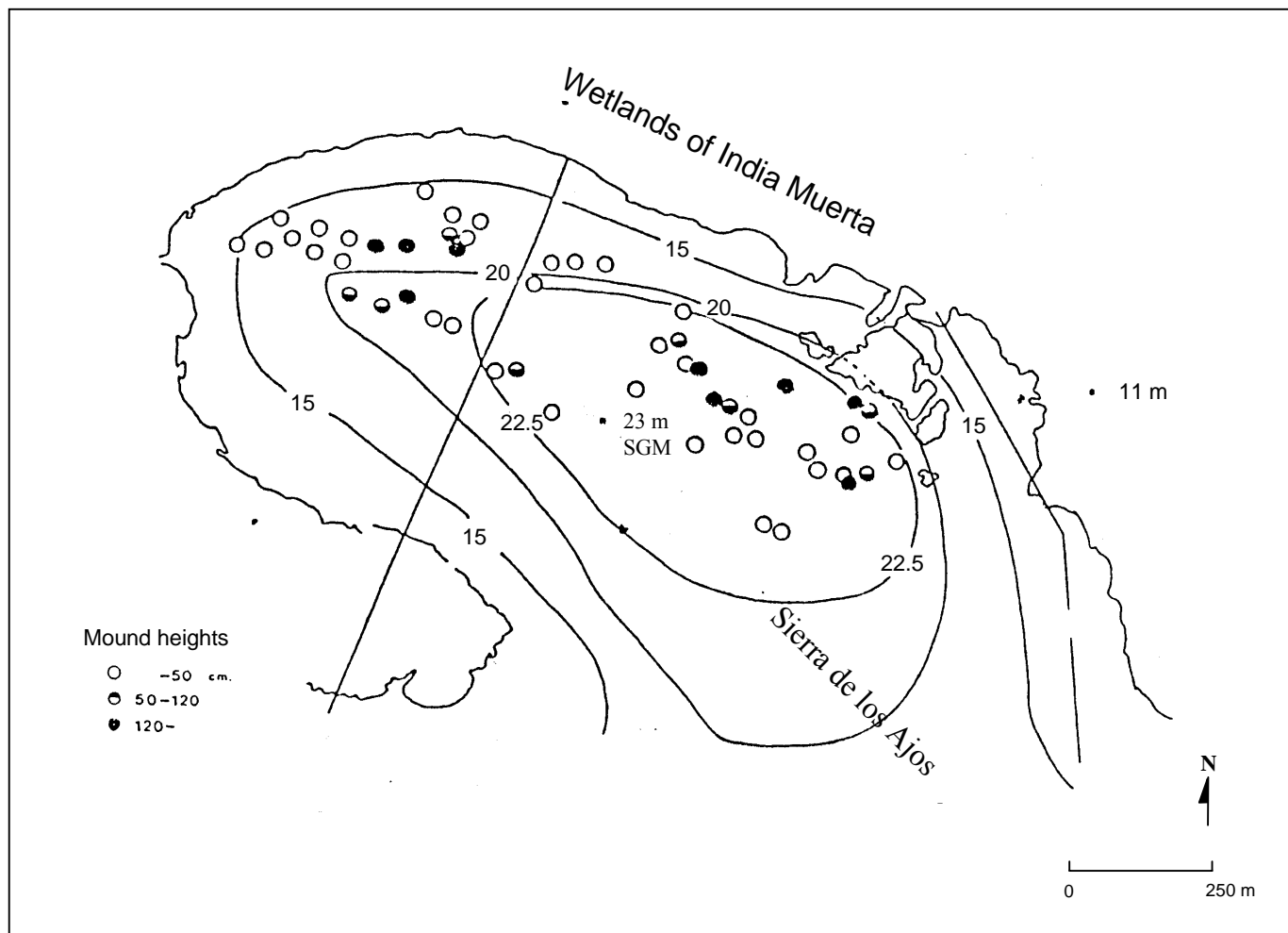


Figure 2.4. Colina da Monte Mound Complex (after Bracco 1993).

No detailed presentation of the stratigraphy of Mound Alpha was ever published. Bracco (1993) mentioned the presence of three distinct layers in terms of color and texture in Mound Alfa. He (op.cit.) only described the basal layer as: “The most clearly defined level corresponds to the last level –or basal level- of the mound. It is characterized by an ashy layer, presenting the highest concentration of charcoal (spread all over the unit, but with clear areas of aggregation), and a decrease in gravel content”.

The most important results of the excavations carried out at Mound Alfa was an assemblage of five radiocarbon dates from the lower component described above, dating between 3,550 and 3,950 bp (see Table 4.4) (Bracco 1993). Three of these dates were obtained from a hearth on top of which a milling stone base was located. The active face of the plant-grinding tool was turned down on the hearth. No complete burials were defined at Mound Alfa, but only the presence of a partial burial constituted by a fragment of a calvarium. The excavator also noted the low frequency of artifacts recovered from the excavation of Mound Alfa. The presence of a distinct Preceramic and Ceramic Component is not mentioned in the report. However, it is reasonable to assume a Preceramic Mound age for the basal component of Mound Alpha based on the 5 radiocarbon dates obtained from it and the similarities in color, texture, and artifact content that this component shares with the basal components excavated by the author in Mounds Gamma and Delta (see Chapter 4) as part of this study. Little information has been presented about the excavations carried out at Mound Beta except for the recovery of a partial burial, consisting of a fragment of a calvarium and two long bones located below two blocks of rhyolite.

On balance, the Los Ajos’ project was an important one. It constituted not only the first systematic survey of the northern end of Sierra de los Ajos, but also the first time a mound complex of such large size, internal complexity, and structural elaboration was ever excavated in Uruguay. The most significant outcome of this excavation was the suite of five radiocarbon dates obtained from the lower component of Mound Alfa, where Bracco demonstrated that the process of mound building started around 4,000 bp. Significantly, these new dates pushed back the chronology for the emergence of the “Constructores de Cerritos” from ca. 2,500 bp to 4,000 bp.

In addition, Bracco (1993) pointed out the marked differences that exist between the archaeological records of the previous small mound sites, excavated in the wetlands of San Miguel, and the large complex multi-mound sites. He observed two important distinctions about the small mound sites excavated by the CRALM. The first one was the rare presence of burials and the second one was the low frequency of artifacts recovered from mound contexts. Although he did not suggest a possible function or any particular use for these mounds, he stressed the need to reconsider the burial nature of these mounds and emphasized the value of carrying out more intensive excavations in the off-mound areas of these sites.

Despite Bracco's (1993) preliminary effort, before the current project, no accurate map of the entire site has been produced. Thus, little was known about the distribution of residential occupation at the site, and significant questions about the site's settlement nature and its occupation history remained unanswered. Although it is recognized that the wetlands of India Muerta display the oldest and best developed Preceramic Mound Component, as well as the largest and spatially more complex sites, many of which display recurrent circular/elliptical formal layouts, the work in the area has been preliminary in nature, limited in extent, and carried out with a methodology ill-suited to study settlement structure. I will return to this topic at the end of the chapter.

### **Sierra de San Miguel: The Isla Larga Site**

The Isla Larga site, CG14E01, is a multi-mound site located on the western extreme of the Sierra de San Miguel, surrounded by the wetlands of San Miguel (Bañado de San Miguel). The first excavations at this site were carried out by archaeologists Femenías and Bosh from the National Museum of Natural History (Museo Nacional de Historia Natural, hereafter NMNH) in 1976. The authors defined a Tupi-Guarani-like urn burial in an extended position and two disturbed burials in the upper part of the mound. The recent re-excavation of the central part of the largest mound (40 m in diameter and 3.8 m in height) exposed the longest continuous occupation of the site, dating from 3,600 bp to the historic period. One significant aspect of this site is the wide variety of burials that it contains, including the presence of late prehistoric period Tupi Guarani funerary urns, including Venetian glass beads, dating to the second half of the sixteenth century (Cabrera et al. 2000). The more recent excavations also identified the burial of seven individuals, corresponding to five adults and two children. There is one possible bundle

burial, three primary extended burials, and other skeletons which could not be properly identified because of their disturbed nature. It is noteworthy that stone blocks were placed on top of the burials recovered from the upper component of the site.

It is interesting to note that a similar pattern was found in the upper Ceramic Mound Component of two mounds at Los Ajos. López Piriz (personal communication 2000), an amateur archaeologist who excavated Mound 4 at Los Ajos, indicated that he found large stone blocks on the upper part of Mound 4 underneath where he found a burial. In a similar fashion several partial burials were defined below the large block that defined the stone structure recovered from the upper part of the Ceramic Mound Component (see Chapter 4).

The information on the material culture presented below was obtained from a preliminary report of the site provided by Cabrera and his colleagues (2000). The raw materials used by the inhabitants at the Isla Larga site are local. They include rhyolite, opal, tuff, and quartz; all of which can be found in a radius of less than 25 km from the site. The ceramics found were made of fine-sand and crushed quartz temper and conform well to the broadly-defined technological characteristics of the Vieira Tradition. Bone implements at the site were common and include mainly points and awls. The faunal assemblage recovered from the site is primarily composed of Pampas Deer (*Ozotoceros bezoartius*), Marsh Deer (*Blastocerus dichotomus*), otter (*Myocastor coypus*), apereá (*Cavia* sp.), and, in minor proportions, birds (including *Rhea americana* egg shells), fishes, lizards, and shellfish. Like other faunal assemblages obtained from the southern sector of the Laguna Merin basin (e.g., CH2D01 and Los Ajos), an important part of the assemblage consists of fragmented long bones of large mammals, possibly, deer. As will be described in more detail in Chapter 6, starch grain analyses carried out at Isla Larga documented the presence of maize, beans, and tubers, dating to the earliest basal levels of the mound around 3,660 bp (Iriarte et al. 2001). This evidence together with the one recovered from Los Indios, Estancia Mal Abrigo, and the paleobotanical studies carried out in this study at Los Ajos indicate that the early Formative cultures practiced a mixed economy.

### **Settlement Patterns and Human-Environment Interactions Models Proposed During this Period**

The former analysis of the settlement pattern in the southern sector of the Laguna Merin basin by Bracco (1992a) clearly indicated that mound sites were restricted to wetland areas. In

the early 1990s, the existing chronology marked the beginning of the mound-building cultures in the southern sector of the Laguna Merin basin by ca. 2,530 bp. Based on Bombin and Klamt's (1976) studies on the calcic horizon in southeastern Brazil, which recorded the presence of a dry episode in the area between 3,500 and 2,400 bp, Bracco (1992a) hypothesized that the onset of more favorable climatic conditions around 2,500 bp fostered the emergence of mound-building societies in the region.

In addition, the studies carried out by Gonzáles (1988, 1989) and Bracco (1992a) in the beach ridges left by the late Quaternary marine highstands, indicated that during the mid-Holocene, the distribution of wetlands in southeastern Uruguay was not only affected by climatic changes, influencing annual rainfall and temperature, but also by mid-Holocene marine transgressions. Radiocarbon dates obtained from the beach ridges of the Laguna de Merin and Laguna de Castillos indicate that the maximum transgression episode in the Holocene took place between ca. 4,390 and 5,210 bp (Bracco 1992a; Bracco et al. 2000d; Gonzáles 1989; Montaña and Bossi 1995) and reached 5 masl. At 3,000 bp, there was another marine highstand that reached 3 masl. These marine fluctuations are recorded at a continental and regional level both in Argentina (Gonzáles 1988, 1989; Gonzáles and Ravizza 1984; Gonzáles and Weiler 1982; Weiler 1994) and Brazil (Martin and Sugio 1989). I will return to these issues in the following Chapter 3.

### **Recent Archaeological Investigations in Uruguay: From 1996 to the Present**

From 1995 to 1996, the archaeology of the region received a new impetus as a result of two major events. The first one was Tom Dillehay's visit to Uruguay in 1995 to teach a seminar titled "The early Formative cultures of the Americas" and to participate in discussions with Uruguayan archaeologists about the archaeology of the region. The second one was the organization of the "International Symposium on the Lowlands" in 1996<sup>5</sup>, sponsored by the Ministry of Education and Culture's National Archaeology Commission (Comisión Nacional de Arqueología-Ministerio de Educación y Cultura), where a team of international scholars, notably,

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<sup>5</sup> "The International Symposium on Lowlands" was held in Montevideo, Uruguay in August 1996. Although the papers for this symposium were, for the most part, written in 1996, funding for the publication came through the Ministry of Education and Culture in 2000. As noted by Duran and Bracco (2000: 5), during the intervening years, there have been many new developments in the archaeology of the area and as a result, many of the discussions and debates proposed in the papers written in 1996 appeared in a different intellectual climate in 2000.



J. Brown, T. Dillehay, C. Erickson, A. M. Falchetti, G. Politis, A. Roosevelt, P.I. Schmitz, and R. Yerkes presented their research and discussed the emergence of cultural complexity in the lowlands across the Americas. This symposium created a broad comparative framework which contributed to extending our understanding of the emergence of mound-building cultures in the region. During the discussions on the early Formative cultures in southeastern Uruguay, one question was frequently raised: If all these earthen structures are ceremonial, where are the domestic sites of the populations supporting such an apparently large-scale ceremonialism? Particularly stimulating was Dillehay's comment (1995b:6) who pointed out that "... most mound sites, characterized by the presence of several mounds, may be a planned aspect of a village settlement interpretable as an expression in material form of key symbolic elements in the cosmology and social organization of the society which built and used them." This question became even more hastening when trying to explain the large mound complexes located in the freshwater, upper wetlands of India Muerta that bear formal and recurrent spatial arrangements, suggesting planned communities (Dillehay 1995b). The interpretive dilemma became even more problematic given the lack of archaeological examples in the region that could help explain the development of this type of intermediate-level societies.

### **Landscape Archaeology Approaches**

Concomitant with these new questions and developments, some researchers, mostly influenced by the works of Criado (1991, 1993), started to apply "Landscape Archaeology" approaches within a phenomenological vein (Bradley 1993, 1998; Tilley 1994) to interpret the archaeological record of the region (Gianotti 2000; López 1998, 2001; López and Gianotti 2003; López and Pintos 2000; Pintos 2000).

Four main projects emphasizing a Landscape Archaeology approach have been carried out in the southern sector of the Laguna Merin basin. These include (a) López and Pintos' survey in the Laguna Negra basin; (b) López' intensive excavation program at the Los Indios site in Arroyo de los Indios, (c) Pintos' survey and excavation program at Laguna de Castillos, and (d) Gianotti's excavation program in the Arroyo Yaguari wetlands in northeastern Uruguay (2000; Gianotti et al. 2003). These projects will be briefly described below.

### ***The Laguna Negra Basin: Sierra de los Difuntos and Potrero Grande***

In 1996, López and Pintos (2000) surveyed the hills surrounding the Laguna Negra basin, locally referred to as Potrero Grande and Sierra de los Difuntos. In the surveyed area, they distinguished two distinct patterns. In the Sierra de los Difuntos, they identified 14 sites, where 10 correspond to mound sites. In this area, all mound sites are isolated and placed on top of flattened knolls. Most of these mounds have a circular base, averaging 30 m in diameter, and do not exceed 1.5 m in height. Researchers carried out a few test units at these sites and found a low density of artifacts constituted only by some quartz flakes and one ceramic sherd. With regards to the location of the mounds on the landscape, they indicated that "... apparently the geoform behaved as a director map for the placement of mounds. The mounds are located on top of knolls from where it is possible to exert a situational control of vast areas of the lake as well as of the extensive palm forests that occur on either side of this hilly chain" (López and Pintos 2000:153).

In contrast, in the Potrero Grande area, researchers located 36 mounds arranged in a clustered pattern of 2, 3, and up to 10 mounds in each group. These mounds are larger (50 m in diameter) and taller (up to 3.5 m) than the ones found in Sierra de los Difuntos. The authors argue that given the complexity of these multi-mound sites, characterized by circular or horseshoe arrangements of structures in addition to the presence of a diversity of mound shapes, their construction may have entailed "planning and coordination of labor and energy" (López and Pintos 2000: 154). Furthermore, the researchers noted that at these mound complexes, the concept of "Cerrito" as an isolated unit of analysis is useless and does not allow researchers to adequately assess the complexity of these sites. Later, López (2001) argued that in the mound-complexes located on the hills and knolls of Sierra de San Miguel, Potrero Grande, Los Ajos, and Laguna Negra are associated with places of high visibility and highly productive zones, including wetlands, lagoons, palm forests, and streams.

### ***Los Indios Site***

Los Indios site is a multi-mound, multi-component site located over a tongue-shaped spur overlooking Arroyo de los Indios. The site is positioned in a strategic position that connects both Laguna Negra with the wetlands of San Miguel and the hills of Potrero Grande with Sierra de la Blanqueada. Los Indios has a total of four mounds. Two of which (Mound I and II) are

connected through a ramp facing a third one (Mound III), creating a central open space that opens up to the west. The fourth one (Mound IV) is a burial mound located on top of a knoll facing the other mounds, where thirteen burials were recovered. To the west of the mound cluster, the site exhibits two distinct ridges (see López 2001:247, Figure 7). The oldest Preceramic Archaic occupation at the site dates to ca. 5,000 bp and is represented by a buried A horizon below the mounds. According to López and Gianotti (1997; 2003), the development of mounded architecture and the appearance of a central plaza area took place around 3,000-2,500 bp. Based on chronology and stratigraphy, artifact density, and mound contents, these authors argue that it is during this time that Los Indios began to be partitioned into distinct areas. Mounds are interpreted as ceremonial/monumental in nature. The public spaces are represented by a central “plaza” area bearing the lowest artifact densities. The midden ridges (“micro-relieves”) contain the highest artifact densities and are interpreted as habitation areas.

Los Indios has been a key site to construct López’s (2001) (see below) regional periodization for the southern sector of the Laguna Merin basin. However, this chronological scheme overlooks the importance of older, larger, and spatially more complex Preceramic Mound Period sites in the wetlands of India Muerta. While a valuable addition to our understanding of the development of public/ceremonial spaces during the later early Formative period, Los Indios is too late a site to speak to the emergence of early Formative societies. I will return to this point in more depth at the end of the chapter.

### ***Laguna de Castillos: Cráneo Marcado Site***

Pintos carried out archaeological work in Laguna de Castillos in the context of “The Archaeology at the Craneo Marcado Site, Laguna de Castillos Basin Project” (“Arqueología en el Sitio Craneo Marcado, cuenca de la Laguna de Castillos”) from 1995 to 1996 funded by the National Archaeology Commission (Comisión Nacional de Arqueología). No final report of this project has been provided yet since Pintos is currently writing his dissertation with these data. The excavations carried out at the sites located in this basin have been briefly reported in Pintos (2000). Each one of the sites contains three mounds and their associated off-mound areas. At one site, Craneo Marcado, located in the northern sector of the Laguna de Castillos, Pintos (2000) defined two sectors, a stratified site located on top of an ancient beach ridge of the Laguna de Castillos and three low mounds aligned in an E-W direction, located on top of a knoll

overlooking the Laguna de Castillos, approximately 50 m from the other sector of the site. The components of the site date between ca. 2,930 and 3,050 bp. At Craneo Mercado's Mound B, Pintos (2000) recovered four burials accompanied by quartz cores and flakes, polished spheroids, and a pipe. He also recovered a fragment of a skull with cut marks and a phalange in a context characterized by the presence of abundant deer, nutria, and other mammal bones from the sector of the site located on the beach ridge. At the other site, Guardia del Monte, he obtained a basal date of ca. 4,600 bp, indicating that this site was contemporaneous with the earliest date obtained from the Cabo Polonio site (López 1993).

From the analysis of the spatial distribution of mounds in the Laguna de Castillos basin, Pintos noted the following patterns. First, he observed that all the mounds are situated on topographically prominent positions in the landscape. Second, he noted that it is possible to visualize all the other mound sites from each of one of these mound sites. Based on this evidence, he concluded that these two patterns create "basins of inter-visibility" ("cuencas de intervisibilidad"), which are associated with the environmental zones that have the largest aggregation of natural resources. In a very similar vein to López and Pintos (2000), Pintos (2000: 80) states that "the natural shape of the basin and the principal geoforms contained in it seem to act as a unit or director plan, which may have inspired the monumental semantization of this landscape". He conceives this as an "... active construction that based on the strategy of building earth monuments claims dots and lines (Ingold 1986; Criado 1993) in order to progressively close spaces in a landscape that became more divided" (Pintos 2000:81).

### *Arroyo Yaguari Wetlands*

This region comprises a vast wetland that extends over the floodplain of the Arroyo Yaguari, an affluent of the Tacuarembó River that flows into the Middle Negro River. These extensive marshes present a high concentration of mounds which are arranged in circular, linear, and combined circular and linear mound complexes (Camila Gianotti, personal communication 2002). The sites present both Preceramic and Ceramic components. Two radiocarbon dates from the basal layers of the Preceramic components of two mounds excavated in this region placed them between ca 3,200 bp (Gianotti et al. 2003) and ca. 3,170 bp (Sans et al. 1985). Though more work is currently underway, it appears that the Preceramic Mound Component of the mounds in this region is later than the one in the Wetlands of India Muerta.

### *Assessing Landscape Archaeology Approaches*

In general, López, Pintos, and Gianotti interpret the appearance of mounds as a major breakthrough in the history of hunter-gatherers in the region. The beginning of mound-building practices is perceived as an innovative behavior where these groups “show the intention” to monumentalize the landscape by constructing ceremonial/monumental architecture. In this regard, López (2001:237) views the beginning of mound construction as “...a novel cultural behavior of mid-Holocene specialized hunter-gatherers that started building mounds in strategic locations of the landscape previously characterized as hunting camps”. In this respect, he states that the first mounds are the “...product of Preceramic hunters-gatherers bearing high mobility who hunted in the region perhaps from the time of the first settlement of the region. One of the possible functions of these older mounds was to serve as territorial markers, built to signal and claim the rights of exploitation zones of the concentration of resources ... A complementary function of these mounds was to facilitate the orientation and travel of hunter-gatherers in this flooded landscape.” In a similar line of thought, Gianotti (2000:90) interpreted the earthen structures as monuments that represent the first evidence of “... an effective transformation of the natural environment, the narrowing of the breach that exists between nature and culture and the first attempt of this latter to prevail over nature.” At the Laguna de Castillos basin, Pintos (2000) suggested that the construction of mounds should be interpreted as the appearance of monumental architecture. More specifically, since mounds contain burials, they conform to a landscape “... fundamentally connoted by the monumentalization of the dead” (Pintos 1999: 78). Following Vincent (1991), Pintos views in the monumentalization of the death of certain individuals, the historic consolidation of a new social order where society places a major role on ancestors therefore reflecting a change from the classificatory to a lineage system of kinship relations (*sensu* Meillassoux 1978). Others, like Gianotti (2000: 94), interpret all earthen structures as monumental architecture, regardless of the presence or absence of burials. In her own words: “The absence of interments allows us to understand the emergence of non-funerary architecture that together with the mounds produces important ceremonial spaces.” These authors (López 1998, 2001; López and Gianotti 1997) adhere to the mode of “growth by layers” of mound construction and often provide loose analogies with the burial mounds built by the Kaingang of southeastern Brazil (Mabilde 1983) and the earlier investigations of Dillehay (1986, 1990, 1992a, 1995a) with the Mapuche of southern Chile. The problem with these analogies is

that the Kaingang burial mounds is that they are ceremonial spaces where geographically dispersed tribal populations come together to bury an important chief, host inter-group gatherings, foster group reciprocity, forge inter-group alliances or perform cyclical rituals. Consequently, these ceremonial sites are more places to be regularly visited and to practice cyclical rituals rather than long-term occupations. Furthermore, these sites are usually characterized by the presence of one prominent mound frequently associated with a ceremonial court (see Dillehay 1986, 1990, 1992a, 1995a; Mabilde 1983; Teschauer 1905; Willey 1971:447). Saving the cultural distances, these ethnographic examples could be a good analog for “informing our imagination” (*sensu* Binford 1987) about the plausible nature of single, isolated prominent mounds. However, the numerous mound complexes in the wetlands of India Muerta that this study investigates are well-planned villages and consequently, cannot be adequately interpreted using the aforementioned ethnographic analogies.

## **Recent Work in the Wetlands of India Muerta**

### ***Puntas de San Luis Site***

The Puntas de San Luis site is located in the upper course of the San Luis River (10 masl) and is surrounded by one of the largest extensions of palm forests. This locality is connected to the west with the wetlands of India Muerta through the Estero del Medio. The site contains 15 mounds, spread over 16 ha and arranged in a U-shape format oriented N-S. The mounds are circular in shape, averaging 35 m in diameter and with varying heights between 1 and 4.2 meters. Five radiocarbon dates obtained from the excavation of the central part of three mounds at the site place it chronologically between ca. 1,360 and 3,750 bp (Bracco and Ures 1999; Bracco et al. 2000d). This evidence corroborates the early dates for the Preceramic Mound Component documented at Los Ajos.

Bracco (2000b) conducted test excavations in five of the earthen structures and six test units in the adjacent off-mound areas. Eleven burials were recovered from these excavations. At Mound I, he defined two secondary burials. One burial comprises an isolated skull with a long bone and the other one is a secondary burial constituted by highly fragmented bones of an individual associated with a dog burial, a polished bone artifact, and quartz flakes. At Mound II, he recovered nine interments. One primary burial made of a slightly flexed individual and eight

secondary burials, where three are constituted by isolated post-cranial bones and the other five consist of a skull accompanied by one post-cranial bone, generally a long bone. No special grave goods were found accompanying these secondary burials and three of the skulls display evidence of scalping and defleshing (Pintos and Bracco 1999). An interesting aspect of the site is a lack of correspondence between the age of the skeletons and the sediments where these burials were defined. Radiocarbon assays on the sediments yielded dates between ca. 3,650 and 3,550 bp while direct conventional dates on the skeletons are substantially younger, between ca. 1,360, 1,390, and 1,470 bp. This evidence indicates that these individuals were interred in pits long after mound sediments were deposited.

Though no detailed analysis of the different artifact and ecofact classes has been published to this date, Bracco (2000b) noted that, in general, these mounds present low artifact densities, in particular, ceramics, and that the lithics and bones constitute most of the remains. Bracco and his colleagues (2000b) interpreted the high density of burnt anthill chunks in the upper layers of the mounds as a result of intentional firing of anthills by pre-Hispanic populations in order to use it as fill material to build the mounds. These authors suggest that the burnt anthill chunks may have allowed these earthen structures to reach a greater height without necessarily needing to enlarge the base of the mound. Bracco and his colleagues (2000b) believe that the same engineering concept was applied to the earthen structures built in the San Miguel and the Los Ajos sites (previously excavated by Bracco in 1993) where these societies used gravel as consolidating material instead of burnt anthill chunks.

The Puntas de San Luis site, which is generally contemporaneous with Los Ajos, share many similarities with Los Ajos. These include (a) a similar site layout, enclosing a central open area, (b) low frequencies of ceramics in mound deposits, (c) the excavations of these two sites indicate that at least, in the wetlands of India Muerta, the interment of individuals in mounds did not immediately start with the construction of the mounds, but began somehow later in the last part of the Preceramic Mound Period, and (c) more recent Ceramic Mound Components exhibit clear mound construction episodes. I will return to these points in Chapter 9 where Los Ajos is considered in regional context.

## **Aerial Photographic Survey of the Wetlands of India Muerta**

Recently, Bracco and his collaborators (1999) carried out a detailed study of the locality constituting the wetlands of India Muerta and Rincón de la Paja, covering an area of 1,100 km<sup>2</sup>. Through the use of aerial photography and ground-checking, they located 601 mounds. The study paid particular attention to the relationship among mound-sites, geomorphological units, and soil types. This study showed that in the southern sector of the Laguna Merin basin, the wetlands of India Muerta present the major aggregation of mound sites. Their analyses revealed a number of patterns. First, these authors noticed that mounds are strongly concentrated in two major geomorphological units: (a) the wetland floodplains and (b) the hills and knolls adjacent to these wetlands. In the wetland floodplains, mounds are isolated (47%) or in small groups of two to three mounds (33%). In this sector of the landscape, mounds are positioned on top of the most prominent levees, following the courses of streams, displaying a linear pattern (Figure 2.7a). On the hill and flattened spurs that overlook extensive wetland areas, mounds are concentrated in large, dense groups, ranging between 24 and 63 mounds. Estancia Mal Abrigo site (Figure 2.5), which was surveyed by the author, is one example of this large complex site. Bracco and his team identified more than 10 of these large, dense groups in the area. Besides, similar to the pattern observed by Copé (1991) in the Jaguarao River valley, Brazil, these authors observed that the mounds located in wetlands are generally taller (some of them reaching 5-7 m) and smaller in diameter (< 30m in diameter) and consequently, the earthen structures aggregated in large complexes on the knolls and hills are relatively lower in height and larger in diameter. Second and last, they found a strong positive correlation between mound complexes and highly fertile floodplain soils.

Despite this wealth of information, Bracco and his collaborators (1999) did not offer any interpretation of these newly discovered patterns. Although by that time, it became clear that the upper freshwater wetland of India Muerta presents the oldest and best developed Preceramic Mound Period occupations as well as the major aggregation of mound sites exhibiting recurrent circular/elliptical formal layouts, the archaeological investigations in the area were preliminary, limited in scope, and carried out with an ill-suited methodology to reveal settlement structure. Therefore, until now, basic questions the nature of settlement and occupational history of these large formally laid out multi-mound sites have remained unanswered, which in turn has



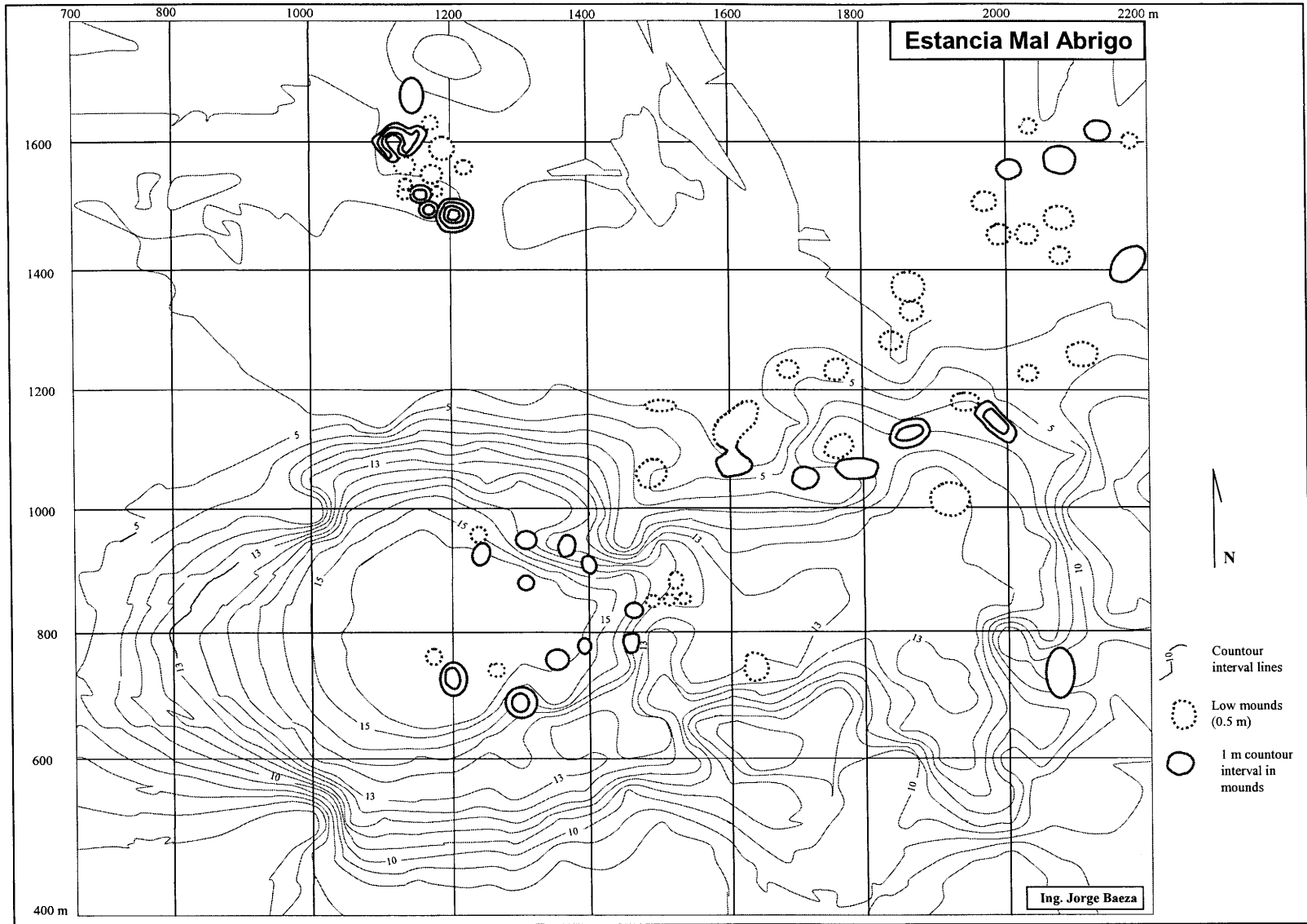


Figure 2.5. Estancia Mal Abrigo Mound Complex.

precluded archaeologists from postulating any theoretical or conceptual models about the societies that built these impressive sites.

The patterns identified by Bracco (1993) and Bracco and his collaborators (1999) were corroborated by my own preliminary work in the wetlands of India Muerta, which consisted of the analysis of aerial photography carried out by Eng. Juan Montaña, walk-overs of most of the important sites, and the intensive topographical mapping of Estancia Mal Abrigo (Figure 2.5) and Los Ajos (Figures 4.2). The map display in Figure 2.6 is based on the 1:50,000 topographical maps of the Servicio Geográfico Militar, the stereoscopic analysis carried out by Eng. Juan Montaña on 1:20,000 and 1:4,000 aerial photographs, earlier sketch maps of the northeastern sector of the Sierra de los Ajos done by Bracco (1993), and my own ground-checking and walk-overs on the sites. Several patterns emerged from this study. In the first place, through a more detailed inspection of the sites in the locality, it became clear that the circular, semicircular, and horseshoe geometrical arrangement of mounds, like Los Ajos, represents one of the most recurrent spatial grouping of mounds within multi-mound sites in the region. Moreover, some sites, for example, like Estancia Mal Abrigo (Figure 2.5), which are constituted by mound groups that occupy 60 ha within the site zone and are distributed into four major clusters. The same is true for Colina da Monte (Figure 2.4) consisting of at least two main mound clusters. The reconnaissance of other large multi-mound sites such as Campo Alto confirmed these observations. Similar patterns were found by Bracco and his collaborators (2000b) in the headwaters of Arroyo San Luis.

Secondly, although most of the sites display the recursive circular/elliptical/horse-shoe layout, there is considerable variability not only in the formal structure of the sites but also in the shapes of the mounds. Some of the most notable variations are presented below. To begin with, it is important to note that both in Los Ajos and Colina da Monte, the central mounds of the site, which flank the clear plaza area, are flat-topped, beveled-edged platform mounds fairly quadrangular in plan, while the most peripheral mounds are low, dome-shape, and circular. While most of the circular/elliptical/horse-shoe site layouts enclose a clear plaza area, in some sites, such as Colina da Monte, the plaza contains a central imposing mound (Figure 2.7b). Likewise, the dimensions and shapes of plaza areas vary from circular to elliptical, from being tightly enclosed by mounds, for example, like at Los Ajos, to larger and more open as in Puntas de San Luis.

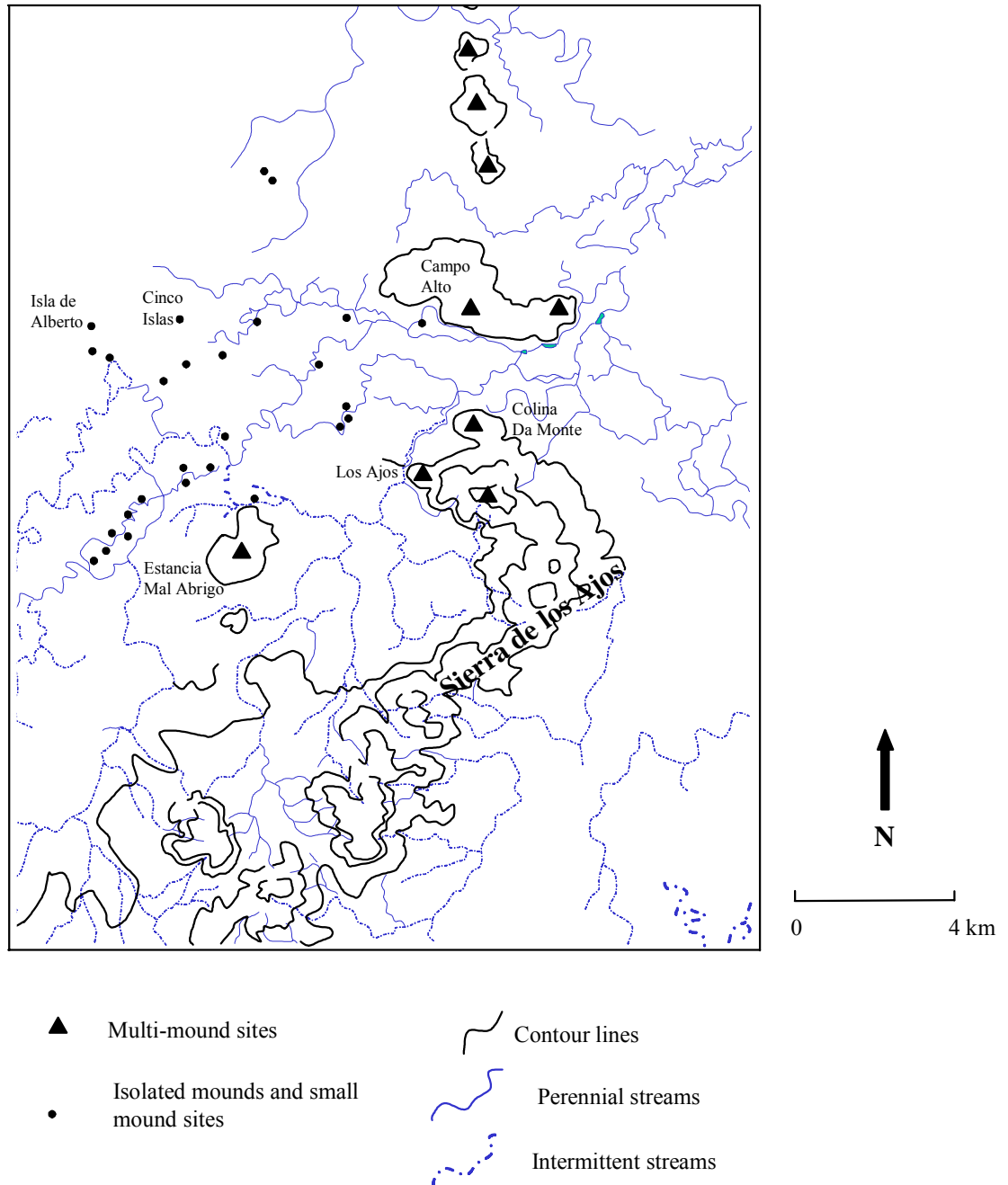


Figure 2.6. Preliminary Archaeological Map of the Eastern Sector Wetlands of India Muerta.



**a**



**b**

Figure 2.7. a: Mound in the Wetland Floodplain, Note Mounds on Top of the Levee of an Intermittent Arroyo; b: Central Platform Mound from Colina da Monte Mound Complex.

a



b



Figure 2.8. Isla de Alberto Site and Platform Mound Site in the Wetland Floodplain. a: Double-Platform Mound from Isla de Alberto, Long Axis of Mound (ca. 150 m), the Higher Platform is ca. 7 m Tall and the Lower is ca. 5 m Tall; b: a. Foreground: Platform Mound; Middle-Ground, Rice Plantation; Background, Patches of Mound Forest Indicating the Location of Isolated Mound Sites Positioned Along the Levees of Arroyo de la Coronilla



a



b

Figure 2.9. Cerrito de la Viuda and Cinco Islas Sites. a: Seven Meter Tall Conical Mound from Cerrito de la Viuda; b: Cinco Islas Site, Note the Circular Arrangement of Mounds in Combination with a Linear Arrangement Projecting to the SSW. (Aerial Photograph No. 183-205, 1:20,000/ Servicio Geografico Militar, Uruguay)



One other major site type represented in the region is the large platform mound that can reach 150 x 50 x 7m (length, width, and height, respectively) consisting of two well-defined platforms connected by a ramp. Figure 2.8a illustrate one of this sites called Isla de Alberto. Figure 2.9b show a platform mound site in the wetland floodplains. In the background of the picture, the patches of mound forest indicate the location of isolated mound sites positioned along the levees of Arroyo de la Coronilla. These sites are associated with two or three low dome-shaped mounds. Notably, most of these sites are oriented SE-NW with the highest platform located to the NW and the low mound positioned in the SE sector of these sites. Another site type is represented by the high conical mounds, for example, Cerrito de la Viuda (Bracco and Ures 1999) (Figure 2.9a), which can attain 7 m high. Other sites present combinations of circular with linear arrangements of mounds like the site called Cinco Islas (Figure 2.9b). This type of variation in site plans and mound types has also been observed by Gianotti (2000: 98, Figure 16) in the wetland of Arroyo Yaguari.

The differences among these sites may be representing temporal and regional variations that will only be resolved with more archaeological work. If the sites are contemporaneous, some of these sites may have been used as special-purpose ceremonial sites, such as the large platform mounds or the high conical mounds. Alternatively, it is possible that the large multi-mound sites represent nucleated villages and the small mound clusters represent hamlets. Similarly, the differences in site layout played out against a more ubiquitous circular/elliptical/horse-shoe format, which possibly reflect a shared worldview, may represent a local reinterpretation of these broader traditions triggered by individual or group agency. All these speculations represent a working hypotheses that deserve future testing as more regional data becomes available in the following years to come.

In the next chapter, I return to the discussion of settlement patterns in greater depth. In doing so, taking into account the different types of wetlands that occur in the region, the specific habitat characteristics and topographical features of particular wetlands areas, the role of climatic changes, subsistence changes as well as landscape archaeology.

### **A New Model of Mound Formation Processes**

Recently, based on the correlation between the sequences of radiocarbon dates and the mound stratigraphies from seven sites in the region (CH2DO1, CH1DO1, CH1D02, CG14E01,

Puntas de San Luis, Los Ajos, and Cerro de la Viuda) (Figure 2.3), Bracco and Ures (1999) challenged the model of “growth by layers”, proposing a new model of mound formation processes. They argue that mounds “grew” slowly and in a continuous fashion. Furthermore, these authors (op.cit.: 19) indicate that “... this constancy (of mound growth) is so extreme that when we plot chronology versus depth, we see that the data adjusts reasonably well to a line of regression and that often the correlation value is very high”. They also argue that as mounds grew and became higher, their equilibrium angles became unstable, thus the need to include increasingly coarse-sized materials such as burnt anthill chunks (Puntas de San Luis) or gravel (Los Ajos) to avoid their collapse. Arguing against the “growth by layer” model of mound construction, these authors stress the incongruence that exists between the direct dates on skeletons and the dates of the sediments found at Puntas de San Luis site. At this site, direct conventional radiocarbon essays on skeletons placed on sediments dating between ca. 3,650 and 3,550 bp yielded substantially younger dates between ca. 1,360, 1,390, and 1,470 bp, marking an “... important hiatus between the period of construction of the mound and the moment in which they (the mounds) were used as a place of interment” (Pintos and Bracco 1999:88). Last but not least, Bracco and Ures (1999), based on the dating of organic sediments extracted with an auger from a 7 m tall conical mound, extended the beginnings of mound building to around 6,000 bp. Using this new model of continuous growth means that the model of growth by layers and its implications for corporate labor need to be reconsidered. Moreover, the new data obtained from the wetlands of India Muerta call for a reexamination of the chronology of the area.

Regrettably, these authors do not mention any specific details about how the mounds “grow” or about their functional nature. As mentioned before, the limited scope of the archaeological investigations carried out in the upper freshwater wetlands of India Muerta have prevented researchers from addressing basic questions of settlement patterns and occupational history of the large, multi-mound sites. As long speculated by Dillehay (1995b), the novel data obtained from the community-focused archaeological investigations at Los Ajos presented in this study, indicate that the formal layout of the site represents a well-planned village incorporating a clearly demarcated central public space which denotes a group-level community (Johnson and Earle 1987). Furthermore, as will be suggested below, the recurrent presence of possibly contemporaneous formal geometrical layout (circular, elliptical, horseshoe) of multi-mound sites indicates the emergence of tribal societies in the region.



The results of this study at Los Ajos indicate that the Preceramic Mound Component in Mound Gamma is the result of the accretion of multiple overlapping residential occupations. The gradual deposition of domestic debris related to the continuous human occupation resulted over time in the formation of a dome-shaped occupational midden that was used as a platform for residential purposes. In this regard, the evidence provided by Bracco and Ures (1999) and the results of this study challenge earlier hypotheses that supported the view that mounds are monumental/ceremonial in nature. They also question the amount of labor invested in the construction of the mound and the organization required to build these earthen structures (see López 2000 and López and Gianotti 1997). It is difficult to conceive, at least in its early stages, that an earthen structure that “grows” 1 cm every 10 years could be an imposing and highly visible monument, which is the product of corporate labor (*sensu* Feldman 1985).

In addition, the archaeological investigations at Los Ajos as well as the study of Bracco and Ures (1999) and Pintos and Bracco (1999) also document that burials started to occur not in the beginning of the formation of the mound, but in the latter part of the Preceramic Mound Period. Overall, the data from the earliest Preceramic Mound occupations from the upper freshwater wetlands of India Muerta, which document the domestic nature of mounds that grew accretionally through the accumulation of midden refuse and the lack of burials in their lower Preceramic Mound Period layers, call into question the idea that mound-building began in association with the creations of ceremonial/monumental spaces (López 2001; Gianotti 2000) or the monumentalization of the dead (Pintos 2000).

### **New Approaches to the Study of Human-Environment Interactions**

During this period, Montaña and Bossi (1995) carried out a preliminary large-scale geomorphological map of the southern sector of the Laguna Merin basin. Together with the earlier work of Gonzáles (1988, 1989) and Bracco (1992a), this study allowed archaeologists (Bracco et al. 2000d) to clearly recognize the presence of three distinct types of wetlands in the area and their associations with the marine terraces left by the Late Quaternary marine highstands. As reviewed above, with the development of archaeological investigations in the region, the beginnings of early Formative societies were pushed back around 4,000 bp (Bracco 1993).

In light of this new evidence, Bracco and his colleagues (2000d) proposed a new paleoenvironmental model for the region. This more recent model was based on (a) extra-regional data provided by the studies on calcic horizons in Brazil (Bombin and Klamt 1976) and Argentina (Iriando and García (1993), (b) the radiocarbon dating of a calcic horizon in the Sopas Formation in northern Uruguay, which was dated to ca. 4,280 bp, and (c) differences in the value of  $\delta^{13}\text{C}$  in the carbonates of shells recovered from Laguna de Castillos' mid-Holocene marine terraces<sup>6</sup>. Their paleoclimatic reconstruction for the area could be summarized as follows. Between an indeterminate early Holocene date and 5,000 bp, the climate was hot and humid. From 5,000 and 2,500 bp, the climate was dry and cold and between 2,500 and 500 bp, the climate became humid and temperate. Based on this model, the authors indicated that when the early Formative cultures emerged, around 4,000 bp, wetlands were less widespread and less permanent than they are today. Concomitantly, the low-lying wetlands adjacent to the Laguna Merin were an unstable environment in the process of formation and subjected to marine tidal regimes. Following this model, they contend that wetlands expanded in extension during the more favorable conditions that started around 2,500 bp.

As will be discussed in detail in the next Chapter 3, there are many problems inherent in these records that prevent us from extrapolating this extra-regional paleoenvironmental information in order to reconstruct the climatic history in the study region and then to relate it to the emergence of early Formative cultures in southeastern Uruguay. In chapter 3 and Appendix 2, this study offers new data and interpretations to address this complex problem.

### **Regional Chronological Sequence by López (2001)**

More recently, López proposed a tripartite regional sequence<sup>7</sup> for the region based on all the information gathered in Uruguay since the start of the CRALM program. The sequence begins with the Preceramic Archaic Period, which in southern Brazil is associated with the broader Umbu Tradition. In Uruguay and in the southern sector of the Laguna Merin basin, this period is the least understood because of the dearth of investigations and the fact that to date,

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<sup>6</sup> It must be noted that the study of shell-carbonate isotopes, although mentioned by Bracco and his colleagues (2000c), has not been published yet, making it difficult for the scientific community to evaluate their work.

<sup>7</sup> A complete list of all the radiocarbon dates available for the southern sector of the Laguna Merin basin can be found in López (2001: 242, Table 1).

deeply stratified Preceramic Archaic sites have not been found. Although López did not provide a precise date for the beginning of the Preceramic Archaic, we can tentatively place it between the Late Pleistocene and the Early Holocene, assuming the peopling of this part of the continent at this time. This period ends with the beginning of the early Formative ca. 4,190 bp. The Preceramic Archaic Period is generally found in the buried A soil horizon on top of which the construction of the mound started. In the southern sector of the Laguna Merin basin, this level is represented at Los Indios, in the wetlands of the San Miguel stream at CH2D01 and CH1D01, and at Los Ajos in the wetlands of India Muerta (see Chapter 4).

The early Formative period, begins with the Preceramic Mound Period, between ca. 4,190 bp until the first appearance of ceramics between 3,000 and 2,500 bp. Bracco and Ures (1999) obtained a date of  $5,420 \pm 260$  bp (URU 014) from the bottom of the “Cerrito de la Viuda” Mound, a conical, 7 meter tall mound (Figure 2.9a). The date was run on organic sediments from a soil column extracted with a soil auger from the center of the mound. This early date may push back the beginnings of the Preceramic Mound Period, however, until more reliable dates from secure contexts are obtained, I assigned the beginnings of the PMP the date of 4,190 bp based on the earliest date of Los Ajos, which marks the beginning of the early Formative.

López (2001) notes that the lithic industry of this period is characterized by a high diversity of raw materials, many of which are not local and exhibit bifacial reduction, pressure flaking, and high rates of maintenance. This period also is characterized by abundant bifacial projectile points, bola stones, and nut breaking stones. López (op.cit.) argues that the lithic industry of the Mound Preceramic Period is similar to the one found in the Preceramic Archaic Period. The faunal assemblages from this period indicate that these societies exploited deer, marine mammals, small and medium terrestrial mammals, fishes, foxes, and wildcats. López (2001) further argues that the exploitation of the *Butia capitata* palm became intense from the start of this period and that it has during this period that the seasonal exploitation of marine resources also began. In the southern sector of the Laguna Merin basin, this period is well-represented in (a) the floodplains of the wetlands of India Muerta (Bracco y Ures 1999), (b) the flat knolls that surround the wetlands of India Muerta (Bracco 1992a, Bracco y Ures 1999; see Chapter 4), (c) the western sector of Sierra de San Miguel at the Isla Larga site (Cabrera 1999), (d) the site of Potrerillo in the Potrero Grande area (López and Castiñeira 1997), (e) the Castillos

Laguna (Pintos 2000), and (f) is associated with the Atlantic coast at the site of Cabo Polonio (López 1995). In other areas of Uruguay, we know with certainty, that this period is clearly represented in Arroyo Yaguari (Sans et al. 1985; Camila Gianotti, personal communication 2003). Unfortunately, neither Prieto and his colleagues (1970) in Treinta y Tres nor Santos (1965, 1967) in Rivera, clearly indicate if the mounds in these two regions contain a Mound Preceramic Period. In the neighboring region of southeastern Brazil, the Mound Preceramic Period is present in Camaqua (Lagoa Phase), Rio Grande (Patos Phase), Santa Victoria do Palmar (Chui Phase), and the Jaguaroa River valley.

The Ceramic Mound Period starts with the adoption of ceramics by these groups around 3,000-2,500 bp. López (2001) stated that during this period significant changes took place. First, as the waters from the last mid-Holocene marine transgression receded, the wetlands below the 5 masl, such as the low floodplains of the San Miguel wetlands, witnessed a more intensive occupation. Second, he indicates that there is a change towards a mixed economy, characterized by the adoption of cultivars, notably, maize, beans, and squash. This change took place in conjunction with the acquisition of new technological innovations, including ceramics, the use of microliths, and an increase in the reliance on local raw materials. Thirdly, he argued that there was a demographic increase and reduction in the residential mobility of these groups. Fourthly, he contends that this period marks the beginning of monumentalism, evidenced by the presence of more earthen structures, the increase in volume of some structures, and the intensification of funerary activities. Last but not least, López proposes that during the Mound Ceramic Period there is an increase in the internal structure and complexity of sites. This latter aspect is evidenced in the appearance of domestic habitational sectors in mound sites, the remodeling of earthen structures, for example, the building of ramps, and the fact that some sectors of the site become more restricted to ceremonial activities. He noted that this pattern is well exemplified at Los Indios with the appearance of public spaces with ceremonial monumentalism around 800 bp, suggesting a higher degree of social integration (López 2001: 238).

To briefly anticipate the results of this study, the new data from the wetlands of India Muerta and in particular, the data obtained from the excavations at Los Ajos does conform well, in many aspects, with the regional sequence presented by López (2001). In the first place, we need to indicate that the southern sector of the Laguna Merin basin encompasses a great number of sites spread out over a large region and distributed over a wide span of time. Therefore, the

different characteristics that each sites exhibit are probably the result of temporal and regional variations. López's model, for example, is mainly based on the locality of Los Indios corresponding to the wetlands below 5 masl. As indicated before, mound construction at Los Indios is far too late to address the initial use/function of these earthen structures in the region.

Both at Los Ajos and Punta de San Luis funerary activities appeared and became more intense during the last part of the Preceramic Mound Period. Similarly, at both Los Ajos and Punta de San Luis, the Ceramic Mound Components witnessed the remodeling of earthen structures. For example, Los Ajos Mound Gamma experienced, for the first time, filling episodes and a change in shape from a fairly low dome-shape mound to a tall, flat-topped, beveled-edged, quadrangular mound (Chapter 4). However, the appearance of mounds at Los Ajos during the earlier PMC was indeed a novel aspect of the archaeology of the region, but its primary use was residential and not ceremonial/monumental. Indeed, the earliest Preceramic Mound occupation was domestic and direct evidence for monumental mound construction during this component is currently lacking. However, during the Ceramic Mound Period, though the central mounds continue to serve for residential purposes, Los Ajos acquired a strong public ritual nature characterized by the formalization and spatial differentiation of its inner precinct.

López (2001) indicates that the adoption of cultigens took place during the CMP around 2,500 bp, however, based on the microfossil botanical data from Los Ajos, Isla Larga, Estancia Mal Abrigo, and Los Indios, the adoption of cultigens took place shortly after the earliest occupations of the Preceramic Mound Period and well before the adoption of ceramics (Iriarte et al. 2001; see Chapter 6). Similarly, the lithic analysis of Los Ajos shows discontinuity between the Preceramic Archaic and the Preceramic Mound periods indicated by a slight change to a more expedient technology both in the formal and informal tools (Chapter 5). The results of Los Ajos agrees with the general trends proposed by López regarding (a) a major reliance on a mixed economy during the Ceramic Mound Period (see Chapter 6), (b) a more intense residential occupation of the site, which is reflected in the build up of midden refuse areas; and (c) given the current paleoenvironmental evidence, it is reasonable to suggest that a more intensive occupation of the lower wetlands (below 5 masl) took place as the water from the marine highstand receded and these areas become dry, more stable, and started to be converted into fresh-water marshes.

## **Main Research Questions Proposed in this Study**

As should be apparent from this historical overview of the archaeological investigations carried out in the mid-South Atlantic area, this is a vast and environmentally diverse area with a long and complex history of human occupation. The goal of this section is to examine three interrelated and interdependent topics germane to this study region, notably, theoretical and methodological approaches and its environmental history.

## **Conceiving the Early Formative Cultures of Southeastern Uruguay as Intermediate-Level Societies**

As discussed in Chapter 1, given the heterogeneity that early Formative societies in the Americas exhibit in terms of economic, social, and political aspects, traditional neo-evolutionary and oppositional concepts of non-stratified societies cannot capture the degrees and kinds of variation that early Formative societies display. Because at this point a more precise definition of the social formations characteristic of the early Formative period in the region must await more detailed archaeological investigations, it is appropriate to embrace a broad characterization of intermediate-level societies; one that separates itself from rigid classificatory approaches permitting us to explore the heterogeneous nature of intermediate-level societies. A broad conceptualization of tribal societies like the one recently “resurfaced” by Parkinson (2002) and Fowles (2002) is useful to accommodate the organizational variability that intermediate-level societies display in terms of economic, social, and political aspects. By focusing on both aspects, the organizational variability and history, these authors move away from comparing types to an emphasis on comparing historical trajectories. This more encompassing concept of intermediate-level societies is useful to separate complexity from hierarchy; allowing us to explore the variety of fluid “lateral” mechanisms that structure and organize intermediate-level societies, such as kinship, ideology, among others. Under this more flexible framework, we move away from the dilemma of forcing some cultures into rigid oppositional categories of complex or simple societies and begin to explore and explain variability. Paraphrasing Nelson (1995), this flexible interpretative framework allows us to explore not just how complex these societies are, but more importantly, how these societies are complex.

## **The Study of Community Organization**

It has become clear with the more recent archaeological investigations in the southern sector of the Laguna Merin basin and in particular, in the wetlands of India Muerta, that the archaeological sites located in the upper freshwater wetlands (located above 10 masl) display several important characteristics that are key to understanding the emergence of early Formative societies in the region. In the first place, it presents the oldest and best developed Preceramic Mound occupation in the area. Although at present we lack extensive comparative data from similar mound complexes in the region, there is mounting evidence indicating that the upper freshwater wetlands in the southern sector of the Laguna Merin basin began to be more intensively occupied during the mid-Holocene. Currently, there are four sites with absolute dates for the Preceramic Mound Component ranging between ca. 4,190 and 2,960 bp. At Los Ajos site, we have a suite of eight radiocarbon dates, which date the PMC between ca. 4,190 and 2,960 bp (Bracco 1993; Chapter 4). The upper part of the PMC at Puntas de San Luis, Mound II, dates between ca. 3,730 and 3,550 bp. The Isla Larga site basal preceramic level presented a date of ca. 3,660 bp. Cerrito de la Viuda, a 7 m tall conical mound, has an early date from its basal level (7 m below surface) obtained from sediments extracted with an auger, ca. 5,420 bp, and two additional dates of ca 3,590 (4 m BS) and 2,710 bp (2.5 m BS) (Bracco and Ures 1999). More investigation and stratigraphic excavation from this site are needed to confirm this early date. In addition, limited test excavations carried out by the author at the Estancia Mal Abrigo site document the presence of a deep Preceramic Mound Component in two mounds at this site (see Figure 2.3).

Furthermore, the upper freshwater wetlands of India Muerta exhibit the main aggregation of mound sites in the region (Bracco 1993; Bracco et al. 1999; Bracco et al. 2000a). In the third place, many of the sites are large, multi-mound ones that have a recurrent circular, elliptical, spatial arrangement (e.g., Los Ajos, Colina da Monte, Estancia Mal Abrigo, Cinco Islas). In the fourth place, Bracco and his collaborators (1999) have noted that the location of these large, multi-mound sites is not random, but highly selective in strategic places of the landscape. In their aerial photographic survey of the wetlands of India Muerta and Rincon de la Paja, they showed how in the wetland floodplains, mounds are isolated (47%) or in small groups of two to three mounds (33%), positioned on top of the most prominent levees, following the courses of

streams, thus, displaying a linear or curvilinear pattern. In contrast, on the hill and flattened spurs that overlook extensive wetland areas, mounds are concentrated in large, dense groups, ranging between 24 and 63 mounds. Bracco and his team identified more than 10 of these large, dense groups in the area. Last but not least, Bracco and his collaborators (1999) found a strong correlation between mound complexes and highly fertile floodplain soils.

A similar type of settlement pattern seems to be the case for areas surveyed in southern Brazil and northeastern Uruguay. A close inspection of the regional archaeological maps of the mid-South Atlantic further supports the idea that the upper freshwater wetlands were intensively occupied during the Preceramic Mound Period. The regional surveys carried out in southern Brazil in Camaquá (Rutschling 1989: Map 3), Jaguarao River valley (Copé 1991: Map 2), Bage and Don Pedito (Brochado 1984) and in Uruguay in Treinta y Tres Province (Prieto et al. 1970) and Arroyo Yaguari (Gianotti 2000) clearly mark the aggregation of mound sites in the upper interior wetlands that are close to the headwaters of major streams that flow into the Laguna Merin and the Lagoa dos Patos. In the absence of archaeological excavations and indeed, of site chronologies, we are currently unable to offer a more conclusive generalization about the more intensive occupation of the upper freshwater wetlands during the mid-Holocene in the mid-Atlantic area. However, the more intense occupations of the upper interior freshwater wetlands and the presence of deep Mound Preceramic occupations, recorded at some of these regions, notably, the Jaguarao River valley (Copé 1991), suggest that these sectors of the landscape along the mid-Atlantic region were privileged locations for human occupation.

In contrast, the areas immediately adjacent to these lagoons' shorelines, which are located below the 5 and 3 masl mid-Holocene marine terraces, contain thinner Preceramic Mound occupations. Evidence indicates that these lower sectors of the landscape were unstable and covered intermittently by the waters of marine transgressions. It was only after 3,000 bp, when the sea-level receded, attaining its present level that these zones were more intensively occupied, as reflected in the well-developed Ceramic Mound Component at CH2D01, CH1D01, and Los Indios.

As has already been reviewed before, although PRONAPA researchers acknowledged the presence of mound clusters in the different regions studied (see Camaqua, Bage, Don Pedito, Jaguarao River valley, Treinta y Tres), they did not study the spatial arrangements of mounds in detail. In most of the cases, they reduced the unit of archaeological analysis and interpretation to



the data provided by individual mounds rather than emphasizing the study of community organization. A similar situation occurred in the southern sector of the Laguna Merin basin in Uruguay, where most studies have been preliminary, limited in scope, and carried out with a methodology inappropriate to study community patterns. Overall, this has hampered recognition of community patterns, consequently offering a skewed picture of the complexity and variability of factors involved in the emergence and development of early Formative societies in southeastern Uruguay.

This is unfortunate because the large mound complexes in the wetlands of India Muerta exhibit integrated site plans, constituting ideal sites to study community patterns. In particular, the formal layout of my study site, Los Ajos, lends itself to the study of site formation and internal spatial organization. The formal layout of Los Ajos and many of the multi-mound sites in the wetlands of India Muerta is indicative of the presence of a group-level community. The formal circular/elliptical structure of these sites denotes a form of social organization that reveals some degree of social integration beyond the household level (Johnson and Earle 1987; Kolb and Snead 1997). Therefore, a community-focused study is particularly appropriate in order to investigate Los Ajos. In archaeology, community organization studies concentrate on the consistent practices or interactions between community members within the same spatial location. These recurring practices create archaeologically recognizable material patterns in spatially restricted locations which structure and reflect interactions (Joyce and Hendon 2000:143; Yaeger and Canuto 2000:11). Consequently, community-focused studies can provide insight into the dynamics of identity, social organization, and socioeconomic integration. Moreover, the study of community organization directly relates to how people construct and use space. In other words, the study of community organization serves as an “entry point” in order to examine the dynamics of early Formative societies in southeastern Uruguay.

The analysis of community organization at these sites also is crucial to understanding the complex nature of these sites and properly assesses the cultural complexity of early Formative societies in southeastern Uruguay. Important questions crucial to unravel the nature of the large multi-mound sites in the area have remained unanswered until now. Notably, what do these large, formally laid out multi-mound sites, encompassing tens of mounds and covering dozens of hectares represent? Are they well-planned villages, vacant ceremonial centers, or do they

represent villages with public/ceremonial spaces? What are the formation processes and functions of these mounds? Are they residential, burial, or ceremonial in nature?

The study reported here attempts to throw light into these questions by carrying out a community-focused study at Los Ajos site and employing an excavation program specifically tailored to reveal settlement structure. The methodology and results of the archaeological investigations carried out at the site are described in Chapter 4.

### **The Transforming Landscapes of the Mid-Holocene**

The role of the changing mid-Holocene environment in the emergence of early Formative societies in southeastern Uruguay has long been hypothesized (Bracco 1992a, Bracco et al. 2000d, López 1998). Although major advances have been made on the documentation of the mid-Holocene marine transgressions, we lack, until now, a locally based, precise paleoclimatic reconstruction for the area. As summarized above and presented in more detailed in the next chapter, archaeologists in the region have long speculated about human-environment interaction during the mid and late Holocene based on the uncritical extrapolation of paleoclimatic records from Brazil and Argentina (Bracco 1992a, Bracco et al. 2000d, López 1998). These records present many inherent problems to reconstruct past climate in southeastern Uruguay. To rectify this problem, as part of this dissertation, I carried out a multidisciplinary project designed to reconstruct the paleoclimatic record of the mid-Holocene in southeastern Uruguay. To achieve this, I employed the paleoecological methods of core-drilling and the combined pollen and phytolith records from a core obtained in the wetlands of India Muerta, Rocha Province, Uruguay. These data generated the first combined 14,810 bp pollen and phytolith record for Uruguay. It revealed that the unstable and dry climatic conditions of the mid-Holocene triggered important changes in settlement and subsistence patterns, which gave rise to the emergence of early Formative societies in this region, the consideration of which is the subject of the next chapter.

## **Chapter 3**

# **Changing Mid-Holocene Landscapes and the Rise of Early Formative Societies in Southeastern Uruguay**

### **Introduction**

The dynamic interactions between human populations and their changing physical environments have played a major role in the development of early Formative societies in the Americas during the mid-Holocene<sup>8</sup> (Aldenderfer 1999; Anderson 1995; Bray 1995; Brown 1985; Brown and Vierra 1983; Carr and Gibson 1997; Damp 1984b; Dias 1992; Erickson 1995; Hamilton 1999; Lathrap et al. 1977; Plazas and Falchetti 1987; Sandweiss et al. 1999; Stothert 1985, 1992). A recent review of mid-Holocene climatic changes by Sandweiss and his collaborators (1999: 499) suggests that during the mid-Holocene "... the earth climate was highly variable in comparison with the immediately preceding and succeeding millennia." However, as these authors recognized (op.cit.: 500), these changes were neither global nor synchronous in the different regions of the world. Therefore, the connections between climate and culture change need to be addressed in a case-by-case study with high temporal resolution and precise dating.

It is becoming clear that in order to understand the emergence of early complex societies, we need to focus on both the relationships between humans and global and local climatic changes as well as on how early Formative societies locally managed the environment to meet their needs (e.g. Crumley 1994; Ashmore and Knapp 1999; Feinman 1999). To this end, paleoecological data from "off-site" contexts such as lake and wetlands, which contain identifiable microscopic prints of both global and local climatic changes and vegetational disturbance by humans, coupled with archaeological "on-site" data are helping archaeologists to understand the complex interplay between changes in the physical environment and the cultural responses to them (e.g., Deham et al. 2003; Kolata 2000; Piperno and Pearsall 1998a; Pohl et al. 1996; Schmidt 1994).

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<sup>8</sup> The mid-Holocene is broadly defined as the time period between 8,000 and 3,000 bp.

Wetland areas have constituted one of the main environmental settings where the early Formative cultures of lowland North and South America developed among populations of complex hunter-gatherers (Brown and Vierra 1983; Brown 1985; Gibson 1994, 1996; Saunders et al. 1994, Saunders et al. 1997; Bracco et al. 2000a and d; Carr and Gibson 1997; Iriarte et al. 2001; Spencer 1994; Roosevelt 1999; Nelson 1999).

The early Formative cultures of southeastern Uruguay represent an ideal scenario to study the dynamic interaction between humans and the environment in wetland ecosystems. As reviewed in the preceding chapter, prior and ongoing research projects in the area indicate that the pre-Hispanic populations that lived in southeastern Uruguay experienced marked changes in settlement, subsistence, and technology. These are characterized by an aggregation and circumscription of populations in wetland areas, the adoption of a mixed economy, and a gradual change to a more expedient lithic technology (López and Bracco 1992, 1994; Bracco 1992a; Bracco et al. 2000a; Pintos 2000; Iriarte et al. 2001). Unfortunately, lack of paleoenvironmental data during this transition has hampered researchers from an adequate understanding of the role that human-environment interactions played in the development of early Formative societies. The multidisciplinary paleoecological study presented in this chapter, a 14,810 bp combined pollen and phytolith record obtained from the analysis of a sediment core extracted from the wetlands of India Muerta, was designed to fill in this vacuum of information in order to foster an integrated view of human-environment interactions during the mid-Holocene in southeastern Uruguay.

In the following section, I offer a brief summary of the paleoenvironmental investigations in South America and in particular, in southeastern South America. In doing so, I summarize the problems inherent in extrapolating paleoenvironmental data from other areas; stressing the need to carry out locally-based research such as the one pursued in this study. Before presenting the results of the collaborative paleoecological study, a summary of the geographical setting and environmental characteristics of the study area is provided. First, I outline the general geographical setting of southeastern South America. Second, I offer a description of the study area, the southern sector of the Laguna Merin together with information on the particularities of its modern climate, vegetation, fauna, geomorphology, soils, and a review of the importance of wetland resources.

Following this, I present a summary of the environmental history of the region (see Appendix 2 for more detailed information). Finally, the concluding section examines human-environment interactions during this crucial period in southeastern Uruguay.

### **The of Mid-Holocene Climate in South America**

Paleoenvironmental studies in many regions of South America indicate that a dramatic period of environmental change, characterized by increased dryness, unfolded during the mid-Holocene. However, this period of environmental change differs in its timing and severity from region to region depending on the latitude and total rainfall of sites (*Western Amazon*: Bradbury et al. 1981; Bush and Colinvaux 1988; Liu and Colinvaux 1988; Piperno 1990; Behling et al. 1998; Athens and Ward 1999; *Central Amazon*: Piperno and Becker 1996; *Eastern Amazon*: Perota and Botelho 1990; Martin et al. 1993; *Southeast Amazon*: Absy et al. 1991; Martin et al. 1993; *Central Brazil Cerrados*: Ledru 1993; Ledru et al. 1996; Alexandre et al. 1999; Salgado-Laboriau et al. 1997; Turq et al. 1997).

In southeastern South America as well as in some other regions in South America, different studies report the presence of a period of dryness. However, these studies do not agree on the onset, duration, and severity of it. In southeastern Brazil, Bombin and Klamt (1976) recorded the presence of a dry episode in the area between 3,500 and 2,400 bp based on the presence of calcic horizons in hydromorphic soils from the Formación Hormiga. A recent synthesis of the Late Quaternary pollen record from south (including Rio Grande do Sul, Santa Catarina, and Paraná states) and southeastern Brazil (including Sao Paulo, Minas Gerais, Rio de Janeiro, and Espiritu Santo states) by Behling (2002) indicates that the early and mid-Holocene were characterized by warm and dry climates during which grassland formations prevailed. This author argues that a change to wetter climatic conditions, indicated by an expansion of Araucaria forests, took place between 6,000 and 5,000 bp in southeastern Brazil, and later, around 3,000 bp in southern Brazil.

In Argentina, Gonzáles and Weiler (1984) inferred that an arid period began about 5,000 bp based on the presence of calcic horizons in soils in the San Luis Province of Argentina. Stratigraphic and geomorphological studies carried out by Iriondo and García (1993) recorded that this episode began ca. 5,000 bp and lasted until 3,500 bp in northeastern Argentina. Recent

studies in the same area (Kröhling and Iriondo 1999; Iriondo 1999) based on clay mineralogy indicate that this dry period occurred between 3,500 and 1,400 bp. The palynological study conducted by Prieto (1996) from several locations in the Pampa grasslands of Argentina recorded a period of dryness between 8,000 and 6,000 bp.

Until now, no paleoenvironmental studies have been carried out for the mid-Holocene period in Uruguay. This vacuum of information has been filled in with the extrapolation of data from the climatic history of the adjacent regions of Argentina and Brazil (Bracco 1992a; Bracco et al. 2000d). In the early 1990s, when the existing chronology marked the beginning of the mound-building cultures in the southern sector of the Laguna Merin basin around 2,500 bp, Bracco (1992a) based on the work of Bombin and Klamt (1976), hypothesized that the emergence of these cultures was related to the onset of more hospitable climatic conditions around 2,500 bp after the postulated dry period that lasted between 3,500 and 2,400 bp ended. As more archaeological investigations were carried out in the region, the beginnings of these early Formative societies were pushed back around 4,000 bp (Bracco 1993). Later Bracco and his colleagues (2000d) proposed a new paleoenvironmental sequence for the region based on (a) the regional models of Bombin and Klamt (1976) for southern Brazil and Iriondo and García (1993) for southern Argentina, (b) the presence of a calcic horizon on the Sopas Formation in the north of Uruguay dated to ca. 4,280 bp, and (c) differences in the value of  $\delta^{13}\text{C}$  in the carbonates of shells recovered from the Laguna de Castillos' mid-Holocene marine terraces<sup>9</sup>, which could be summarized as follows. Between an indeterminate early Holocene date and 5,000 bp the climate was hot and humid; between 5,000 and 2,500 bp, the climate was dry and cold; and between 2,500 and 500 bp, the climate was humid and temperate. Based on this model, the authors indicate that when the early Formative cultures emerged by 4,000 bp, wetlands were less widespread and less permanent than they are today. Concomitantly, the low-lying wetlands adjacent to the Laguna Merin were an unstable environment subjected to marine tidal regimes as a result of the mid- and late-Holocene marine fluctuations. Following this model, they contend that wetlands expanded in extension during the more humid favorable conditions that started by 2,500 bp. Nonetheless, the connection between their proposed paleoenvironmental sequence and the emergence of early Formative societies in the region was left unspecified.

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<sup>9</sup> It should be noted that the study of shell-carbonate isotopes, mentioned in Bracco and his collaborators (2000c) has not been published yet. Consequently, a proper assessment of the implications of these data is tentative.

There are many problems inherent in these records that both hamper archaeologists from extrapolating this paleoenvironmental information to reconstruct the climatic history in the study region and relate it to the emergence of early Formative cultures in southeastern Uruguay. First, timing differences for this period in this extensive area (28-38° S) may correspond, as in many other parts of South America, with differences in latitude, total annual rainfall, or different forcing mechanisms such as ENSO (El Niño-Southern Oscillation) events, associated with major climatic processes. This variability cautions researchers against extrapolating paleoenvironmental records from other areas and emphasizes the need to carry out paleoenvironmental reconstructions at a local scale.

Second, both in Argentina and Brazil the different proxy records are not in agreement regarding the timing and duration of this dry period (compare for example Bombin and Klamp (1976) with Behling (2002) or Iriondo and García (1993) with Prieto (1996)). Until these inconsistencies are resolved, it is not appropriate to extrapolate these records to southeastern Uruguay. In fact, as the results of this study will show, the environmental history of southeastern Uruguay demonstrates regional variability compared to those from Brazil and Argentina.

To address this problem, the author carried out a multidisciplinary project to reconstruct the mid-Holocene environment for the area and to correlate environmental changes with the emergence of early Formative societies in southeastern Uruguay. The specific objectives of the paleoecological portion of this study are: a) to reconstruct past plant communities in the Pampa grasslands of southeastern Uruguay for the mid-Holocene period, b) infer both regional paleoclimatic trends and investigate how humans impacted the landscape in response to these climatic changes, and c) to correlate the environmental changes with the development of early Formative societies in southeastern Uruguay. In addition, given the fact that phytolith analysis is a recent technique in the region, two initial comparative baseline studies, which are crucial to the application of this new technique in the area, were carried out. The first was the construction of an inventory of phytolith morphotypes from selected plants in the area. The second was the development of a regional database of phytolith assemblages from modern soils representing the most important vegetation formations that occurred in southeastern Uruguay (Iriarte and Alonso 2002). The analysis of selected native plants and modern soils indicated that of the 50 non-grass plant species analyzed, 25 contribute diagnostic phytoliths at different taxonomic levels, corresponding to all the major ecological zones of southeastern Uruguay. The phytolith analysis

of modern soil revealed significant patterns that differentiate a number of specific habitats, showing that distinct vegetational formations may be discriminated by the phytolith signatures they produce. These results reinforce the utility of using phytoliths as significant indicators for vegetational formations dominated by both monocotyledonous and dicotyledonous' plant species and demonstrate the potential of phytolith analysis for paleoecological and archaeological reconstructions in this region. These studies were crucial to calibrate our interpretations of the phytolith assemblages obtained from the core as well as to help the author distinguish between background noise and phytolith patterns that reflect human's selection of species in the archaeological record (see Chapter 6).

Before describing the results of the paleoecological study, I will outline the environmental characteristics of the study area in the next section.

## **The Study Area**

### **La Plata Basin: A Mosaic of Environmental Transitions**

The study area is situated in southeastern South America in the southeastern sector of the La Plata Basin. La Plata Basin comprises the Bermejo, Paraguay-Paraná river system and the Uruguay River system. It is shared by Argentina, Bolivia, Brazil, Paraguay, and Uruguay. The Paraná and the Uruguay meet at the head of the Rio de la Plata, which forms the world's largest estuary. The La Plata Basin drains about one-fourth of the South American continent and covers a surface of 3,100,000 km<sup>2</sup> (see Figure 1.1, 3.1). The Uruguay River rises in the Brazilian State of Santa Catarina around 150 km from the Atlantic coast at about 28<sup>o</sup> latitude S. Its clear waters subsequently form the boundary between Brazil and Argentina, and Uruguay and Argentina. The Paraná River stretches for more than 4,000 km, making it one of the largest rivers in South America. In the border of Argentina and Paraguay, the Paraná is joined by the Paraguay River, which also flows from Brazil's interior for 2250 km. The vast region surrounding these river courses is flat, has a benign climate, possesses some of the most fertile soils of the continent, as well as vast areas of wetlands and large extension of seasonal tropical forests (Dugan 1993). It is not surprising that today the region is the densest populated and more industrialized on the continent. The two largest cities of the continent lie within the La Plata basin: Sao Paulo and Buenos Aires. The vast floodplains of these rivers figure among the most important in the world.



The extensive wetland floodplains of the Pantanal along the middle Paraguay River are considered the largest wetlands in the world. They abut the borders of Brazil, Paraguay and Bolivia covering over 140,000 km<sup>2</sup>, increasing to 250,000 km<sup>2</sup> when flooded (Dugan 1993). To the south, these large floodplains continue virtually uninterrupted, spreading through the wet-prairie like Chaco region of Paraguay and Argentina. Hundreds of miles above the Rio de la Plata, the Paraná begins to deposit silt to form innumerable and intermittent islands. From the city of Santa Fe downstream the eastern bank is converted to a wide alluvial plain, characterized by large extensions of wetlands, and cut by thousands of arroyos and intersecting canals.

Like the Amazon River system, the La Plata Basin comprises a network of huge rivers that constituted a major avenue for communication among different pre-Hispanic groups. Interestingly, there are no important geographical barrier that separate these two large river systems. As pointed out by several authors (i.e., Lothrop 1932; Lathrap 1970; Torres 1913), to the south of the Amazon, the annual inundation of the Llanos de Mojos and the Gran Chaco merge their basins of the Rio Madeira and the Rio Paraguay, respectively, into a vast “freshwater sea”, opening up a network of waterways extending far south to the Rio de la Plata estuary. In this respect, for the Pre-Columbian populations that had watercrafts, most of the tropical and parts of the temperate areas of South America were connected by easily traveled waterways.

As described in the following sections, the area constitutes a transitional zone between the subtropical and temperate climate and vegetation. It is bordered to the south in Argentina by the Humid and Dry Pampas and to the north and west in southeastern Brazil by subtropical grassland, subtropical semi-deciduous forest, Araucaria forest and the Atlantic pluvial forest. In this respect, this region of southeastern South America has tropical forms entering Paraguay, the extreme northwest Argentina, and parts of Uruguay where climate permits elements of the Brazilian floral and faunal region to dominate.

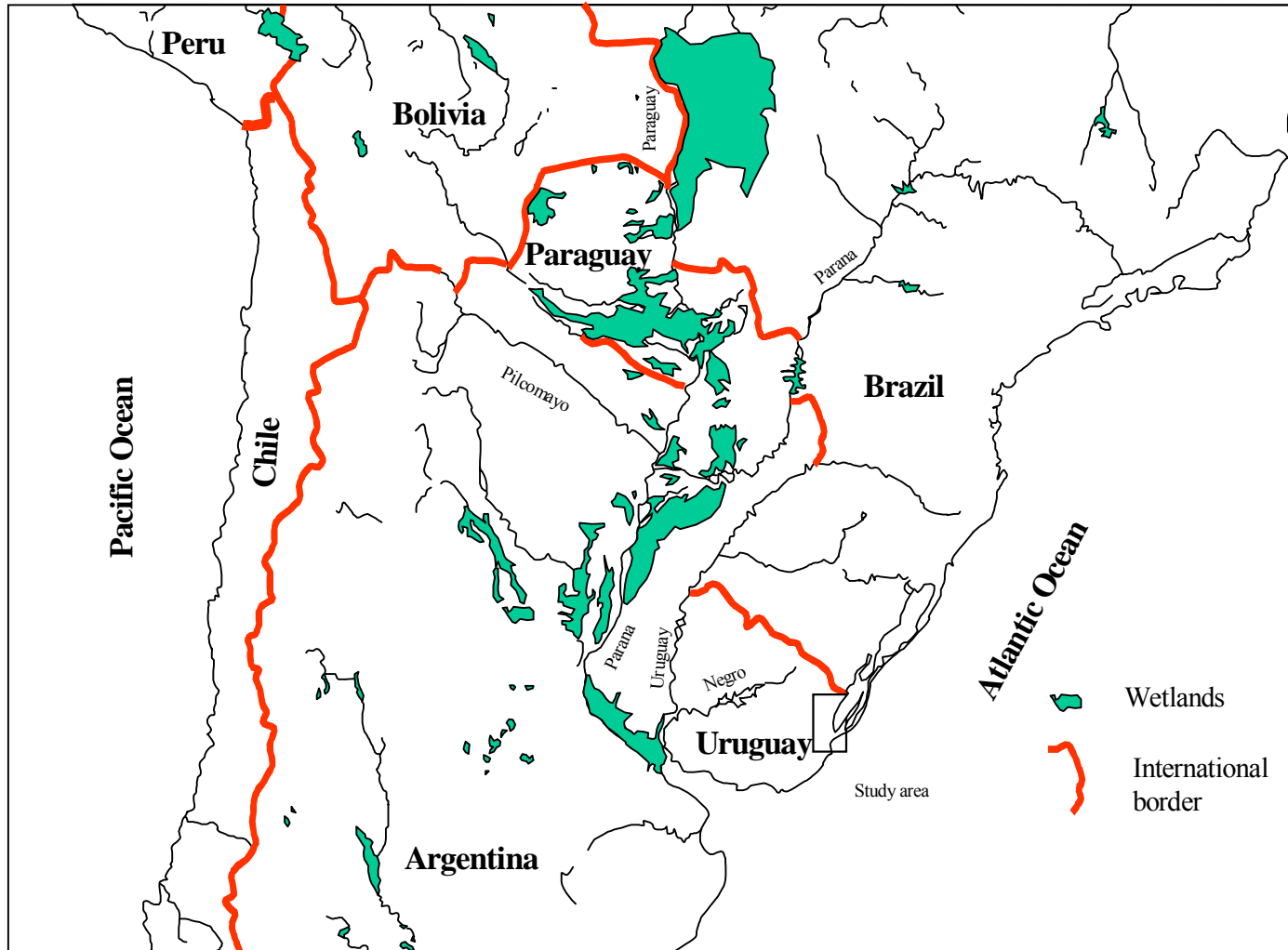


Figure 3.1 De La Plata Basin and Distribution of Wetlands in Southeastern Southamerica.

## **The Area of Study: The Southern Sector of the Laguna Merin Basin**

The study area is located in the southeastern sector of this large system of rivers (Figures 1.1, 1.2, 3.1). It corresponds to the phytogeographic province of the Pampa (Cabrera and Willink 1973), which extends along the eastern Atlantic coast of South America from latitude S 31<sup>0</sup> and 39<sup>0</sup> S. It is demarcated in southeastern Uruguay by the boundary between the sub-regional divisions of the Rio de la Plata Grasslands (RPG), denominated by Leon (1992), as the more temperate “southern campos” and the subtropical “northern campos”. These two subdivisions represent the northern expression of the RPG. The area comprises a coastal plain along the Atlantic coast characterized by slight elevations (maximum 200 masl), generated by the Late Quaternary marine oscillations (Montaña and Bossi, 1995; Tomazelli and Wilcock, 1996; Bracco et al. 2000d). The region is characterized by coastal and inland wetlands encompassing four lakes that are or were connected during the Late Quaternary to the Atlantic Ocean. These lakes appear in the form of a series of micro-basins connecting the ocean with the lagoons, adjacent wetlands, plains, and hills, creating a patchwork of closely packed environmental zones. Bordering these lagoons, one-half million hectares of wetlands have been recognized as one of the most environmentally diverse habitats of the world, supporting a great variety of flora and fauna and including 35% of freshwater fish, 47% of amphibians, 58% of reptiles, 75% of birds, and 51% of the mammals species present today in Uruguay (PROBIDES 2000).

The coastal plain of Rio Grande do Sul is characterized by a diverse assemblage of lakes and lagoons of various sizes which lie behind a chain of barrier islands and dune systems. The two largest lakes in the region are Lagoa dos Patos and Laguna Merin. Lagoa dos Patos stretches 250 km and covers 10,360 km<sup>2</sup>. Laguna Merin is 180 km long and occupies 6 millions hectares between 31<sup>0</sup> and 34<sup>0</sup> S and 51<sup>0</sup> and 55<sup>0</sup> W. In contrast with the uninterrupted, linear, sandy Atlantic shore of Rio Grande do Sul, its continuation into Uruguay is markedly different. The Uruguayan Atlantic coast consists of a series of beach arches separated by prominent rocky points and close-by rocky islands. The rocky points attract marine resources and the islands are places where large colonies of pinnepeds come from the Antarctic to reproduce during the summer constituting a very important economic resource (Vaz Ferreira and Ponce de Leon 1987).

In the interior of this region, low-energy meandering streams, backwater lakes and marshes impounded behind its natural levees and terraces, characterize the extensive wetlands, which creates an extremely rich environment. 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.

### *Climate*

Uruguay has been defined as a transitional zone between temperate and subtropical climate, with major influence from the subtropical region. The climate is subtropical humid, with hot summers and the lack of a dry season (**Caf** type, Trewartha 1968). The shallow relief of the region and the relative uniformity of its vegetation have no major influence on the climate. The meteorological patterns are mainly affected by the presence of the Atlantic and Pacific anticyclones. The Atlantic anticyclone, situated along the Brazilian coast, brings hot and humid air masses accompanied by northerly winds, which create stable, good weather. On the other hand, the cold southerly Pacific polar air, which loses its humidity in southern Chile, blows across the Argentinean Pampas, and reaches Uruguay from the southwest as cold and dry continental polar air. The contact of warm northerly tropical and cool polar southerly airflows originates instable weather fronts that advance and retrocede along the Uruguayan territory bringing precipitation.

The annual average temperature is  $16.0^{\circ}\text{C}$ , and varies seasonally, bearing high average temperatures of  $21.5^{\circ}\text{C}$  during the summer and low average temperatures of  $10.8^{\circ}\text{C}$  during the winter (Merin Lake Basin 1961-1990 in PROBIDES 1998). Total annual rainfall in the region is 1.293 mm. There is an even distribution of rainfall year-round. However, November and December tend to have slightly lower rainfall, while in the winter precipitation is slightly higher. Evapotranspiration makes the major difference between seasons; one third occurs between April and September, and the other two thirds between October and March. The concentration of evapotranspiration during the summer months if associated to low precipitation creates drought conditions in the upland areas of the region.

In the study area, the influence of the coastal lagoons and extensive wetlands create a buffer zone that significantly reduced thermal amplitude, which in turn, reduce the occurrence of

days with frost days. While the rest of Uruguay has 25 to 30 days of frost per year, the Laguna Merin Basin only has 15 days of frost per year at the most.

### ***Modern Vegetation***

The vegetation of southeastern Uruguay is well-studied and probably one of the best known of the region because agronomists have carried out exhaustive inventories of the native grasses of the region in order to assess their grazing capacity (Rosengurtt et al. 1949, 1970; Arrarte Amonte 1969). More recently, the area has also been subjected to intensive studies for conservation purposes and the development of sustainable development programs (Alonso 1996, 1997; PROBIDES 1998, 2000). The grasslands of the region are characterized by the abundance of subtropical grass genera such as *Andropogon*, *Axonopus*, *Panicum*, *Paspalum*, *Schizachyrium* and *Bothriochloa*, among others, and in turn, by the lower presence of *Stipa*, *Piptochaetum* and *Aristida*, which are more abundant in other regional subdivisions of the RPG (Leon 1992).

The vegetation formations of the area can be divided into seven major habitats: wetlands, wet prairies, upland prairies, halophytic communities, and riparian, palm, and mound forest. Appendix 1 presents the plant inventory from the modern vegetation formations of the region collected by E. Alonso during several field trips to the area. The large quantity of grass species present in the region exceeds the scope of this chapter and warrants a separate presentation; therefore, only the most abundant grass species are displayed in Appendix 1. A detailed study of the grasses of the region could be found in Rosengurtt et al. (1949, 1970) and Arrarte Amonte (1969).

### ***Wetlands***

Wetlands, locally known as “bañados”, occur in the low floodplains, which remain covered with shallow water most of the year. Their soils present deep, poorly drained, clayey or peat superficial horizons (PROBIDES, 1998). The vegetation formations of this habitat are characterized by emergent, hydrophytic vegetation, which give rise to diverse vegetation formations locally known by the popular name of the species that dominate the habitat. They include: (a) “juncal” of *Schoenoplectus californicus* (“junco”), (b) “totoral” of *Typha* spp. (“tatora”) (Figure 3.2a), and (c) “espadañal” of *Rynchospora corymbosa* (“espadaña”) (Figure 3.2b). The latter common generic name is also usually given to communities dominated by

*Zizaniopsis bonaerensis*. The herbaceous strata mainly consist of sub-shrubs well adapted to hydric conditions like *Ludwigia* spp, Solanaceae spp, and Ranunculaceae spp, among many others (Alonso, 1997; PROBIDES, 2000). The most common grass species occurring in these formations are the Oryzoid grasses *Leersia hexandra*, *Luziola peruviana* and *Zizaniopsis bonaerensis*, the Panicoid grasses *Echinochloa helodes*, *Paspalum* spp. and *Paspalidium paludivagum* (Alonso 1997), and the Pooid *Glyceria* spp.. A detailed study of the wetland vegetation of southeastern Uruguay can be found in Alonso (1997).

### *Wet Prairies*

Wet prairies occur in areas slightly higher than wetlands. These areas are characterized by flat and poorly drained soils that remain waterlogged during the winter months and thus inundated year-round. A variety of vegetational formations occur in this zone, including short grass prairies locally known as “Varges” (Figure 3.3a) or “Pradera Uliginosa”, “Gramales”, tall bunch grass formations known as “Pajonales” (Figure 3.3b), “Carrizales”, and formations dominated by *Eryngium* spp. (Apiaceae), locally known as “Caraguatales”.

“Praderas uliginosas” are characterized by the dominance of Panicoid grasses such as *Axonopus suffultus*, *A. affinis*, *Stenotapharum secundatum*, and *Paspalum notatum*. “Gramales” are dominated by *Luziola peruviana* and in minor proportions by species of the genera *Paspalum* and *Echinochloa*. “Pajonales” correspond to associations of tall perennial grasses like *Panicum prionitis*, *Paspalum quadrifarium*, and *Cortadeira selloana*. “Caraguatales” are formations dominated by *Eryngium* spp., whose herbaceous strata are very similar to the one characteristic of “Praderas Uliginosas”. In addition to grasses, the herbaceous strata of these vegetational formations is characterized by Asteraceae, Alismataceae, Cyperaceae, Juncaceae, Ranunculaceae, Solanaceae, among species of other families.

### *Upland Prairies*

Upland prairies are located in hills and knolls and are characterized by well-drained superficial soils, which suffer from a hydric deficit during the summer months. The abundant species in these areas are *Paspalum notatum*, *Setaria geniculata*, *Axonopus compressus*, *Paspalum dilatatum*, *Aristida* spp., *Stipa* spp., *Briza* spp., *Chloris* spp., *Eragrostis* spp, among



**a**



**b**

Figure 3.2. a: Mosaic of Wetlands, Wet Prairies and Sparse Palm Groves: 1. “Totoral” (*Thypha* sp.), 2. Wet-Prairie, 3. Palm Grove (*Butia capitata*), 4. “Pajonal” (*Panicum prionitis*); b: Wetland of India Muerta, “Espadanal” (*Rynchospora* sp.).





**a**



**b**

Figure 3.3. a: Project Botanist E. Alonso Sampling Wet-Prairie Patched With Bunch Grass (*Panicum prionitis*) (“Varge”); b: “Juncal” (*Panicum prionitis*).



other less abundant species. In addition, the herbaceous strata also comprise species from Apiaceae, Asteraceae, *Convolvulaceae*, Cyperaceae and Iridaceae (Figure 3.4a).

#### *Riparian, Palm Forest and “Mound” Forest*

In the area, the riparian forests comprise a narrow strip bordering the main streams, and are mainly composed of species from the Anacardiaceae (*Lithraea brasiliensis*, *Schinus longifolius*), Euphorbiaceae (*Sapium* spp, *Sebastiania* spp), Myrtaceae (*Blepharocalyx salicifolius*), and Ulmaceae (*Celtis* spp) (Figure 3.5). The palm forest of *Butia capitata* is characteristic of southeastern Uruguay and southern Brazil, and only in Uruguay, it covers more than 200,000 ha. (PROBIDES 2000) though it is rapidly retreating due to agricultural activities in the area (Figure 3.4b). The sample for this analysis was taken from La Angostura, one of the most dense palm forest stands in the area, having a density of up to 452 individuals per hectare (PROBIDES 2000). In this area, the herbaceous strata is characterized by a short wet prairie mainly composed by associations of *Axonopus affinis*, *Panicum gounii*, and *Sporobolus indicus* (Alonso, 1996).

The mound forest grows on top of artificial mounds and is mainly composed by the following families: Anacardiaceae (*Lithraea brasiliensis*, *Schinus longifolius*), Euphorbiaceae (*Sapium* spp, *Sebastiania* spp), Myrtaceae (*Blepharocalyx salicifolius*, *Eugenia uruguayensis*, *Myrceugenia glaucensces*), Phytolaccaceae (*Phytolacca dioica*), Rutaceae (*Fagara hyemalis*), Salicaceae (*Salix humboldtiana*), Santalaceae (*Jodina rhombifolia*), Sapindaceae (*Allophylus edulis*), Violaceae (*Anchieta parvifolia*), Sapotaceae (*Pouteria salicifolia*), Smilacaceae (*Smilax campestris*), Thymelaceae (*Daphnopsis racemosa*), and Ulmaceae (*Celtis* spp.). The herbaceous strata comprises several families including: the Asteraceae, Bignoniaceae, Caprifoliaceae, Commelinaceae, Lamiaceae, the following families: Asteraceae, Bromileaceae, Rubiaceae, Solanaceae, among many others (see Appendix 1). Grasses are mainly represented by *Poa annua* and in addition nowadays most of the mounds have been invaded by the non-native *Cynodon dactylon* (Figure 3.4b).



**a**



**b**

Figure 3.4. a: View of Los Ajos from the SE: 1. Upland Prairie, 2. Los Ajos Site, 3. Riparian Forest, 4. Wetlands; b: La Angostura, Palm Forest (*Butia capitata*)



a

Figure 3.5. a: Riparian Forest of Laguna de los Ajos.

### *Halophytic Communities*

At present, halophytic communities proliferate in the saline wetlands that occur below the 5 masl terrace that borders Laguna Merin. This vegetation formation is mainly composed by the saline-tolerant grasses *Spartina* spp. (“espartillo”), *Distichlis* spp, *Polypogon* spp, and *Andropogon vaginatum*. Herbs include for the most part Amaranthaceae (*Philoxerus portulacoides*), Chenopodiaceae (*Atriplex* spp, *Chenopodium macrospernum*, *Salicornia ambigua*), in addition to species of Asteraceae, Cyperaceae, and Juncaceae, among others (see Appendix 1).

### *Rock Outcrops*

The superficial soils of the rock outcrops that exist in the top of the hill which remain waterlogged for the most part of the year but the summer months, are dominated by Pooid grasses well adapted to moist and cool conditions like *Agrostis tandilensis*, *Briza minor*, *Melica argyrea* and *Poa annua*, in addition to Panicoid grasses like *Setaria geniculata* and the introduced *Cynodon dactylon*. Other moist-loving species like *Hydrocotyle* spp, *Elocharis* spp, and *Ranunculus* spp are also present. In addition, the slightly concave bow-shaped extensive borrow areas created by the extraction of soil as filling material for the mounds, which creates shallow ponds during the autumn, winter, and most of the spring months, that further increase the presence of Pooid grasses in the hill top where Los Ajos site is placed.

### *Fauna*

As mentioned in the introduction, this region is the most diverse ecosystems in Uruguay supporting a great variety of flora and fauna. Among mammals, one of the most abundant in the region are the aquatic medium-size rodents like the nutria (*Myocastor coypus*) (4.5-9 kg) and capybara (*Hydrochaeris hydrochaeris*) (25-50 kg), which are typically found near water. In comparison with other rodents that inhabit forest or grasslands, semi-aquatic rodents adapted to wetlands and wet prairies habitats attain major population’s densities (Redford and Eisenberg 1992). These habitats constitute the natural habitat for these animals providing for nesting, food and refugia. Nutria is confined to areas with permanent water. It inhabits from swamps and marshes to streams and drainage ditches, but always with succulent vegetation in or near the water. Small rodents are also very abundant in these marshy areas (*Oryzomys* spp., *Holochilus*

spp.). Most of these semi-aquatic small rodents are distributed throughout southern and eastern South America in low, marshy areas, where they are capable of reaching very dense populations. Finally, the “aperea” (*Cavia* sp.) (0.75 kg) and mice (Cricetidae) are mainly grassland herbivores, but are particularly abundant in the wet-prairie ecotone.

Another important resource is large mammals like deer. The first explorers of the seventeenth century described the area as a hunting paradise. Large herbivores, in particular deer, were very abundant attracted by the region’s nutritious food supply supported by the extensive wet prairies existing in the region. In particular, the Pampas Deer or “Venado de campo” (*Ozotoceros bezoarticus*) (30-40 kg) was common in the open vegetation formations of southern South America. The Guazubira Deer (*Mazama gouazubira*) (17-23 kg) also ranges in open grassland areas and forest. The ecotone constituted by marshes, riparian forest, wet-prairies and grasslands may have constituted a privileged habitat for these species of deer. The locally extinct Marsh Deer or “Ciervo de los Pantanos” (*Blastocerus dichotomus*) (100-150 kg), a gregarious deer adapted to wetland areas and weighting between 100-150 kg was also a very important faunal resource.

Marsupials are also abundant in the region including the opossums “Comadreja mora” (*Didelphis albiventris*) (2.75 Kg) and “Comadreja colorada” (*Lutreolina crassiculata*) (0.2-0.8 kg). Both are abundant in forest, grassland, wetlands and disturbed habitats. Between the edentates the most common and abundant species of armadillos are “Mulita” (*Dasyopus* sp.) (1.2-1.8 kg) and “Peludo” (*Euphractus sexinctus*) (5kg).

The order Carnivora is also well represented in the area by several species including “Mano pelada” (*Procyon cancrivorus*) and “Lobito de rio” (*Lutra paranesis*) (10-15 kg). Two species of canids are common in the region: the foxes, “Zorro de monte” (*Cerdocyon thous*) and “Zorro gris” (*Lycalopex gymnocercus*). Dogs (*Cannis familiaris*) were also important and are common as burial offerings.

Among other important mammals that are now locally extinct are the collared pecari (*Tayassu tajacu*) (20 kg) adapted to palm forest and grassland, giant otter (*Pteronura brasiliensis*) (22-32 kg) that lived along the major rivers and streams, giant anteater (*Myrmecophaga tridactyla*), jaguar (*Panthera onca*), and the already mentioned Marsh Deer.

The Atlantic coast also presents important resources. Both the rocky points as well as its close-by islands are inhabited by large colonies of pinnepeds including South American fur seal

(*Arctocephalus australis*) and South American sea lion (*Otaria flavescens*). Like in Rio Grande (Brazil), many fish species like corvine (*Micropogon opercularis*) and “Lacha” (*Brevoortia aurea*) enter the brackish water lagoons that occasionally open to the ocean to feed and spawn. Though in smaller quantities than in Rio Grande do Sul (see Chapter 3), they also make up an abundant and predictable resource. In minor proportions shellfish and crustaceans, mainly shrimp (*Penaeus paulensis*) and crabs “Siri” (*Callinectes sapidus*), could be also collected during this time of the year.

Birds are also extremely abundant in the region, consisting of 311 species, which constitutes 75% of all the birds of Uruguay. Thirty percent are migratory birds that use the wetlands to rest, feed and as refugia during their intercontinental trips. Among the birds of major economic importance are the waterfowl (21 species) and the “Nandu” (*Rhea americana*). “Nandu” or Greater Rhea, is the largest bird in South America (130 cm long), which inhabits open grasslands of southern South America. It is flightless and is mainly hunted for its meat, feathers, and eggs (600 grams). It is a gregarious animal that could be found in groups of 15 to 20 individuals. Females lay their eggs in communal nests that usually contain from 40 to 60 eggs (Arballo and Cravino 1999:178). Males are specially aggressive and territorial during the reproductive season, which make them easier to hunt during this period. Bola stones (“boleadoras”) is the historically known device to hunt them.

### *Geomorphology and Soils*

Both Montana and Bossi (1995) and Tomazelli and Wilcock (1996) have indicated that two major geomorphological processes have affected the southern sector of the Laguna Merin basin during the Late Quaternary: (a) alluvial fan depositional system; and (b) barrier-lagoon depositional systems. As a result of these two processes, the west plain of the Laguna Merin Basin is transected from W to E by several ancient alluvial fans and from S to N by four marine terraces, which are the result of Pleistocene and Holocene sea-level rises (Figure 3.6). The alluvial fan depositional system extends from the Sierra de San Miguel north to Rio Grande do Sul along the piedmont of the Pre-Cambrian crystalline rock formations that surrounds lakes Merin and Patos known as Cuchilla Alta in Uruguay and Serra do Sudeste in Brazil.

The Quaternary glacio-eustatic fluctuations in sea level have produced great displacements of the shoreline on the very low gradient coastal plain and continental shelf of Rio Grande do Sul

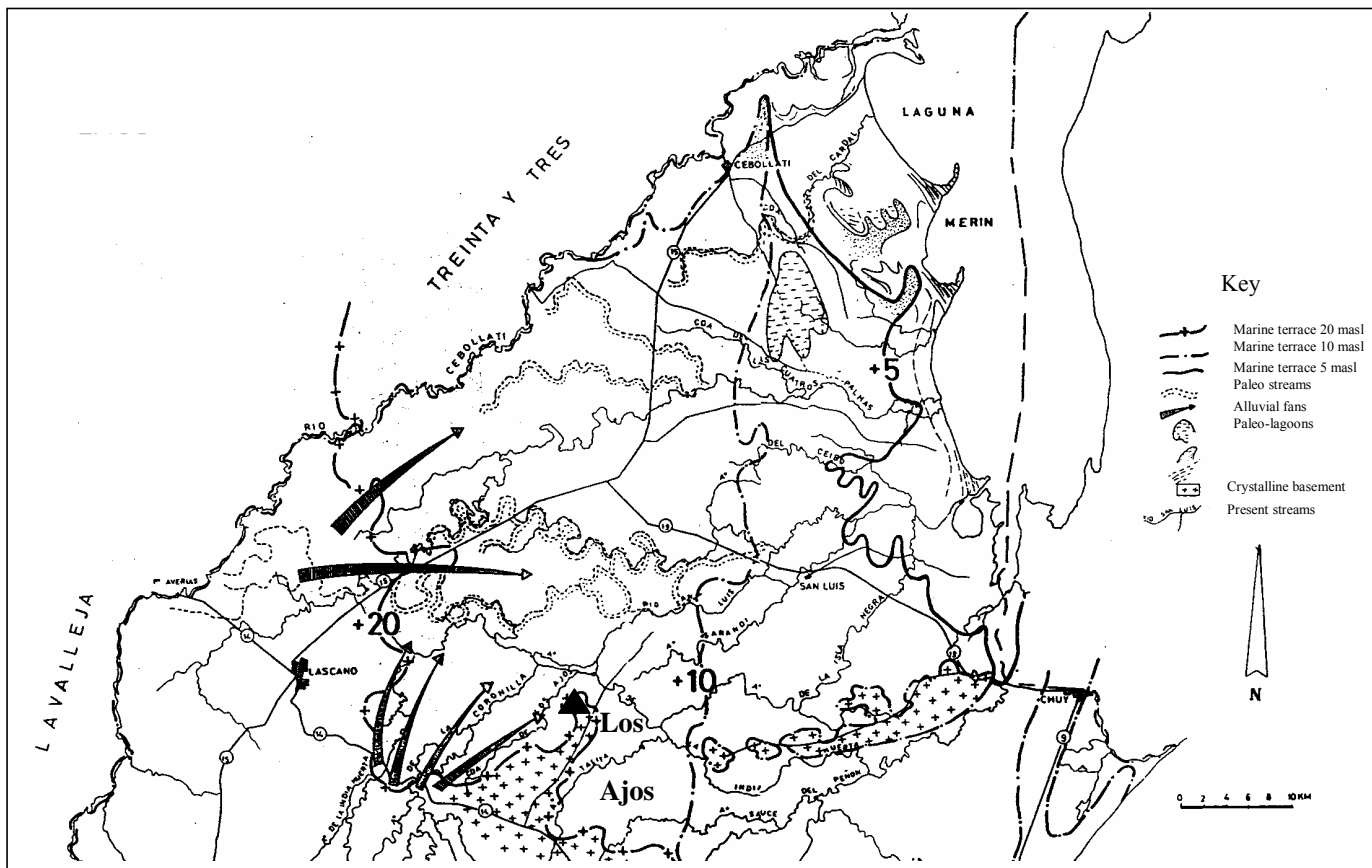


Figure 3.6. Southern Sector of Laguna Merin Geomorphological Map (after Montaña and Bossi 1995:Figure 11)

in Brazil and southeastern Uruguay. As a result of this shoreline shifting at least three of these barrier-lagoon systems were deposited and preserved landward of the present coastline.

In the southern sector of Laguna Merin basin, Montana and Bossi (1995) have identified and mapped three distinct marine terraces (Figure 3.6). The highest terrace occurs between 15 and 20 masl, ca. 50 km from the Laguna Merin margin. It is the most ancient of the three, and therefore, the least preserved. The authors assigned a Late Pleistocene age, ca. 110,000-120,000 bp by comparison with the dated terraces Pleistocene age, ca. 110,000-120,000 bp by comparison with the dated terraces located at the same height in Argentina (González and Ravizza 1984; González et al. 1986). To the west of this terrace, the terrain becomes progressively hilly toward the hilly chain known as “Cuchilla Alta” which is part of the broader Pre-Cambrian crystalline basement. To the east, toward the Laguna Merin, lay the flat wetlands of India Muerta. The second terrace is located within 7 and 10 masl, ca. 20 km. from the lagoon border. By comparison with a dated marine highstand of 10 masl in Argentina (González and Ravizza 1984), Montana and Bossi assigned an estimated age of 35,000 to 40,000 bp to this terrace. The third and lower terrace is located 5 masl. This terrace has been dated in four different points between ca. 4,390 and 5,210 bp (Bracco et al. 2000d; Bracco and Ures 1999; González 1989). At 3,000 bp, there was another marine highstand that reached 3 masl, which has been dated by Bracco (1992a) and González (1989) in the Castillos Lake. These marine fluctuations are also recorded at a continental and regional level both in Argentina (González 1989; González and Ravizza 1984; González and Weiler 1982; Weiler 1994) and Brazil (Martin and Sugio 1989).

In combination, the alluvial fan and the barrier lagoon depositional systems have created different types of wetlands. Below the lowest and more recent terrace, closer to Laguna Merin wetlands, are associated with tidal plains and ancient oxbow lakes. This area is characterized by the presence of long, ovoid lagoons oriented N-S, which present sandy margins and pelitic floors. Due to its recent marine origin and the periodic overflows of Laguna Merin brackish waters, these wetlands are saline. The soils in this area are deep, poorly drained, and are saline or saline-sodic. In many areas the high percentage of soluble salts prevents the growth of vegetation, and therefore there is no accumulation of organic matter in the superficial horizon of the soils. In areas where soluble salts are not so high, the characteristic halophytic vegetation grows (Duran 1979; Sombroek 1984; Montana and Bossi 1995).



Interconnected abandoned meandering streams and their associated floodplains that developed below their levees characterize the wetlands that occur above 10 masl. Unlike the salty marshes that develop below the lower 5 masl terrace, these wetlands bear a lower saline content and their expansion depends on rainfall.

The third type of wetlands is associated with floodplains of obstructed drainages, and is characterized by abandoned meandering channels generated above an alluvial plain located between 10 and 20 masl. They are extremely flat, having a general slope of less than 1%. They developed in a SW to NE direction above 15 masl and this genesis is related to an alluvial fan that prograded into a bay that function ca. 110,000 bp related to the older marine highstand that reached 20 masl during the Late Pleistocene. They present two major geomorphological features: paleo-channels and floodplains. The former constitute permanent wetlands, while the latter are semi-permanent. The soils of the region are deep, poorly drained, are neither saline nor alkaline, and they represent the most fertile soils of the region (Altamirano 1998; Bracco et al. 1999). Nowadays, more than 50% of them have been drained for rice cultivation. As will be discussed below, several characteristics of these wetlands related to its environmental history made them a preferred place on the landscape for pre-Hispanic populations.

### ***Wetlands: Diverse and Abundant Resource Areas***

Wetlands are now recognized as one the most environmentally diverse habitats in the world, supporting a great diversity of flora and fauna (Mitsh and Gosselink 2000). Wetland environments have provided a critical loci for prehistoric and historic native groups offering 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). Importantly, wetlands also provide greater stability, reducing risk during periods of environmental change since they contain a stable supply of water. In addition, they are an ideal context for the adoption and intensification of agriculture (e.g., Blake 1999; Niederberger 1979; Pohl et al. 1996; Sherrat 1980; Siemens 1999).

The southern sector of the Laguna Merin basin constitutes a mosaic of closely juxtaposed environmental zones combining the Atlantic coast sand dune beaches, rocky points and islands with coastal lakes and lagoons bordered by extensive salt and freshwater wetlands, wet-prairies,

upland grasslands, hills, as well as palm, riparian and hilly forest stands. The study area is rich in a variety of both animal and plant resources. It is not only characterized by a great diversity of species, but also by supporting them in great abundance (PROBIDES 2000). This is particularly true for semi-aquatic rodents and deer, which prosper in large numbers in these wetland-wet prairie ecotones. For example, medium size aquatic rodents like nutria (*Myocastor coypus*) were extremely abundant in the area. They were commercially exploited for their fur, reaching up to 265,000 individuals captured per year in Rocha Province (FAO 1980). Capybaras (*Hydrochaeris hydrochaeris*) are confined to areas with permanent standing or running water. Their densities could reach up to 12.5 individuals/hectare and in Uruguay, herds range from seven to fifteen individuals. Similarly, small aquatic rodents inhabiting low, wet grassland and marshy areas like “Rata de bañado” (*Holochilus brasiliensis*) grow abundantly in the region (Redford and Eisenberg 1992).

Large mammals such as deer also were extremely abundant in the area. Orestes Araujo (1900) pointed out that the name Sierra de Los Ajos, translated as “Garlic Hills”, came from the large aggregations of deer in the area. Adult males produce a very strong, pungent, garlic-smelling odor from the interdigital gland on the hind feet that could be smell from far distances thus, the name given to these hills. Pampas Deer lives in groups that rarely exceed five individuals, but congregate in large numbers in feeding grounds. The extensive wet prairies in the wetlands of India Muerta, locally referred to as “Vargés”, provide abundant forage capable of supporting higher population densities of herbivores compared to other areas (Arrarte Amonte 1969) and probably constituted a favorite feeding ground that encouraged large aggregations of deer. The now locally extinct Marsh Deer (*Blastocerus dichotomus*) (100-150 kg), a gregarious deer adapted to wetland areas and weighing between 100-150 kg also represented a prime protein resource for pre-Hispanic populations.

The colonies of pinnepeds available in the Atlantic coast comprise one of the most important economic resources in addition to fish, shellfish, and crustaceans. Along many rocky points and nearby rocky islands such as Cabo Polonio or Punta de Loberos, sea lions constituted a predictable, abundant, and easily localized resource, which was particularly easy to hunt during the summer mating season when they become strongly territorial. During this time, their dependence on land is absolute and ineludible. Although they are experienced swimmers, these

marine mammals move very slowly on land; becoming an easy prey for experienced hunters (Lanata and Winograd 1990; Schiavinni 1993; López and Iriarte 2000).

As mentioned before, the area stands out for the diversity and abundance of birds since it provides feeding and nesting grounds as well as a resting place and refuge for migratory birds. The larger birds such as waterfowl, “Chajá”, “Cisne de Cuello Negro”, and Greater Rhea (*Rhea Americana*) may have constituted an important economic resource for pre-Hispanic populations. The Greater Rhea was not only important for its abundant meat and large eggs, but also for its feathers.

In terms of plant resources, palm forests constitute an extremely rich seasonal resource for prehistoric populations living in the area. Palm fruits are available between December and April and could be stored for long periods of time. López and Bracco (1992) calculated that assuming a mean density of 200 specimens/ha, palm forests can produce up to 2,000 kg of fruits per hectare, from which 1630 kg correspond to the pulp and the remaining 270 kg to the fruit nut (endosperm). The pulp is rich in glucose while the nut is rich in lipids, constituting a much-appreciated ingredient in the diet of pre-Hispanic communities. The possibility of long-term storage of palms by transforming them into flour is suggested by an early chronicle (1605-1607) by Jerónimo Rodríguez (Cesar 1981:25) who observed the following practice in the Lagoa dos Patos: “They divide the year into four parts, three months they eat corn, the other three months they eat beans, the other three mandioca<sup>10</sup>, and the remaining three months, they eat flour that they make from a certain palm”.

Root crops also are an easily procured plant resource, which played an important role as a carbohydrates, protein, and minerals source. In this regard, wetlands and wet prairies provide an abundant and year-round supply of belowground tubers and rhizomes. Moreover, as Dillehay and Rossen (2001) have pointed out, when the underground part of these plants is left or stored in their natural underground habitat, they are foods with a long “use-life” and banking capacity. Unfortunately, tubers are almost never preserved outside exceptional anaerobic or dissecating conditions. However, due to new recovery techniques, in particular starch grain analysis, researchers are now able to obtain them from archaeological contexts characterized by poor preservation of macro-botanical remains. In southeastern Uruguay, starch grains of *Canna* sp. and *Calathea* sp. have been recovered from three archaeological sites, confirming the importance

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<sup>10</sup> Mandioca is the common name for *Manihot esculenta*.

of this resource for pre-Hispanic populations (Iriarte et al. 2001) (see Chapter 6). Several other important bulbous hydrophytic food plant species, which have been an important part of the diet of native populations across the Americas such as nutgrass (*Cyperus* sp.), spikebrush (*Eleocharis* sp.), and cattails (*Thypha* sp.) among others (e.g., Chamberlein 1911; Fowler 1990; Gragson 1997; Schmeda-Hirschmann 1994; Greaves 1997; Perry 2000) also are abundant in the area and may have represented an important plant-food resource.

Wetlands also represent an ideal setting for the adoption and intensification of agriculture (Niederberger 1979; Pohl et al. 1996; Sherrat 1980; Siemens 1999). The upper freshwater wetlands present several favorable characteristics for the practice of horticulture. First, unlike other continental areas in Uruguay that experience 25 to 30 days of frost, in the southern sector of the Laguna Merin, the influence of coastal lakes and lagoons and the extensive wetland areas produced a buffer zone which dramatically reduces the occurrence of frost days in this region. Second, the upper freshwater wetlands provide greater stability in water supply and therefore, reduce risks during periods of drought. Third, the seasonally exposed organic soils in wetlands margins constitute an excellent place to practice flood-recessional horticulture. When dry during the spring and summer months, the superficial peat horizons of the wetlands of India Muerta contain soils that are highly fertile, hold moisture, and are easy to till. In addition, the floodwater and the overbank flow of the Cebollatí River that inundates the area, periodically replenishes these soils with nutrients (Juan Montaña, personal communication 2000). Alternatively, in the wetlands floodplains, the top of levees and in particular, the back-slope of levees represents an ideal context for the development of a seasonally pulsing agriculture (Siemens 1999). Last, the numerous oxbow lakes and abandoned channels occurring in the wetlands floodplain constitute excellent fishing grounds; representing a prime protein resource.

In sum, wetlands not only concentrate diverse and abundant wild resource, but also are a good setting for the practice of flood recessional small-scale horticulture. In fact, phytolith and starch grain analyses from archaeological sediments and residues from plant-grinding tools have shown that early Formative societies of southeastern Uruguay practiced a mixed economy, combining hunting-gathering-fishing wild resources with the adoption of maize (*Zea mays*), squash (*Cucurbita* sp.) and possibly, domestic beans (*Phaseolus* sp.) and tubers (*Canna* sp. and *Calathea* sp.).

## **The Paleoclimatic Record: A Combined Pollen and Phytolith Record for the Late Quaternary Vegetation and Climatic Change from the Wetlands of India Muerta**

In this section, a summary of the pollen and phytolith record from the sediment core extracted from the wetlands of India Muerta is presented. Along with this summary, the importance of climatic changes as revealed by the pollen and phytolith analyses in order to understand the emergence of early Formative cultures that developed during the mid-Holocene in the region is offered. The detailed description and interpretation of the core is presented in Appendix 2 (A Combined Pollen and Phytolith Record for the Late Quaternary Vegetation and Climatic Change from the Wetlands de India Muerta, southeastern Uruguay).

In summary, the results of the paleoclimatic record indicate that the Late Pleistocene period (ca. 14,810 and 10,000 bp) was characterized by drier and cooler conditions, indicated by the presence of a C3-dominated grassland and minor representation of Cyperaceae. These conditions prevailed until ca. 10,000 bp with the onset of a warmer and more humid climate in the Holocene, which are indicated by the establishment of wetlands, as indicated by the formation of black peat, the increase in wetland species, and the replacement of C3 Pooid by C4 Panicoid grasses.

The early Holocene (ca. 10,000 and ca. 6,620 bp) witnessed an amelioration of the cooler and drier conditions of the late Pleistocene fostering a wetland environment and climatic conditions typical of today. The mid-Holocene (ca. 6,620 to 4,040 bp) was a period of climatic instability. Around 6,500 bp, a period of environmental flux characterized by alternating drier and humid conditions occurred. The drier peaks resulted in the expansion of halophytic communities in the flat, low-lying areas of the wetlands of India Muerta. About 4,040 bp a massive spike of Amaranthaceae/Chenopodiaceae (Amar/Chen) coupled with a radical drop in wetland species indicates another major and more severe drying trend. After this episode, begins a decrease in halophytic species, which possibly represents an amelioration of mid-Holocene drier climatic conditions and the onset of more humid and stable climatic conditions.

Significantly, the paleoclimatic record shows a strong parallel between changes in the physical environment and the emergence of early Formative societies in southeastern Uruguay. This record indicates that around 4,040 bp, broadly contemporaneous with the beginning of early Formative cultures, the region experienced a major drying episode. The reduced precipitation and run-off during this dry period may have caused a decrease in the surface water recharge to

the inland wetlands and waterways. Both the pollen and phytolith records and the continued formation of peat evidenced in the core during this period indicate that the wetlands of India Muerta did not dry out. Therefore, wetlands, although reduced in extension, continued to provide abundant and easily accessible aquatic resources and most probably drew birds and terrestrial fauna to them. This period may have caused the desiccation of the upland grasslands, deepening the resource gradient between wetlands and uplands prairies. These dryer mid-Holocene conditions probably caused a decrease in the productivity of the grassland vegetation, which is the major source of forage for deer populations. This likely resulted in diminishing returns from grasslands. Under these circumstances, it seems reasonable to suggest that the groups expand their diet breadth to include a major proportion of lower rank but more predictable resources like the ones that are abundant in wetlands such as birds, smaller rodents, and plant resources such as tubers. Our poor understanding of the Preceramic Archaic Period and the lack of faunal and botanical data from this period prevent us from testing this hypothesis.

In this regard, during this period of environmental change, although reduced in extension, the upper freshwater wetlands may have become attractive places for pre-Hispanic populations coping with this period of instability and environmental change. Wetlands seemingly provided greater stability reducing risk during periods of environmental change since they offered a stable source of water supply. In fact, the area that is located in the distal part of the India Muerta alluvial fans is the least susceptible to water stress, and probably, the one that remained with the highest water table during dry summers in comparison with other areas in the region (Juan Montaña, personal communication 2000).

The current archaeological data indicates that during this period, local populations did not disperse (e.g., disaggregate into smaller groups and increased mobility) or out-migrate to other regions, but opted for orienting their settlement towards the upper freshwater wetlands where they began to established more permanent communities in strategic locations such as Los Ajos.

In the next section, I will bring together our current knowledge of the settlement pattern in the area, the environmental characteristics of the area, the new paleoclimatic data obtained from this study, and the existing record of the mid- and late-Holocene marine fluctuations in order to interpret and then briefly summarize the settlement patterns in the area during the mid-Holocene.

## **Settlement Patterns in the Southern Sector of the Laguna Merin Basin**

In this section, I present the regional settlement patterns of the southern sector of the Laguna Merin basin. Although more work needs to be done, the nature of the settlement patterns in the region is coming into sharper focus. Based on the current paleoclimatic information and previous archaeological work summarized in Chapter 2, I attempt to show the strong correlation that exists between the environmental history of the region and the location and characteristics of early Formative sites in terms of chronology, location, and size of sites in the landscape. Below, two overlapping spatial scales of analysis are defined and examined. One is the broader regional scale of analysis that embraces the southern sector of the Laguna Merin basin. This region is examined in order to reflect on the question of why the oldest and more intense Preceramic Mound occupation took place in the upper freshwater wetlands. The second, the local scale of analysis, I examine our current data in the wetlands of India Muerta in order to bring to light the dual pattern of settlement, characterized by smaller mound sites in the wetland floodplains and larger, spatially more complex, nucleated multi-mound sites in the flattened spurs (“lomadas”) contiguous to wetlands areas. As will be shown below, the different types of wetlands, the mid and late-Holocene marine oscillations and the changes in the climate played a major role in determining the regional and local settlement patterns.

This section focuses only on the regional and the study area settlement patterns. The site scale of analysis is described and discussed in detail in Chapter 4 and Chapter 8. However, when necessary, a brief description of sites is given to illustrate the spatial complexity of mound complexes in the area.

To examine the regional settlement patterns, I concentrate on the southern sector of the Laguna Merin Basin and in particular, in the wetlands of India Muerta, which to date, possess the most detailed archaeological and paleoenvironmental data to investigate settlement patterns. As summarized above, the area presents different types of wetlands whose genesis is related to the marine oscillations that occurred during the Late Quaternary (Montana and Bossi 1995; Bracco et al. 2000c) (Figure 3.6). To briefly recapitulate from the geomorphology and soils section, if we draw a topographical transect in E-W direction from the Laguna Merin shore-line to the Cuchilla Alta hilly chain, we can recognize three main types of wetlands (Montaña and Bossi 1995). The lower wetlands are located in the area between the present lake margin and the 5 masl

marine terrace. They are characterized by the presence of tidal plains, oxbow lakes, and ovoid lagoons, oriented S-N, and characterized by salt and brackish marshes generally exhibiting deep, poorly drained saline-sodic soils. As mentioned before, a high percentage of soluble salts prevent the growth of vegetation, precluding the accumulation of organic matter in the superficial horizon. In areas where the soluble salts are not so high, the characteristic halophytic vegetation grows. Depending on the wind patterns, lake elevation, and the arrangement of numerous stream channels guiding water into the lake, the influx of water from streams variously reduces the salinity of these wetlands and the Laguna Merin waters. All these factors converge to form a dynamic mosaic of salt, brackish, and freshwater marshes.

Interconnected abandoned meandering streams associated with floodplains that developed below their levees characterize the second type of wetlands between 5 and 10 masl. Unlike the brackish-salt marshes that develop below the lower 5-masl terrace, these wetlands bear a lower saline content and their expansion and water coverage depends exclusively on rainfall. The third type of wetlands is associated with floodplains and obstructed drainages and is characterized by abandoned meandering channels generated above an alluvial plain between 10 and 20 masl. The system of abandoned meanders that characterizes these wetlands is the result of the northerly migration of the Cebollatí River channel to its current position. These wetlands are extremely flat in topography, developed in a SW to NE direction above 15 masl, and present two major geomorphologic features: paleo-channels and floodplains. The former constitutes permanent wetlands while the latter are semi-permanent. The soils of the region are deep and poorly drained and are neither saline nor alkaline, consisting of the most fertile soils in the region, supporting the richest and most abundant fauna and flora in the region.

Based on current data, I propose, as a working hypothesis, that in the southern sector of the Laguna Merin basin two main factors are responsible for the older and more intense early Formative occupation of the upper freshwater wetlands above 15 masl. First and most notably, during the mid-Holocene, the wetlands below the 5 masl marine terrace were a highly unstable environment covered intermittently by waters of the mid-Holocene marine highstand, which inhibited pre-Hispanic populations from settling in and exploiting them more intensively. It was only after 3,000 bp, when the waters of the mid- and late-Holocene marine transgressions receded and the sea stabilized at its present level, that more intense occupation of these areas



took place. This is evident in Rio Grande, southern Brazil (Schmitz 1976) and in the lower wetlands areas of Arroyo de San Miguel, Uruguay (López and Bracco 1992).

Second, the upper freshwater wetlands compare favorably with the brackish and salt marshes below the 5 masl marine terrace because they (a) support a higher biomass and are thus able to sustain larger populations of animals, (b) present the most fertile soils of the area (Durán 1970; Altamirano 1998; Bracco et al. 1999), which are seasonally replenished with nutrients by floodwater and the overbank flow of the Cebollatí River that inundates the area (Juan Montaña, personal communication 2000), and (c) in particular, the area where this study was carried out is located in the distal part of the India Muerta alluvial fan that is the least susceptible to water stress. In comparison to other areas of the region it probably has the highest water table during dry periods. This latter advantage was critical during the dryer conditions of the mid-Holocene.

As summarized above, broadly contemporaneous with the beginning of early Formative cultures, the region experienced a major period of environmental flux characterized by alternating dry and humid periods. The major aridity episode peaked around 4040 bp. During this major dry episode, the wetlands of India Muerta, although reduced in their extension did not dry out and thus continued to concentrate abundant and rich resources. On the contrary, this mid-Holocene period of dryness may have caused the desiccation of the upland grasslands, deepening the resource gradient between wetlands and upland prairies, which resulted in increasing diminishing returns.

In summary, during the mid-Holocene drying trend, the upper freshwater wetlands were the most stable areas of the regional landscape; they were not directly affected by the mid-Holocene marine transgressions, and probably supported the richest and most abundant economic resources. Accordingly, during this period, the upper freshwater wetlands may have become attractive locations for the pre-Hispanic populations coping with this period of instability and impoverishment of natural resources. It is likely that the more favorable conditions that the upper freshwater wetlands exhibited during this period promoted the aggregation of populations along these restricted and limited resource-rich wetland areas. This process was probably accompanied by a reduction in residential mobility, greater locational constraints, and an increase in population density in this area, which ultimately provided the impetus which triggered the process of early village formation.

The archaeological record of the mid-south Atlantic area reflects the processes mentioned above. In the southern sector of the Laguna Merin basin, this pattern was first documented by Bracco (1993), later corroborated by Bracco and his collaborators (1999) and then by my own survey of the area (see Figure 2.6). The study of Bracco also evidenced a positive correlation between density of sites and fertility of the soils. In this regard, a low density of sites was found in the halomorphic soils below the 5 masl brackish and salt marshes. In contrast, in the upper freshwater wetlands, large, nucleated mound complexes are positioned contiguous to the most fertile soils of the region. This proposition is further supported by an examination of the preliminar archaeological map of the region displayed in Figure 2.6. Moreover, this pattern seems to hold consistently for the broader mid-south Atlantic coast. As discussed in the preceding chapter, the same pattern is observed in the archaeological maps of other areas of the mid-South Atlantic region such as the Treinta y Tres Province (Prieto et al. (1970), Camaqua region (Figure 2.2; Rutschling 1989), and the Jaguarao River (Copé 1991: Map 2). All these archaeological maps noticeably mark the aggregation of mound sites in the upper areas close to the headwaters of major streams that flow into the Laguna Merin and Lagoa dos Patos, while the areas immediately adjacent to these lake margins, the occurrence of sites is sparser and less permanent. These patterns need to await more work in these areas to be corroborated.

### **The Local Settlement Patterns: The Wetlands of India Muerta**

As summarized in the preceding chapter, the investigations by Bracco (1993) and Bracco and his collaborators (1999) in the wetlands of India Muerta identified the following settlement patterns. First, in regional terms (as discussed in the previous section), they noted that the upper freshwater wetlands of India Muerta display the largest aggregation of mound sites. At a smaller scale, they observed that in the wetland floodplain that mound sites are isolated or in groups of two or three positioned on top of the most prominent levees following the courses of the streams, displaying a linear pattern. In contrast, in the hills and flattened spurs adjacent to extensive wetlands areas and in large topographical prominences (above 15 masl) in the wetland floodplains, mound sites are large and spatially complex, displaying circular, horseshoe shape, linear or combined geometrical arrangements (see for example Figures 2.4, 2.5, 4.2-3). In the particular case of the northern end of the Sierra de los Ajos, Bracco (1993) noted that mound

clusters are located on top of hills following its flattened ridges and that the largest density of mounds is located on flat knolls immediately adjacent to extensive wetland areas. However, Bracco and his collaborators (1999) did not elaborate on the factors that may have shaped this apparent settlement pattern. In this section, I attempt to demonstrate the rationale behind the selection of particular flattened spurs for the location of the largest multi-mound sites in this area, which is not random, but intimately related to the topographic, hydrologic, and vegetation characteristics of the locality.

The first observable pattern is the circumscription of all mound sites to fertile wetland floodplains (López and Bracco 1992; 1994; Bracco 1992a; Bracco 1993; Bracco et al. 1999; Bracco et al. 2000d). The general location of sites in the region not only allows for immediate access to the rich and abundant wetland resources, but also is located in ecotonal areas. These transitional zones comprise a mosaic of wetlands, wet-prairies, upland prairies, riparian and palm forest, which present a greater diversity and abundance of resources than the surrounding areas by themselves. Second, the largest, more numerous and spatially complex multi-mound sites occur in the more stable sectors of the landscape, such as the flattened spurs of the Sierra de los Ajos (e.g., Los Ajos, Colina da Monte, Campo Alto) and the topographical prominences in the wetland floodplains (e.g., Estancia Mal Abrigo and Cinco Islas). Like Los Ajos, these large multi-mound sites do not only contain a central formal mounded area surrounding a central communal space, but they also present a large peripheral outer sector bearing more disperse and less formally integrated mounded architecture that may constitute large domestic outer precincts.

These sites located in higher topographical positions are secure from the seasonal flooding and at the same time allow for immediate access to the rich-resource and fertile wetlands areas. Unlike the more unstable locations in the wetland floodplains, which are subjected to unpredictable seasonal inundations, these locations were preferred sites for the establishment of larger and more permanent communities. The same pattern in which established, permanent communities are located on higher, more stable topographical areas adjacent to rich resources zones, has been documented in other areas with extensive wetland floodplains notably, the Illinois River (Brown and Vierra 1983: 171, Figure 9.1), the lower Mississippi valley (Gibson 1994: Figures 3 and 6), Amazonia (Denevan 1996; Heckenberger et al. 1999), and the lowlands of the Gulf coast (Cyphers 1997).

Within these flattened spurs and knolls overlooking the wetlands, there are other regularities that could be observed. For example, large sites are generally located where the active channel of streams impinges against the slopes of the hills and where numerous lagoons or oxbow lakes occur. These would have provided pre-Hispanic populations with easily accessible water, the excellent fishing grounds that oxbow lakes supply, and readily-access to the riparian forest resources, which grow along the major lagoons in the area. In addition, as mentioned before, this particular area comprised the distal sector of the wetlands of India Muerta alluvial fan and thus, (a) it was the least susceptible to water stress and most probably was the one that remained with the highest water table during dry periods compared to other areas of the region and (b) its soils were periodically replenished with nutrients from the floodwater and overbank flows of the Cebollatí River that inundates the area and periodically replenishes these soils with nutrients (Juan Montaña, personal communication 2000).

### **Summary**

It is my contention that the significant mid-Holocene drying trend that took place around 4,040 bp acted as a catalyst, causing the reorientation of settlements toward wetland areas, promoting the aggregation of populations in these preferred locations, which ultimately unfolded the process of village formation. Overall, combining the environmental features of the region, the new paleoclimatic record for the area, and our current knowledge of the mid- and late-Holocene marine oscillations, it becomes clear why the upper freshwater wetlands were preferred locations for early Formative societies to establish the more permanent settlements. Within the upper fresh-water wetlands, the more stable flattened spurs of Sierra de los Ajos and topographical prominences in the wetland floodplains were favored locations for the establishment of larger, spatially complex, more permanent nucleated settlements. Within the more unstable wetlands floodplains, smaller sites, mainly isolated mounds and clusters of 2 to 3 mounds were located on top of the more prominent levees of permanent streams. The mid-Holocene drying trend provided the impetus for the social processes that set off the emergence of early Formative societies in the region. I will return to these issues in the final chapter to consider them in depth. The next chapter present the archaeological investigations carried out at the Los Ajos site.

## **Chapter 4**

### **Archaeological Settings and Research at Los Ajos**

#### **Introduction**

One of the major lacunae in the archaeology of the area is a lack of community organization studies in large, formally arranged multi-mound sites. Despite the fact that the wetlands of India Muerta display the largest and spatially most complex sites, which contain the oldest and best developed Preceramic Mound Component, previous work in the area has been preliminary, limited in extent, and carried out with an ill-suited methodology to study settlement structure. Consequently, important questions crucial to study the nature of Los Ajos and by extension the large multi-mound sites in the area have remained unanswered. What do these large, formally laid out multi-mound sites, encompassing tens of mounds and covering dozens of hectares represent? Are they well-planned villages, vacant ceremonial centers, or do they represent villages that include public/ceremonial spaces? What are the formation processes and uses of these mounds? Are they residential, burial, or ceremonial in nature? Given the fact that Los Ajos was occupied over a period of ca. 3,500 yr, what was the occupational history of the site? More importantly, what was the nature and dynamics of the societies that built these complex mound sites?

In order to address these questions, this study is specifically tailored to study community patterns at the Los Ajos site. The archaeological investigations were originally planned at one of the circular mound clusters at the Estancia Mal Abrigo site (Figure 2.5), to follow up with previous preliminary work carried out by the author (Iriarte et al. 2001). However, for reasons beyond my control, the rice-growing company that owns Estancia Mal Abrigo did not grant me permission to carry out excavations at this site. Under these circumstances, I selected Los Ajos, which shares many commonalities with the circular mound clusters at Estancia Mal Abrigo, as I will describe below.

The selection of the Los Ajos site to study community organization was based on the following criteria. First of all, sites with complex mounded architecture geometrically arranged in circular, elliptical, and horseshoe formats such as Los Ajos represent one of the most recurrent spatial groupings of mounds within multi-mound sites in the region (Bracco et al. 1999; Iriarte et

al. 2001). Therefore, if we understand the nature of the occupation at Los Ajos, we can start to shed light on the settlement structure and the function of multi-mound sites in southeastern Uruguay. Secondly, the formal layout of Los Ajos and its internal structural units (e.g., mounds, plaza area, and crescent-shaped rises) lend itself to the study of the organization of the settlement and thus, represent an ideal context to test different scenarios about the uses and the nature of the occupation at the site. Thirdly, the prior work of Bracco (1993) at the site revealed the multi-component nature of this site bearing both a Preceramic and Ceramic Mound Components. Furthermore, currently, Los Ajos has the oldest and best dated Preceramic Mound Component in the region, consisting of a suite of five radiocarbon dates from the basal layer of Mound Alfa, ranging from ca. 3,950 to 3,550 bp (Table 4.4, below). Fourthly, the relative small size of Los Ajos has the potential to yield valuable information on community patterns within the time and labor constraints of a one-year project. Last but not least, the paleoclimatic record obtained through the combined pollen and phytolith analyses from the core sediment extracted from a nearby “off-site” location in the wetlands of India Muerta facilitated the correlation with the archaeological “on-site” data from Los Ajos to explore human-environment interactions during the mid-Holocene.

This chapter focuses on the field investigations carried out at Los Ajos. I begin with a description of the site’s geographical setting and its mounded and non-mounded architecture. Then, follows a detailed description of the excavations methods employed in order to study community organization and reveal the occupational history of Los Ajos. After that, I present the excavation results organized in terms of the stratigraphy in conjunction with information about the type and depth of deposits and features encountered. This chapter provides a chrono-stratigraphic framework for the artifact and ecofact analyses that are presented in the next Chapters 5, 6, 7. The results of the archaeological investigations presented in this chapter will be integrated with the study of artifact density trends, distribution of anthropogenically altered soils, and artifact assemblage composition that will be offered in Chapter 8. These combined data, will then be considered collectively in the concluding Chapter 9, where the final interpretations of this study are presented.

## Los Ajos Site

### Geographical Setting

Sierra de los Ajos is a hilly chain located in the northern sector of Rocha Province, 50 km away from the Atlantic coast. It runs in a NE direction for 20 km and reaches a maximum altitude of 90 masl. Los Ajos is located in the northern end of this hilly chain, which is characterized by a group of gentle knolls oriented S-SE/N-NE (Figure 2.6). To the north, these knolls descend into the wetlands locally known as “Estero del Medio” and “Bañado Rincón de la Paja”; and to the west they gently descend into “Bañado de la India Muerta”. Los Ajos site is situated on the flat top of a circular knoll (“lomada”), located in the eastern end of Sierra de los Ajos. The topography of this knoll is gentle, descending into the wet prairies and wetlands that surround the site (Figure 4.1). Within the circular flat top knoll area, where Los Ajos site is situated, there are no major natural boundaries constraining the size of the occupation and thus, facilitating the establishment of large communities. To the south, east, and north sectors of the site, the slopes slide down into the flat wet prairies with a 3.8%, 3.4%, and 2.8% slope, respectively. To the west of the site, Sierra de los Ajos ascends smoothly with a 1.6%<sup>11</sup> slope. The site is bordered by Laguna de los Ajos, which is part of an integrated system of active and abandoned lagoons and meanders that comprise the wetlands of India Muerta (Figure 4.1). The soil in the central sector of Los Ajos is characteristic of rocky hills and knolls in the area, referred to as “Litosols” (Altamirano 1998:51). Litosols are constituted by slightly developed, superficial, A-R horizon soils that are not deeper than 30 cm and could be as shallow as 2-3 cm in areas where hard rocks are highly resistant to weathering. In general, the slightly developed A horizon surface is sandy with gravel inclusions. Below this A horizon, there is a gravel layer of decomposed rock that lies on top of the rhyolite bedrock.

In terms of vegetation, Los Ajos site is located in a hilly prairie dotted with exposed rock outcrops (Bracco 1993; Iriarte and Alonso 2002). In an outward direction from the center of the hilltop, where the central part of the archaeological site lies, the site is bordered by a succession of wet prairies, marshes, riparian forests, and the Laguna de los Ajos. A narrow strip of riparian

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<sup>11</sup> The slope percentage is represented by the vertical change in elevation across a certain horizontal distance. It is calculated by dividing the vertical distance by the horizontal distance.

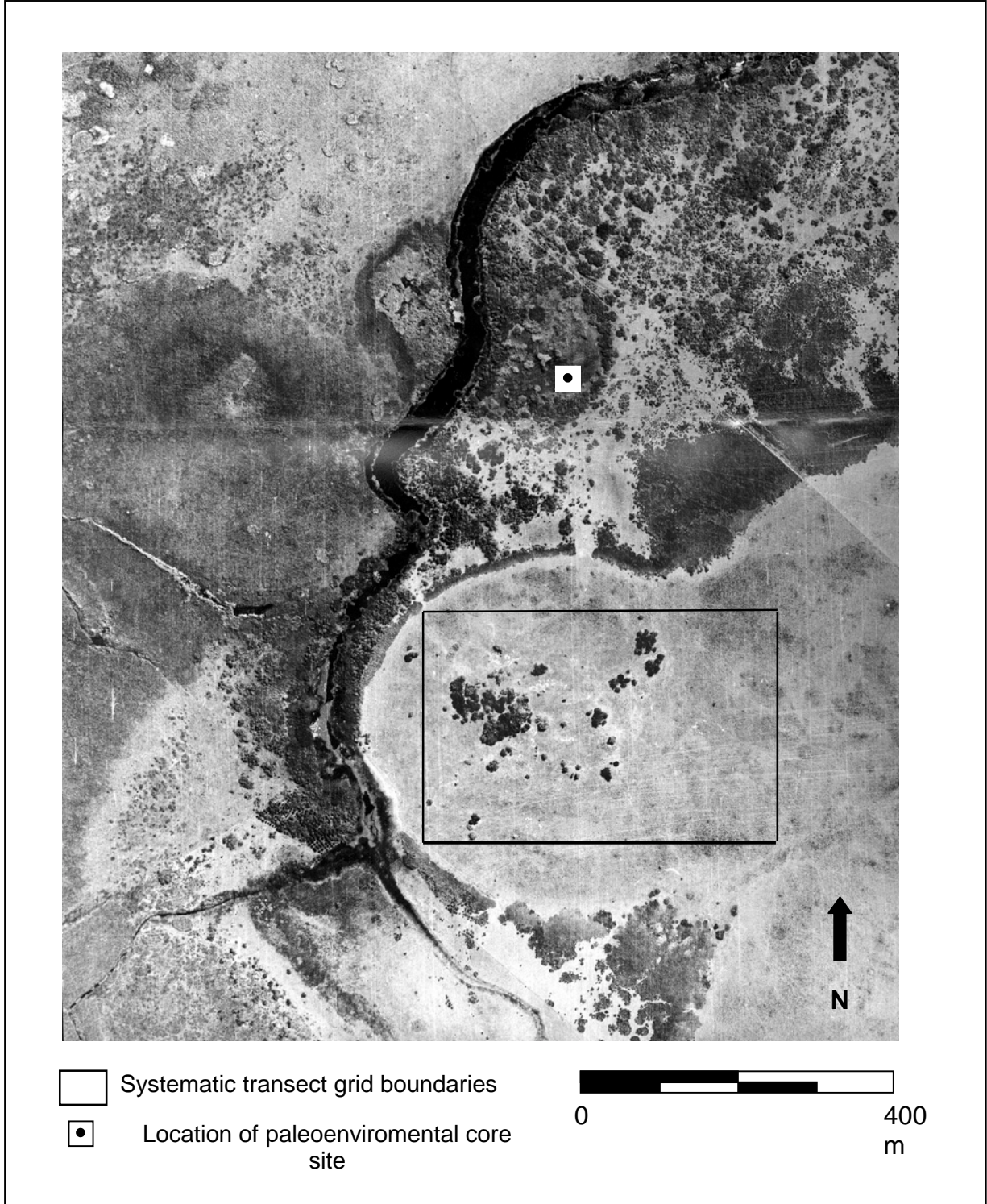


Figure 4.1. Aerial Photograph 1:5,000 of Los Ajos Site Showing Location of Grid Limits and the Location of the Paleoenvironmental Core Site.



forest, which does not reach more than 50 m wide, borders Laguna de los Ajos. A detailed description of the vegetation formations of the area was presented in the Modern Vegetation section of Chapter 3. In addition, Appendix 1 contains the plant inventory of the area carried out by project botanist Licenciado Eduardo Alonso (see also Iriarte 2003; Iriarte and Alonso 2002).

Los Ajos is situated in a clearly advantageous location within the wetlands of India Muerta for a number of reasons. The site is positioned in an ecotonal area surrounded by Laguna de los Ajos, wetlands, wet prairies, upland prairies, gallery forest, and the most fertile soils in the region as well as nearby the extensive palm forests on the north of the site. More importantly, the site has ready access to all these habitats, but also is located on a stable landscape position, free from the periodic floodings of the wetlands of India Muerta. This is not the case at the smaller sites in the wetlands floodplains, which are often subjected to inundations. The site also is located in the distal sector of the India Muerta alluvial fan, which is less susceptible to water stress because it has the highest water table during dry periods. Moreover, its soils are periodically replenished with nutrients by the floodwater and the overbank flow of the Cebollatí River that frequently inundates the area (Juan Montaña, personal communication 2000), which make it a suitable place for the practice of flood-recessional horticulture. As will be argued below, all these characteristics provide indirect evidence that lend support, together with other lines of evidence developed throughout this study, to the proposition that Los Ajos was a fairly permanent and large community.

### **Archaeological Description of the Site**

As reviewed earlier in Chapter 2, Bracco's work at Los Ajos (1993) marked a breakthrough in the archaeological investigations carried out in the region. However, to this date, we still do not have enough information about the characteristics of the site, such as a map of the entire site, the definition of site limits, the distribution of residential occupations, and the site's settlement history.

In order to obtain a complete topographic map of the site, I and an engineer, Diego Perera, produced a topographic survey of the entire site and laid out a 50 x 50 m grid in order to place the test units to conduct a systematic interval transect sampling in the off-mound areas of the site. Figure 4.2 shows a combined topographic and planimetric map of Los Ajos. Following

the earlier excavation of the site by Bracco (1993), who identified the excavated mounds with Greek letters, Alfa and Beta, respectively, I used the same approach and referred to the mounds excavated during this project as Gamma and Delta, respectively. The rest of the mounds were identified arbitrarily with numbers. Figure 4.3 displays a detail topographical map of the central sector of the site done by Bracco (1993), indicating the location of the excavation units referred to in the text below. What follows is the description of the site as we perceive it today, knowing beforehand that the site presents a long and complex architectural history that will be unravel in the chapters to follow.

The Los Ajos site is one of the largest and most formally laid out multi-mound sites in the southern sector of the Laguna Merin Basin covering ca. 12 ha. The central zone of the site, located on the highest part of the knoll, includes seven flat-topped, beveled-edged mounds closely arranged in a horseshoe format, whose base is located to the northeast and opens to the west. The presence of a circular and an elongated dome-shaped mound in the opposite southwestern sector encloses a central, cleared, fairly oval space of 75 x 50 m called the plaza area (Figure 4.3, 4.4a). Together, this compact and formal central sector of the site, which includes the central plaza and the mounds that flank it, is denominated the *inner precinct*. Its detailed topographical contour map is shown in Figure 4.3.

The outer sectors of the site, peripheral to the inner precinct, present a variety of architectural and topographical features, which are more disperse and less formally laid out. They consist of two crescent-shaped rises framing the inner precinct, five circular and three elongated dome-shaped mounds, a vast outer, off-mound area of subsurface domestic debris and several borrow areas. To the NE of the inner precinct, there is a crescent-shaped rise 14-25 m wide and 0.40-0.80 m tall, which extends over 150 m surrounding Mounds Alfa and Delta at a distance of 15-20 m from each other (hereafter called TBN<sup>12</sup>). At its base, the crescent shape becomes wider prolonging itself to the NE and forming a rounded elongation (Figures 4.2, 4.3, 4.4b), which faces the platform Mound 13. Collectively, the horse-shoe arrangement of more imposing flat-topped, beveled-edged mounds, the TBN crescent-shaped rise, and Mound 13 seem to form part of an integrated architectural plan. Mound Delta at the base of the horseshoe arrangement of platform mounds, the base of the TBN and the orientation of Mound 13 all point

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<sup>12</sup> The denomination TBN comes from the informal name given to the crescent-shape rises referred to as “bananas”. TBN means “Trinchera Banana Norte” and TBS stands for “Trinchera Banana Sur”.

to the NE. Altogether, they appear to represent an emergent and idiosyncratic form of public architecture possibly used to perform centralized public ceremonies during the CMC at Los Ajos. On the SW end of the inner precinct, there is an arc-shaped rise that encircles Mounds 5, 8, and 9. It is longer, lower and narrower than the TBN, measuring 4-8 m wide and 15- 35 cm tall and extending over 150 m (hereafter called TBS).

Separating the mounds from the crescent-shaped rises is a flat area devoid of any midden accumulation, called intermediate area. In the TBN, this area extends from 8 to 25 m long; in the TBS, this area is much larger covering between 15 and 60 m in length (see Figure 4.2). These flat areas produced the effect of pronouncing the height of the steep-sided platform mounds, creating a sharp differentiation of space and adding a more formal impression to the inner precinct.

The more peripheral areas of the site present a more informal layout characterized by the presence of low, circular and elongated dome-shaped mounds. To the east of the inner precinct occur the large, very low Mound 9 and the elongated Mound 8 oriented in N-S direction. To the N/NW of the site occur the low elongated Mound 10 oriented N-S and the two low, circular mounds, Mound 11 and Mound 12. The low circular Mound 14 and the elongated, dome-shaped, Mound 15 are located to the E/SE of the inner precinct. In combination with these more informally laid out mounds in the peripheral area, the systematic trench transect of test units revealed a vast outer flat off-mound areas bearing subsurface domestic debris covering ca. 12 ha. Beyond the crescent-shaped rises, there are extensive borrow areas. Some of these borrow areas cover an area over 4,000 m<sup>2</sup>. Only the most prominent ones were mapped and plotted in Figure 4.2.

Tables 4.1, 4.2, and 4.3 offer a detailed description of the dimensions (length, width, height, and slope), shapes, and orientations of the mounds identified at Los Ajos. The flat-topped, beveled-edged mounds have a quadrangular base, mostly quadrangular to rectangular tops, with surface areas that range from 434 to 2639 m<sup>2</sup>. They present slopes that range from slight (7.1%) to fairly steep (65.5%) ones and are the tallest mounds of the site between 1.7 and 2.5 m tall. Interestingly, as in other multi-mound sites in the region, such as Colina Da Monte, the platforms mounds are located in the central part of the site. The dome-shaped mounds are circular and elongated in planar view. The comparisons among different types of mounds generated interesting patterns. In contrast to the platform mounds, the dome-shaped mounds are

lower; varying from 0.3 to 1.41 m high, exhibit larger bases but smaller tops, and have gentler slopes (3.4-38.2%). Unlike the platform mounds, most of the dome-shape mounds are located in the periphery of the site. Only one platform mound, Mound 13, is not located in the inner precinct of the site. It is placed to the NE of this central sector of the site and it appear to be articulated with the TBN base and Mound Delta.

In general, the formal and more compact layout of the inner precinct contrast with less formal and more dispersed arrangement of architecture in the outer precinct, which lacks and integrated formal arrangement. As mentioned above, the NE sector of the inner precinct together with the TBN and Mound 13 form an integrated architectural plan. Significantly, they also marked a prominent spatial asymmetry within the inner precinct. On the one side, the NE sector of the inner precinct is more formal and prominent characterized by the steep-sided, relatively high platform mounds presenting a flat, fairly rectangular area at the top. These are framed by a larger, wider, and taller crescent-shaped rise, which articulates with Mound 13. On the opposite side of the plaza, the SW end is less formal and conspicuous, being characterized by low, dome-shaped, circular mounds, which are surrounded by less visible TBS crescent-shaped rise. To what extent these spatial differences reflect incipient social inequalities between two possible distinct residential wards, one located to the SW and the other to the NE of the inner precinct are question that will be discussed in the chapters to follow as the results of the investigation are presented.

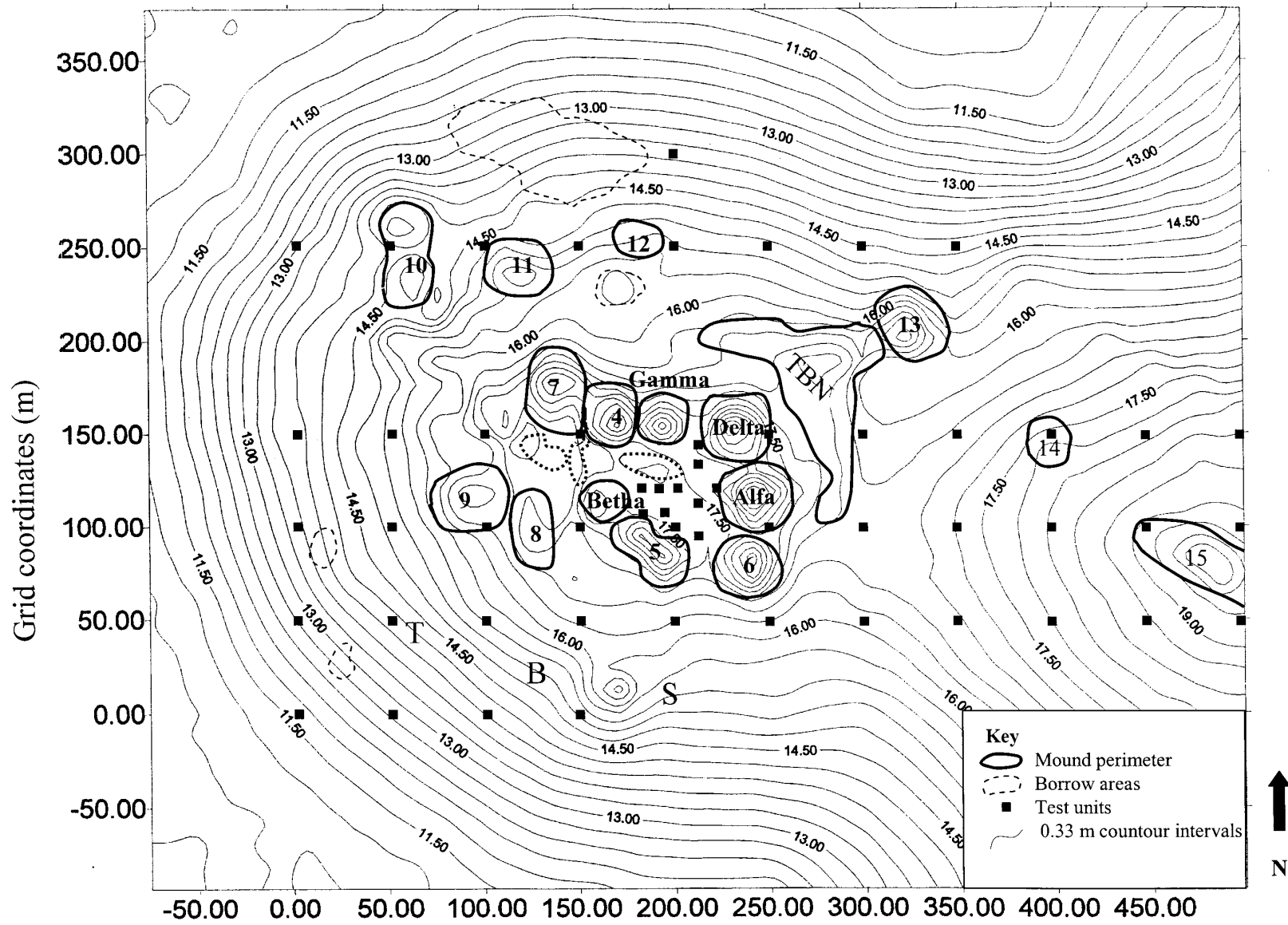


Figure 4.2. Topographical and Planimetric Map of Los Ajos Site

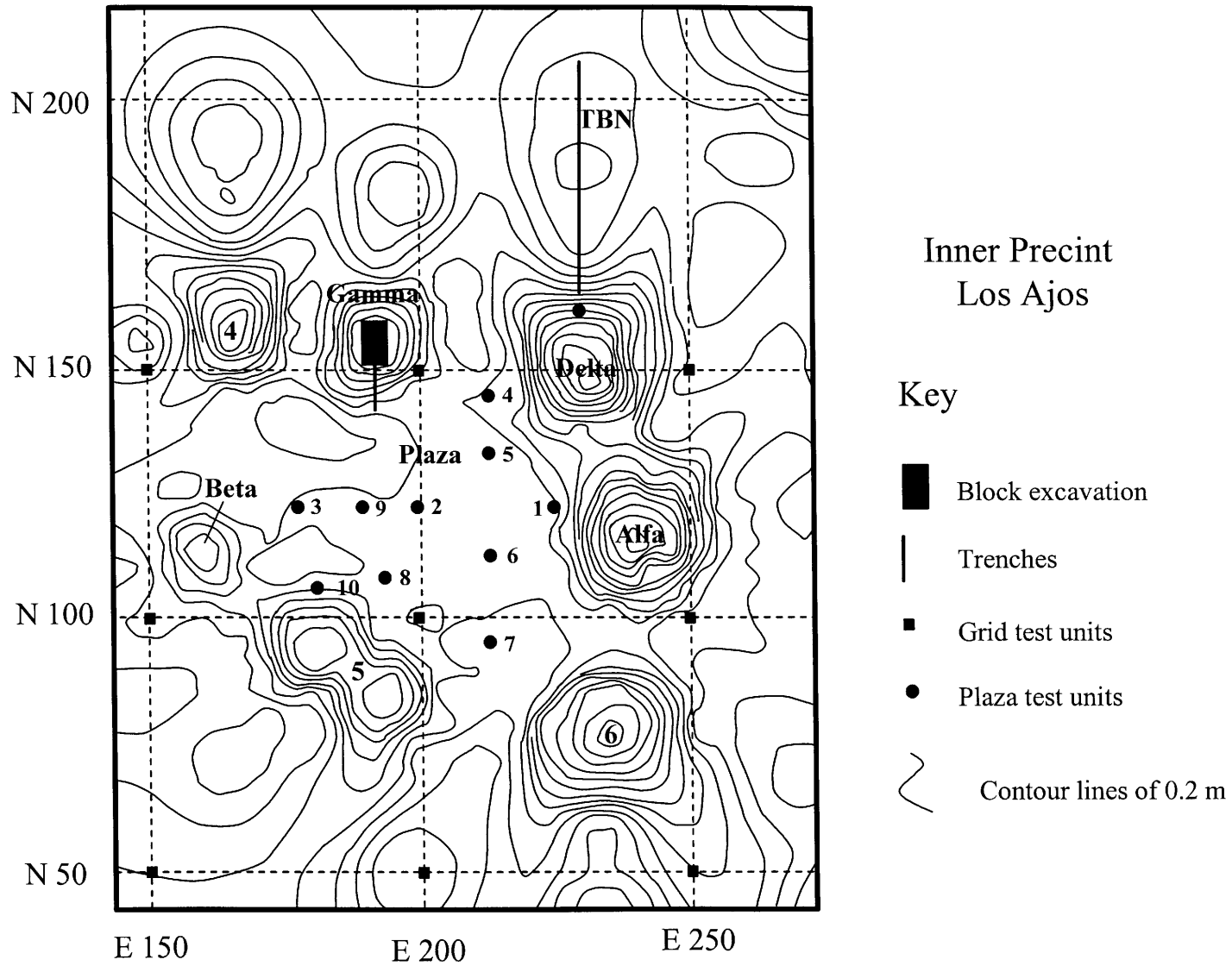


Figure 4.3. Inner Precinct of Los Ajos (Redrawn from Bracco 1993)

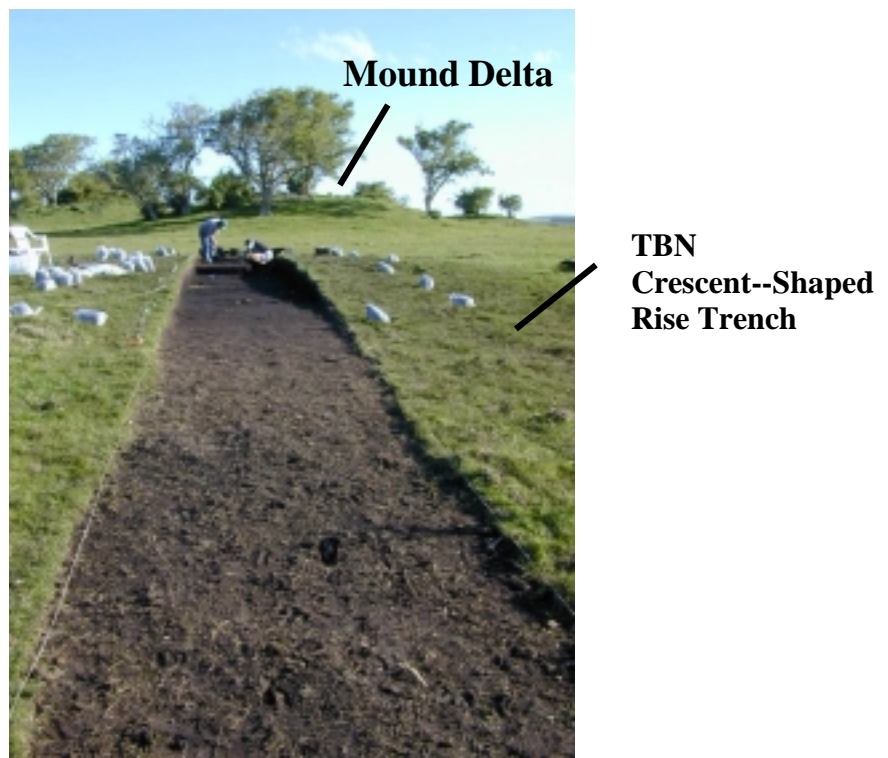
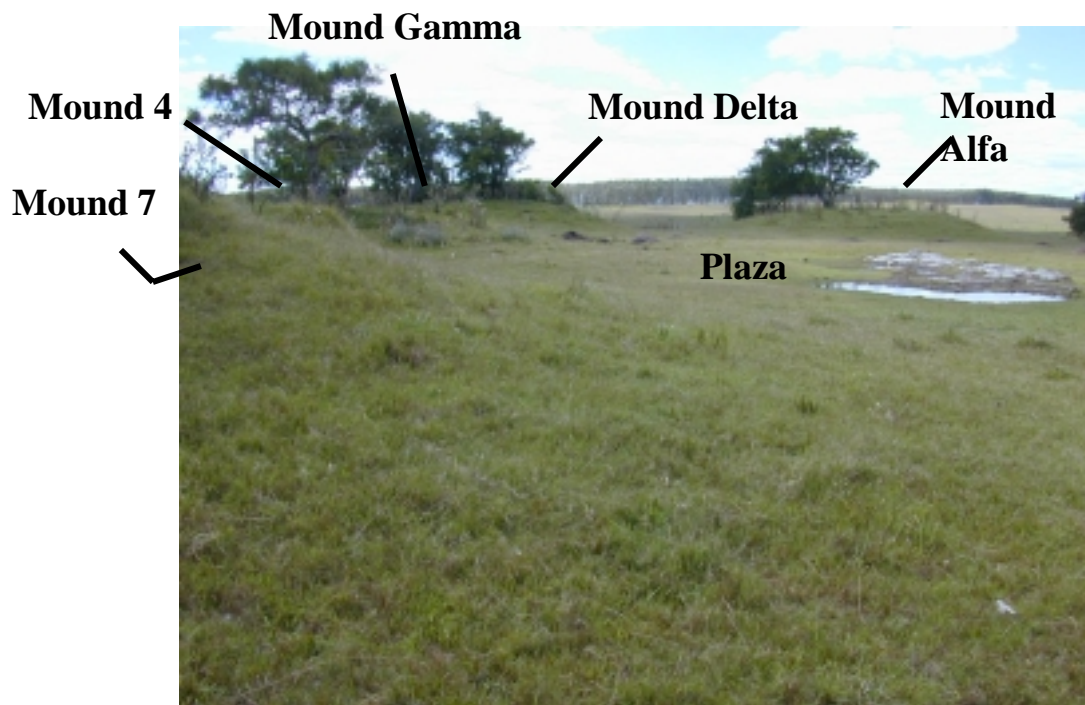


Figure 4.4. a: View of the Central Part of the Site from E to W, Note the Flat-Topped, Beveled -Edged Shape of the Mound; b: View of the TBN Trench from N to S.

Table 4.1. Dimensions, Shape, Height, Slope, and Orientation of Los Ajos Site Mounds.  
 All measurements are in meters. Surface is expressed in m<sup>2</sup>.

Mound	Mound base					Mound top							Orientation	Profile
	Length	Width	Diameter	Surface	Shape	Length	Width	Diameter	Surface	Shape	Height	Slope		
Alfa	33.3	32.1		1071.4	Q	13.1	15.5		202.7	Q	2.45	34.3	S-N	FT-BE
Delta	32.1	33.3		1071.4	Q	12.5	13.1		163.7	Q	2.48	29.8	S-N	FT-BE
Gamma	21.4	20.2		433.7	Q	7.14	10.7		76.5	Q	1.72	41.3	S-N	FT-BE
4	23.8	19		453.5	R	7.14	10.7		76.5	Q	2.34	65.5	S-N	FT-BE
Betha			17.9	251.7	C			4.17	13.7	C	1.41	29.6		DS
5	36.9	23.8		878.7	O	22.6	11.9		269.3	O	1.69	47.3	315 NW	DS
6	33.3	28.6		952.4	Q	11.9	14.3		170.1	Q	2.42	33.9	S-N	FT-BE
7	47.1	29.4			E	17.6	20.6			Q	1.88	21.3		FT-BE
8	44.1	20.6			E	29.4	8.82			E	0.95	8.08	S-N	DS
9			38.2	1148.2	C			23.5	434.8	C	1.24	8.43	S-N	DS
10	55.9	26.5			E	41.2	11.8			E	1.34	9.11	S-N	DS
11			35.3	978.4	C			11.8	108.7	C	1.19	5.06		DS
12			26.5	550.3	C			11.8	108.7	C	0.87	5.92		DS
13	55.9	47.1		2629.8	Q	20.6	17.6		363.3	Q	2.1	7.14	320 NW	FT-BE
14			26.5	550.3	C			17.6	244.6	C	0.3	3.4		DS
15	82.4	32.4			E	38.2	11.8			E	1.38	6.7	310 WNW	DS

Note on abbreviations:

- FT-BE Flat-Topped Beveled-Edged
- DS Dome Shaped
- Q Quadrangular
- R Rectangular
- C Circular
- O Eight-shape



Table 4.2. Dimensions, Shape, Height and Slope of Flat-Topped, Beveled-Edged Mounds.

All measurements are in meters. Surface is expressed in m<sup>2</sup>.

	Mound base				Mound top				Height	Slope	Orientation
	Length	Width	Surface	Shape	Length	Width	Surface	Shape			
Alfa	33.3	32.1	1071.4	Q	13.1	15.5	202.7	Q	2.5	34.3	S-N
Delta	32.1	33.3	1071.4	Q	12.5	13.1	163.7	Q	2.5	29.8	S-N
Gamma	21.4	20.2	433.7	Q	7.1	10.7	76.5	Q	1.7	41.3	S-N
4.0	23.8	19.0	453.5	R	7.1	10.7	76.5	Q	2.3	65.5	S-N
6.0	33.3	28.6	952.4	Q	11.9	14.3	170.1	Q	2.4	33.9	S-N
7.0	47.1	29.4		E	17.6	20.6		Q	1.9	21.3	S-N
13.0	55.9	47.1	2629.8	Q	20.6	17.6	363.3	Q	2.1	7.1	320 NW
AVG	35.3	30.0	1102.0		12.9	14.6	175.5		2.2	33.3	
STD	12.3	9.3	803.2		5.0	3.6	105.6		0.3	18.0	
MIN	21.4	19.0	433.7		7.1	10.7	76.5		1.7	7.1	
MAX	55.9	47.1	2629.8		20.6	20.6	363.3		2.5	65.5	

Table 4.3. Dimensions, Shape, Height and Slope of Circular, Dome-shaped Mounds.  
 All measurements are in meters. Surface is expressed in m<sup>2</sup>.

	Mound base			Mound top			Height	Slope	Orientation
	Diameter	Surface	Shape	Diameter	Surface	Shape			
Betha	17.9	251.7	C	4.2	13.7	C	1.4	29.6	
9	38.2	1148.2	C	23.5	434.8	C	1.2	8.4	S-N
11	35.3	978.4	C	11.8	108.7	C	1.2	5.1	
12	26.5	550.3	C	11.8	108.7	C	0.9	5.9	
14	26.5	550.3	C	17.6	244.6	C	0.3	3.4	
AVG	28.9	695.8		13.8	182.1		1.0	10.5	
STD	8.1	362.0		7.3	163.5		0.4	10.8	
MIN	17.9	17.9		17.9	17.9		17.9	17.9	
MAX	38.2	38.2		38.2	38.2		38.2	38.2	

To anticipate the results, the archaeological investigations at Los Ajos indicate that platform mounds postdate dome-shaped mounds. The former are the result of the remodeling of the latter through intentional capping episodes with gravel. The initial dome-shape mounds, which correspond to the Preceramic Mound Component, are the result of the accretion of multiple overlapping residential occupations. The later platform mounds correspond to the Ceramic Mound Component and are built through the accretion of occupational refuse, intentional capping episodes, and the repeated placement of interments. I will return to these points below.

### **Excavation Methods: Revealing Community Organization**

Taking into account the characteristics of the mounded and non-mounded architecture described above and with the objective of studying community organization at Los Ajos, the excavation program was aimed at (a) delineating site size and its boundaries; (b) defining how settlement space is partitioned in mound and off-mound areas; (c) documenting the nature of activities in the various partitions; and (d) determining how these different areas relate to the organization of the community and occupational history of Los Ajos. Based on the nature of the deposits at Los Ajos, the excavation program sought two complementary strategies. On the one hand, the shallow deposits of the off-mound areas were targeted through a systematic interval transect sampling strategy of 1.5 x 1.5 m test units (hereafter called grid units). On the other hand, the deep mound deposits were excavated through a block excavations and trench transects.

The shallow deposits of the off-mound areas were targeted through a systematic interval transect sampling strategy. Transects were laid out at 50 m intervals in N-S/ E-W direction. The grid covered an area of ca. 12 ha with an E-W axis measuring 500 m and the N-S axis measuring 350 m. Test units of 1.5 x 1.5 m, spaced at 50 m intervals along the transects were excavated, and were assigned North (N)/ East (E) coordinates with reference to the control stakes placed at 50 m intervals across the field where the grid was laid out. The N 0 E 0 coordinate is located at 33 42'02.9" S and 53 57'32.4" W UTM coordinates. A total of forty seven test units of 2.25m<sup>2</sup> were excavated in the off-mound points of the grid laid over the 12 ha area. Given that only one grid test unit (N100 E250) fell within the plaza area, ten additional test units of 1 x 3 m were targeted across the plaza area in order to get a better understanding of its stratigraphy and artifact

content (hereafter referred to as plaza units). Combining the grid units with the targeted plaza units, they together add up 135.75 m<sup>2</sup>, generating a sampling intensity of the off-mound areas of 0.090%.

The second excavation strategy consisted of a block excavation and trenches. A block excavation of 5x7 m was placed on top of Mound Gamma. Mound Gamma was chosen for the following reasons. First, three mounds at the site have already been excavated. Bracco (1993) excavated Mounds Alfa and Beta and Colonel López Piriz, an amateur archaeologist, excavated Mound 4 in the 1950s (Dr. Gustavo Uriarte and Colonel López Piriz, personal communication 1999). Second, most of the other mounds, which are located in the central part of the site, such as Mounds 6, Delta, and 9 exhibit extensive evidence of bioturbation due to the presence of rodent burrows and several trees on top of them. Therefore, the presence of only one tree, the relatively small size of the mound as well as the absence of any major superficial indications of extensive bioturbation, were all taken into account when selecting Mound Gamma to carry out a block excavation. The main purpose of this large block excavation was to uncover any structure that may appear on the top section of the mound. Figure 4.3 depicts a topographical map of the inner precinct of Los Ajos showing the location of Mound Gamma block and trench excavations. Figure 4.5 (below) illustrates the provenience map of these excavations to aid the reader.

In addition, two trenches were excavated with the goal of understanding the articulation between mound and off-mound stratigraphies. One trench of 1x10 m was placed from the center of the south border (sector 1/C) of Mound Gamma block excavation following a south direction to the center of the plaza area (see Figure 4.5 below). The other trench, measuring 40 m long by 2 m wide, was placed in the area that interconnects the off-mound area, the TBN crescent-shaped rise, the intermediate area within the TBN, and the lower and upper slopes of mound Delta. Figure 4.18 (below) illustrates the provenience map for the TBN trench. The purpose of this trench was to understand the nature of the TBN crescent-shaped rise, its chronology, and its relation to other architectural forms at the site.

The excavation strategy was tailored to detect both household scale features and provide baseline data on artifact distribution suitable to carry out trend analysis, define activity areas (e.g., Flannery 1976; Stark 1991; Siegel 1995; Pool 2003), and ascertain chronological relationships, as well as dietary patterns. The test units, the block excavation, and the trench transects were aimed at providing a better understanding of the nature of the midden

accumulation and the occupational history of the site through controlled observation of the composition and boundaries of the mound and off-mound deposits (e.g., color, texture, and internal structure), the distribution of cultural features in relation to mound strata, and the analysis of artifact attributes (e.g., size, weight, and densities), and features in conjunction with stratigraphy. All of these provided a means for defining mound formation processes in order to differentiate fill from occupational events and understand the modes and rates of deposition (Flannery 1976; Hall 1994; Lesure 1997). It also provided baseline stratigraphic data for defining the site chronology. In sum, if we include all the excavation units, a total of 264.75 m<sup>2</sup> were excavated in a period of seven months from August 1999 to February 2000.

The crew consisted of two permanent workers and a maximum of fifteen undergraduate students from the State University of Uruguay (Departamento de Antropología, Facultad de Humanidades y Ciencias de la Educación, Universidad de la República) who worked full-time on a 10-day shift period. Both the test units and the trench transect were excavated down to the base of the cultural deposits, using standard troweling and shovel-skimming techniques, following 5 cm arbitrary levels since cultural strata was extremely difficult to define due to the dark homogeneous color of the sediments. Intensive hand excavation was carried out to uncover features such as stone- structures, hearths, and burials. However, in most instances, the extreme accuracy of piece plotting was sacrificed in order to open a large block unit and favor the discovery of features and the collection of a greater sample and wider range of assemblages.

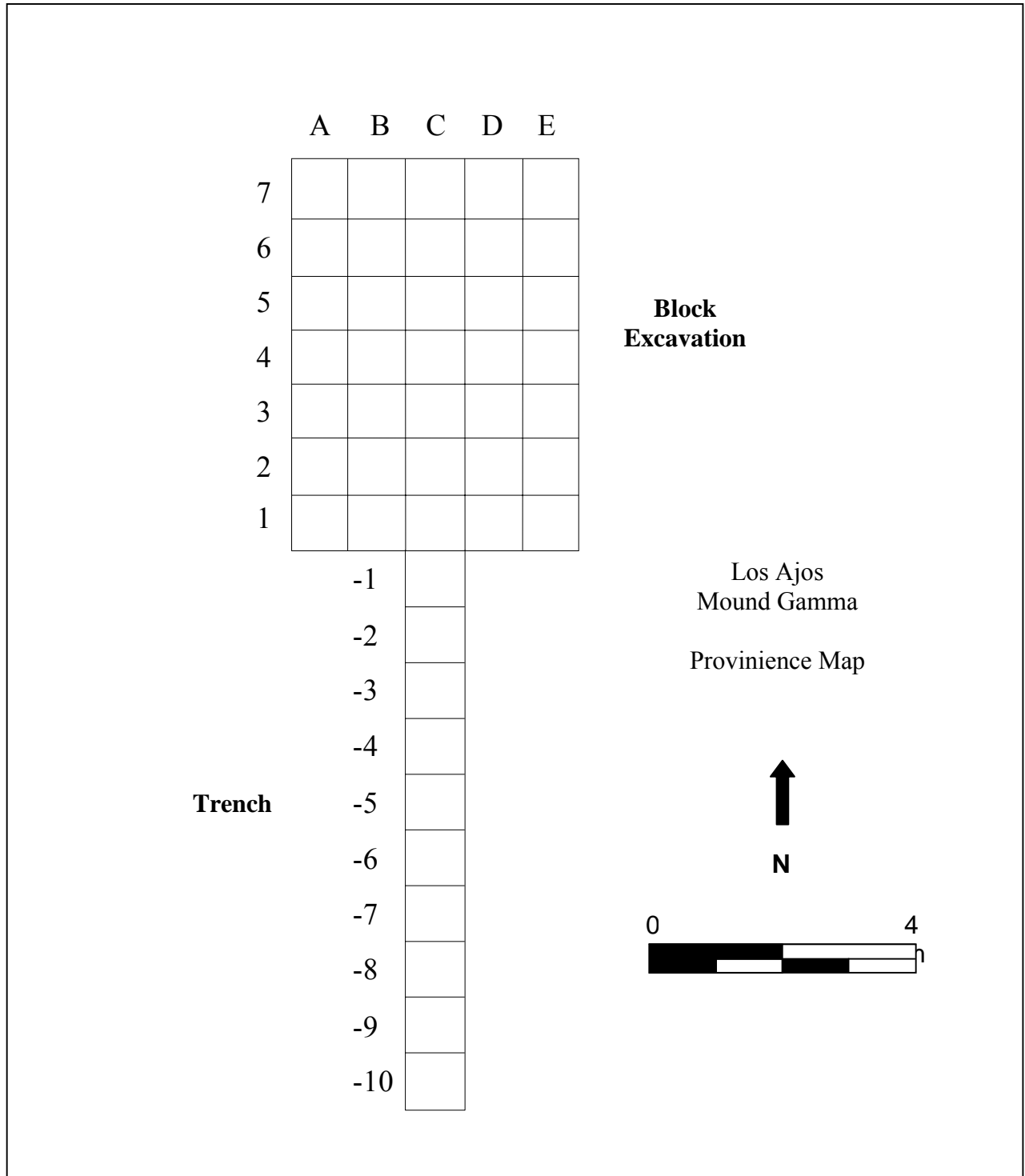


Figure 4.5. Provenience Map, Mound Gamma Block Excavation and Trench. Figure 4.3 show the location of the block excavation and the trench within Mound Gamma in the central sector of the site.

All excavated sediments were screened through a 5 mm mesh sieve. Additionally, 20-liter flotation samples and 50 g for phytolith samples were collected from each level and from selected features (A detailed description of flotation, phytolith and starch grain analyses methods are offered in Chapter 6). During excavation, charcoal samples from well-documented and controlled features were collected for radiocarbon dating. All the artifacts from the excavation were washed and catalogued in the field laboratory. The floor of each excavated level was graphically recorded with line drawings and photographs showing soil color and artifact location before a new level was dug. Stratigraphic features were sectioned during excavation to reveal their vertical patterning and then were drawn and photographed both in plan and profile. At the completion of each test unit, when 10 cm of sterile soil were encountered below the lowest cultural layer or when the bedrock was hit, the north and west walls of the unit were drawn and photographed in profile.

### **Analysis Strategy**

In this section, I briefly explain the rationale of the analytical strategies followed in order to analyze and then interpret the cultural materials recovered during the excavations at the site. More details of each assemblage are provided in the specific chapters. In general terms, the analyses of all collected materials followed three main stages: (a) classification, (b) data manipulation, and (c) interpretation.

In the case of lithic and phytolith analyses, all three stages were carried out by the author. The results of the lithic analysis are offered in Chapter 5. Oscar Marozzi mainly did the analysis of the lithic debitage under the supervision of the author. The author carried out the analysis of the lithic tools.

Chapter 6 offers an integrated analysis of starch grains and phytoliths from plant grinding tools' residue and selected sediments with the faunal analysis of the bone assemblage in order to elucidate the early Formative economy. The author learned phytolith analysis through an internship at the Smithsonian Tropical Research Institute in Panama (hereafter STRI) under the supervision of Dr. Dolores Piperno in 1999, funded by STRI and a Kentucky Research Challenge Fellowship. Between April and December 2001, as part of the Wenner-Gren – STRI funded project titled “Human-Environment Interactions in Southeastern Uruguay during the Mid-

Holocene”, the following analyses were performed at STRI under the supervision of Dr. Dolores Piperno: (a) the construction of a phytolith modern plant reference collection, including 110 selected species from southeastern Uruguay; (b) phytolith analysis of modern soils from the most representative vegetation formations (Iriarte and Alonso 2002); (c) phytolith analysis from archaeological sediments from profiled walls and selected features; and (d) phytolith and starch grain residue analyses from plant processing tools recovered in this study. The starch grain analysis from plant-processing tool residues was carried out by Dr. Dolores Piperno and Irene Holst.

Paleontologist Licenciado Andrés Rinderknecht from the Museo de Historia Natural in Uruguay performed the faunal identification using both the animal reference collection curated at the aforementioned museum and his own. The combined results of phytoliths, starch grains, and faunal analyses are presented in Chapter 6.

Archaeologist Oscar Marozzi carried out a preliminary ceramic analysis using attributes defined in previous ceramic analysis carried out in Uruguay (Bracco 1992b, 1993; Bracco et al. 1993; Bracco and Nadal 1991) and southern Brazil (Schmitz 1976) (see Appendix 6), which are presented in Chapter 7. Textural and chemical analyses of soil samples were done at the University of Kentucky’s Agricultural Laboratory and are presented in detail in Appendix 7 and are interpreted and discussed in Chapter 8. The radiocarbon assays were processed at Beta Analytic Inc. and are displayed in Table 4.4. Their stratigraphic positions are sketched in Figure 4.6 and 4.17 (see below)



Table 4.4. Radiocarbon Dates from Los Ajos.

Provenience (Unit)	Depth (cm)	Lab number	Dated material	Conventional C-14 age bp	Intercepts of radiocarbon age with calibration curve (cal. bp)*	1-Sigma calibrated results (cal. bp)	2-Sigma calibrated results (cal. bp)
Mound Delta	205-210	Beta-158277	charcoal (EC)	2,960±120	3140	3300-2940	3400-2740
Mound Gamma, sector 1/D	210-215	Beta-158279	charcoal (EC)	3,460±100	3700	3850-3600	3980-3470
Mound Gamma, sector 6/C	270-275	Beta-158280	charcoal (AMS)	4,190±40	4280	4830-4810	4840-4580
TBN trench, sector 6	190-195	Beta-158281	charcoal (AMS)	1,660±40	1550	1580-1530 1630-1500	1690-1660,
TBN trench, sector 7	160-165	Beta-158278	charcoal (AMS)	1,050±40	950	970-930	1050-920
Mound Alfa, Layer III	285-290	URU 0033	charcoal	3,870±280	4344, 4340, 4287, 4267, 4262	4808-3874	5034-3484
Mound Alfa, Layer III	295-300	URU 0034	charcoal	3,690±270	4070, 4046 3988	4418-3643	4830-3364
Mound Alfa, Layer III	280-285	URU 0052	charcoal	3,550±60	3833	3902-3724	4056-3644
Mound Alfa, Layer III	340-345	URU 0089	charcoal	3,950±80	4415	4518-4262	4780-4151
Mound Alfa, Layer III	345-355	URU 0088	charcoal	3,750±140	4141, 4125 4091	4351-3900	4518-3700

(EC) Extended counting

\* Calibrated date ranges were derived from Calib 4.1 Program, Stuiver et al. 1993 [available at <http://depts.washington.edu/qil/calib>].

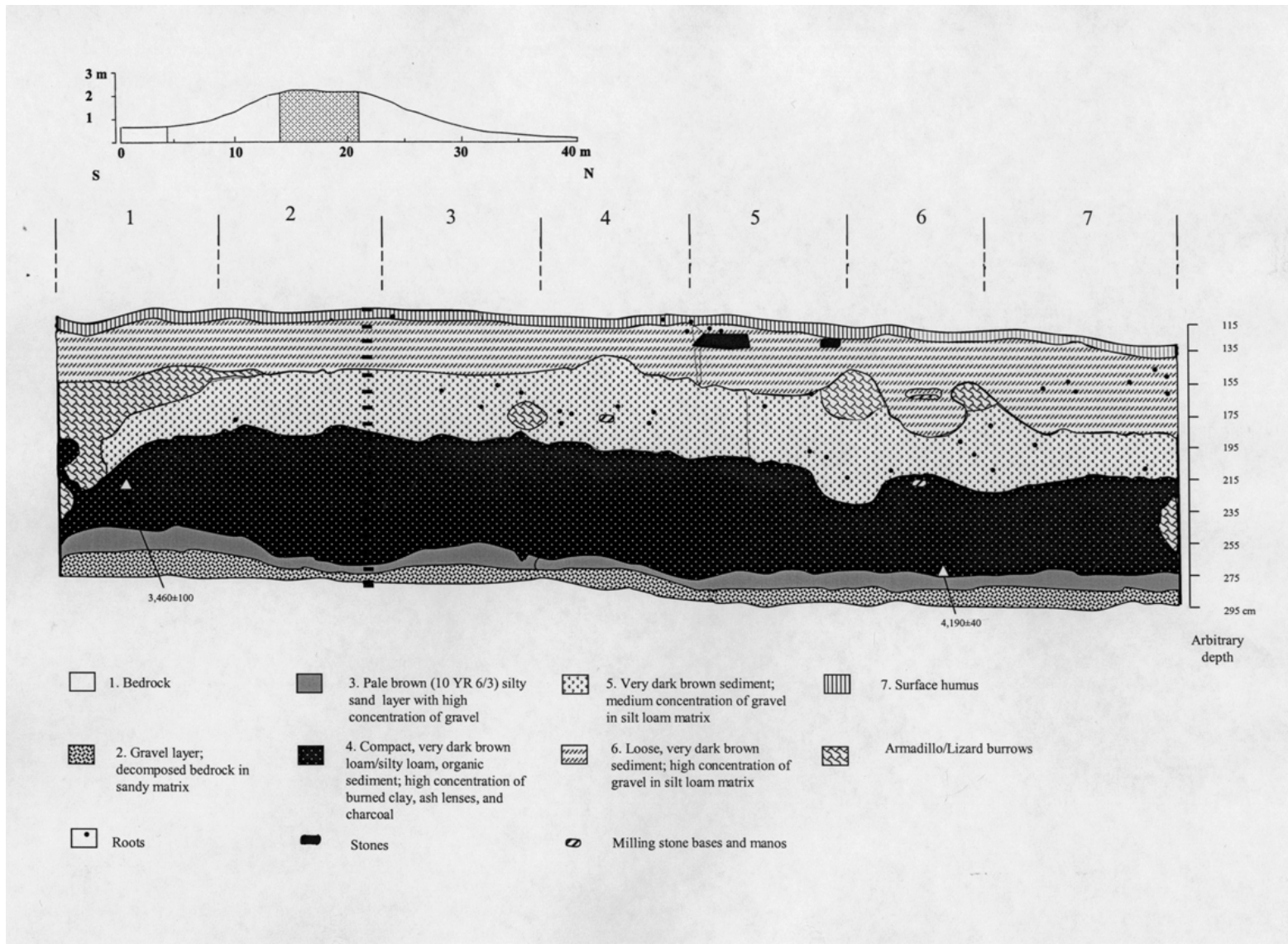


Figure 4.6. Mound Gamma Block Excavation Viewed from West Wall.

## **Excavation Results**

This section details the excavations with a focus on the stratigraphy, the type and depth of deposits, and the features encountered. The description of the excavations that follows is meant to provide both stratigraphic and chronological contexts for the more detailed description of artifacts that are presented in Chapters 5, 6, and 7. The description of the excavations is organized in mound and off-mound areas and within these two major divisions I offer a description by excavation unit, component, layer, and features encountered.

To anticipate the results, three major components were identified based on the assessment of stratigraphy, radiocarbon dates, and the relative position of diagnostic artifacts content: a Preceramic Archaic Component (PAC) (Early Holocene – ca. 4,190 bp), a Preceramic Mound Component (PMC) (4,190 to 3,000-2,500 bp), and a Ceramic Mound Component (CMC) (3,000-2,500 bp – Contact Period).

Before proceeding with the description of the excavation results, some preliminary remarks are in order. On the one hand, it should be mentioned that these components are better defined in some parts of the site than in others. The artifacts obtained from the large excavations in Mounds Gamma and Delta and the TBN trench, which present deeply stratified contexts, clear stratigraphic divisions and radiocarbon dates could be more securely assigned to each of these components. On the other hand, in shallow off-mound areas where radiocarbon dates were not obtained, the definition of these components is less precise. This situation is made worse by the lack of diagnostic time-sensitive artifacts but the presence of ceramics. In this regard, we should view the temporal divisions in the off-mound contexts as coarse-grained and subject to refinement with future work at the site.

### **Mound Excavations**

#### **Mound Gamma**

A block excavation of 5 x 7 m was placed in the central part of Mound Gamma. As the provenience map in Figure 4.5 shows, the internal grid of 1 x 1 m sectors was designated with numbers 1-7 in a S-N direction and with letters A-E in an E-W direction. The upper surface of the mound lies at an arbitrary level of 115 cm deep and the excavation was carried down to an

arbitrary depth of 300 cm. For clarity, the layers are defined from the most deeply buried (earliest) to the shallowest (latest), rather than in the order they were encountered.

### ***Preceramic Archaic Component***

*Description.* The Preceramic Archaic Component consists of the two lowermost layers that comprise the buried hilltop soil on top of which the mound sediments were deposited. This type of A-R soil that is buried below the mound is defined as “Litosol” (Altamirano 1998:51). This type of soil is common in the rocky knolls of the area and is constituted by a slightly developed, superficial, A-R horizon type soil. Its slightly developed surface A horizon is sandy with gravel inclusions below which there is a gravel layer of decomposed rock that lies on top of the rhyolite bedrock. It is within the gravel layer and superficial buried A horizon that the cultural materials pertaining to the Preceramic Archaic Component are embedded. The Preceramic Mound Component sediments that were deposited on top of them later sealed these.

Layer 1 corresponds to the deepest level and is represented by rhyolite bedrock. The bedrock follows the natural topography of the site and rises from 300 to 280 cm deep from N to S (Figure 4.6). The second layer, Layer 2, varies from 5 to 10 cm deep and consists of a gravel layer embedded in a sandy matrix, which corresponds to the decomposed bedrock. It accompanies the slight slope that ascends from N to S. It follows the topography of the bedrock rising from 300 and 265 cm deep from N to S. Despite the fact that this layer contained cultural materials, due to its hardness, it was excavated with a pick. Layer 3 consists of a pale brown (10YR 6/3) silty sand layer with a high percentage of gravel, varying in depth from 5 to 10 cm (285 and 255 cm are its lowest and highest depths, respectively).

*Chronology.* The Preceramic Archaic Component in Mound Gamma is a shallow, compact, non-stratified component, lacking radiocarbon dates, which comprises 10-15 cm of gravel and a shallow superficial A horizon. Tentatively, I have assigned a late Early Holocene age until the beginning of mound formation, around 4,190 bp. For the purposes of artifact classification into temporal components, Layers 2 and 3, between 255 and 275 cm deep were assigned to the Preceramic Archaic Component.

*Interpretation.* The Preceramic Archaic is one of the least understood periods in the region. This is mainly the result of the dearth of investigations on this period and the fact that, to this date, deeply stratified Preceramic Archaic sites have not been identified in the region. At Los Ajos, only lithic artifacts were recovered, which alone are insufficient evidence to infer subsistence practices and settlement patterns for this long time span. Based on the lithic analysis of this long-term component, I infer that the groups of the Preceramic Archaic Component occupied Los Ajos less intensively, were possibly more mobile, and probably practiced a more specialized subsistence than Preceramic Mound Period (see below Chapter 5). These points are developed further in Chapters 5 and 9.

### ***Preceramic Mound Component***

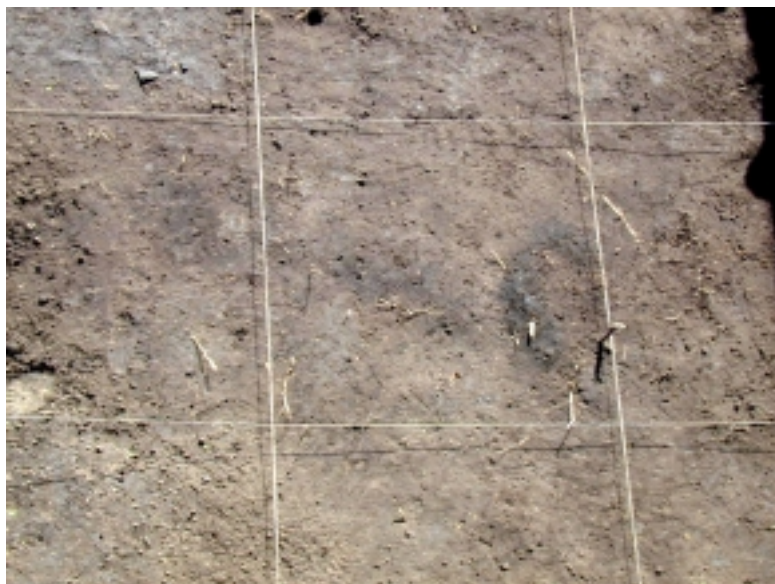
*Description.* Layer 4 corresponds to the Preceramic Mound Component. It consists of compact, dark brown loam/silty loam organic sediment, containing high concentrations of burned clay, ash lenses, and charcoal. Vertically, this layer extends from a maximum depth of 275 cm to a minimum of 190 cm. It is constituted by relatively undifferentiated deposits that lack stratigraphy or other significant internal structure, but contains different concentrations of charcoal or burned soil associated with hearths and hearth rubble. This compacted layer is composed of domestic debris such as charcoal flecks, tiny lithic debris, small fragments of charred bone, ash, and soot lenses, and small pieces of burned clay embedded in a black, organic, loamy sediment. It also exhibits the highest abundance of animal bones in comparison with all the excavation units. This layer has been previously described in several sites of the region (Cabrera et al. 1988; López 1992; 2001) and is informally referred to as “turrón”, meaning Italian nougat in Spanish. In planar view, this layer appears as mottled, multicolored, irregular patches of different shape and depth. In occasions, entire chunks of burnt soil are recovered, which are characterized by an oxidized yellow/ reddish yellow outer layer and a black non-oxidized core. In profile, this layer is black and densely mottled with burned soil chunks. Another important characteristic of this layer is the lack of intervening non-cultural sediments or other evidence of long-term abandonment, such as the development of soil horizons.

No structural features were recovered in this layer except for the presence of a hearth in place, a circular ash lens, a partial burial associated with a circular stone structure and two

human bone clusters. The hearth was defined at 215 cm deep, sector 3/B and is characterized by a shallow but distinct oval stain of 1.6 by 1.25 m, bearing discrete dark brown areas surrounded by a lighter gray periphery, containing ashy sediments, fragments of burnt clay, and small amounts of tiny charcoal flecks (Figure 4.7a). At 190 cm deep, sector 1/A, a thin, circular, ash concentration of 40 cm in diameter was found (Figure 4.7b).

The largest feature encountered in the upper part of this layer is a stone structure composed of eight stones and two fine-grained rhyolite cores arranged in a circular pattern that was defined around at 190 cm deep in sector 4/B (Figure 4.8a, 4.9). Immediately below the circular stone structure, which encloses a roughly circular area of ca. 1.7 m in diameter, a partial human burial was excavated (Figure 4.8b). The burial consists of a fragmented skull facing downward and four adjacent long bones lying horizontally and oriented ESE, ESE, SE and NNE direction (Figure 4.8b, 4.9). This interment was devoid of any obvious grave goods. The complete unit where the burial was recovered was floated but no artifacts were recovered. We interpret the circular stone structure as part of a distinct mortuary practice based on its close spatial association with a partial burial and the lack of any other feature associated with the stone structure.

**a**



**b**



Figure 4.7. a: Hearth Structure, Mound Gamma, 215 cm Depth, Sector 3/B;  
b: Ash and Soot Concentration, Mound Gamma, 190 cm Depth, Sector 1/A.





Figure 4.8. a: Stone Ring, Mound Gamma. 190 cm Depth, Sector 4/B; b: Pedestaled Stone Ring with Exposed Burial, Mound Gamma, 205 cm Depth, Sector 4/B.



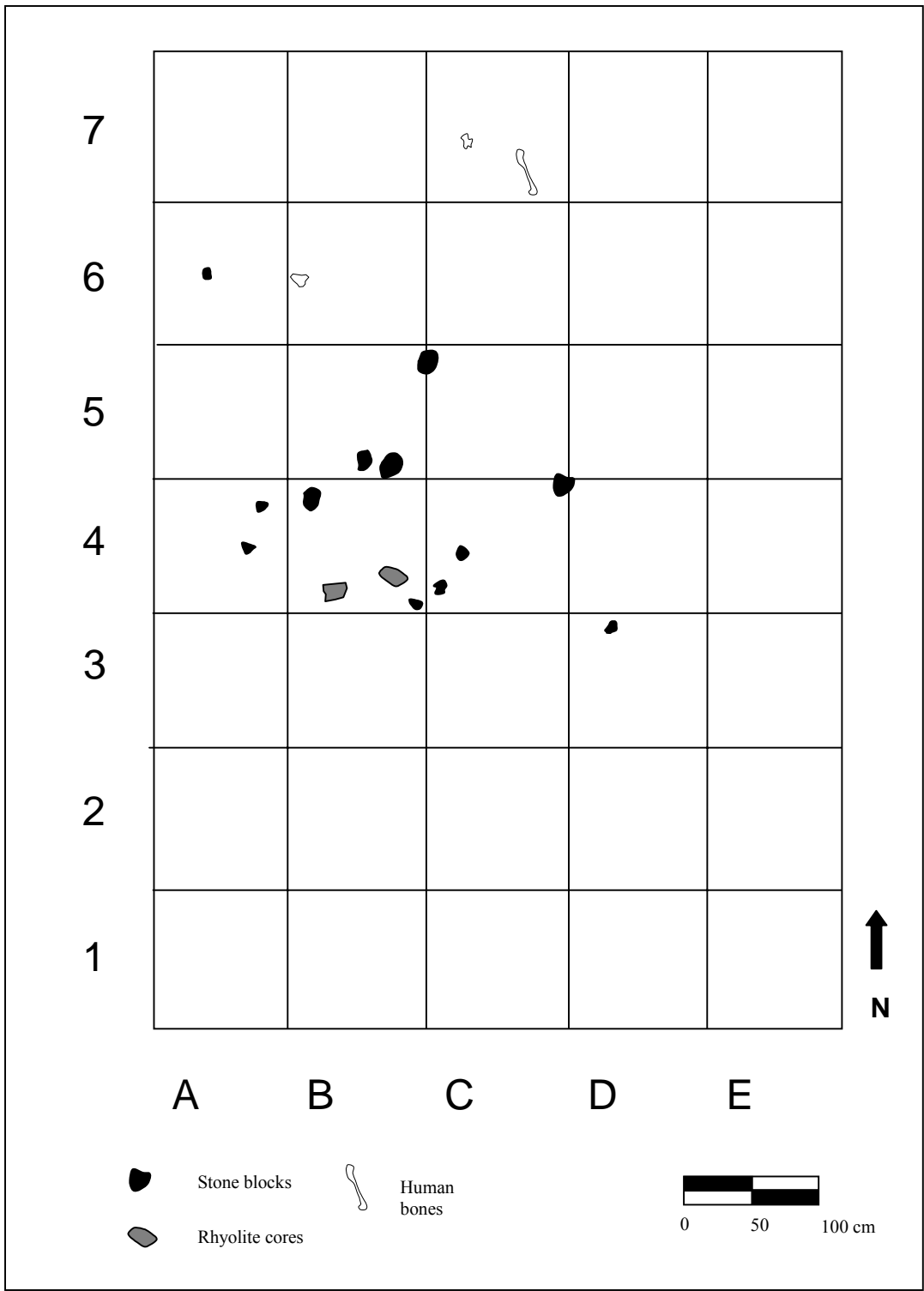


Figure 4.9. Plan Map of Mound Gamma, 190-215 cm Depth.

In addition, at the same depth, a human bone cluster, consisting of a long bone lying horizontally and oriented in NWW direction in conjunction with a small fragment of disintegrated, heavily shattered possibly, human bone was defined at level 190 cm deep in sector 7/C (Figure 4.10a). At the same level, but in layer 6/B, two other isolated bones were recovered (Figure 4.10b).

In comparing the stratigraphy of Mound Gamma with Mounds Delta and Alfa, it is noteworthy that this Preceramic Mound Component also is present in Mound Delta and in Mound Alfa excavated by Bracco (1993). In Mound Alfa, Bracco (1993) described the lowermost layer of the mound in the following terms:

“The most clearly defined (level) corresponds to the last level –or basal level- of the mound. It is characterized by an ashy layer, presenting the highest concentration of charcoal (spread all over the unit, but with clear areas of aggregation), and a decrease in gravel content”.

*Chronology.* The lower part of Layer 4 consists of an undulating irregular transition between the silty sand gravelly layer, representing the surface horizon of the buried soil and the loamy organic dark sediment, corresponding to the PMC. A radiocarbon sample (Beta-158280) from a piece of charcoal recovered from the lowest part of this layer at 270-275 cm deep yielded a date of  $4,190 \pm 40$  bp (ca. 4,820 cal. bp) (calendar year before present). This sector of the occupational midden was intact and no rodent/reptile burrows or roots were present in the lower part of Layer 4. Another radiocarbon sample in the upper part of this layer (Beta-158279) at 210-215 cm deep yielded a date, after extended counting, of  $3,460 \pm 100$  bp (ca. 3,700 cal.bp). In addition, the lower part of this layer in Mound Alfa yielded five dates between ca. 3,550 and 3,950 rbp (Bracco and Ures 1999; Bracco et al. 2000d) (Table 4.4, Figure 4.11).

The test unit placed on top of Mound Delta (see description of the stratigraphy below, Figure 4.19) did not yield charcoal from the lowest part of this layer. A charcoal sample (Beta-158277) from the upper part of this layer yielded a date, after extended counting, of  $2,960 \pm 120$  bp (ca. 3,140 cal.bp).



**a**



**b**

Figure 4.10. a: Bone Cluster, Mound Gamma, 190 cm Depth, Sector 7/C;  
b: Bone Cluster, Mound Gamma, 190 cm Depth, Sector 6/B.

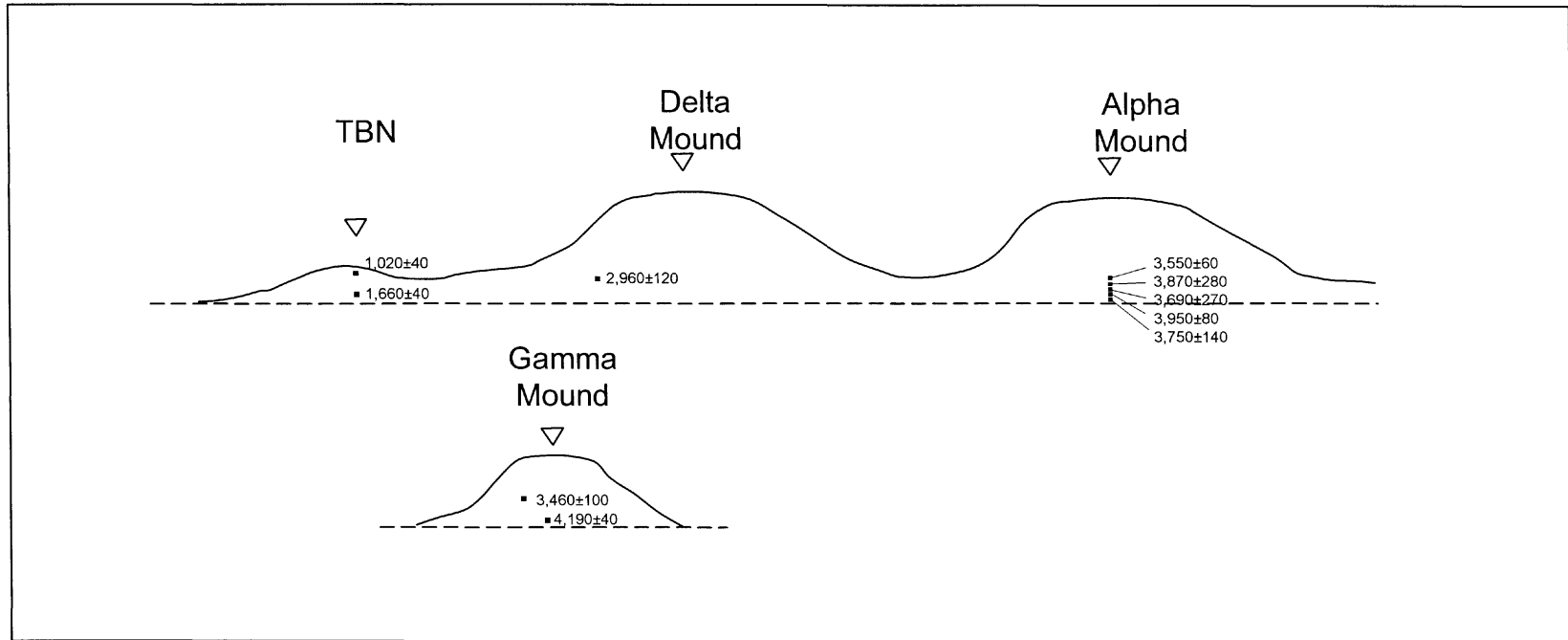


Figure 4.11. Schematic Location of Radiocarbon Dates at Los Ajos.

Altogether, taking into account the similarities in stratigraphy, lithic artifact content (Chapter 5, below), and the eight radiocarbon dates from the PMC across the three mounds (Alfa, Delta, and Gamma), this component at Los Ajos is placed between ca. 4,190 and 2,960 bp. By extrapolating the dates obtained for the appearance of ceramic in the region (Schmitz et al. 1991; Bracco et al. 2000a; López 2001), the upper limit of the Preceramic Mound Period could be extended to ca. 3,000-2,500 bp. However, the upper limit of this component cannot be securely assigned until a more precise date for the adoption of ceramics is obtained for the region. For the purposes of artifact classification into temporal components to be presented in the following chapters, all artifacts contained between levels 190 and 275 cm deep were assigned to the Preceramic Mound Component.

*Interpretation.* The PMC stratigraphy is interpreted as the gradual accretion of multiple overlapping residential occupations. The homogenous stratigraphy; its contents including hearth, hearth rubble, ash lenses, and burnt clay; the lack of filling episodes, and the slow accretional rate lend support to the idea that the PMC layer corresponds to a residential area that grew slowly through the accumulation of domestic debris and rubble from habitation structures, hearths, and garbage. The compacted nature of its sediments is interpreted as the result of walking. Unfortunately, despite intensive hand excavation, no postmolds were identified, which proved elusive to find in the densely mottled multicolored occupational midden. The analysis of artifacts and ecofacts recovered from this component also are consistent with the domestic interpretation of the PMC mound contexts. At this point, I will only briefly mention some of the evidence that further supports the domestic nature of mounds during the PMC. The horizontal distribution of lithic debitage of the PMC contexts of the block excavation (Chapter 8, below) shows a clear pattern marked by low lithic debris density in the central sector and higher densities in the peripheral area. The central area is interpreted as a habitation space regularly maintained and the peripheral area is viewed as a zone where trash is deposited. Moreover, despite the absence of post-molds, the horizontal lithic debitage density trends offer us a coarse delimitation of the house structures on top of Mound Gamma, ranging between 14 and 20 m<sup>2</sup>. On the basis of this approximate habitation structure size, it is safe to suggest that the house structure likely represented the habitation of a single nuclear family and that due to its reduced size; it probably corresponds to a single-room structure (see Chapter 8). The vertical

distribution of lithic debitage shows a pattern of gradual increase in artifact density suggesting the slow accumulation of domestic debris. Furthermore, the lithic assemblage recovered at Los Ajos evidenced a broad range of activities, including manufacture, use, and maintenance of tools, which is what we would expect at a residential site where daily tasks are performed. Bone processing (butchering and consumption) is indicated by the presence of charred bones with cut marks coupled with the large amount of large mammal long bone splinters showing spiral fractures, indicating that bone was processed at the site not only for meat but also for the extraction of marrow and grease. Last but not least, the starch grain and phytolith residue analyses from the mano (Tool 3, 210-215 cm deep, sector 4/C) and selected archaeological sediments (Figure 4.17, below) from the PMC context indicate that the mound was an area where maize was processed and consumed in addition to squash and palms (Chapter 6).

The regular deposition of domestic debris related to the continuous human occupation resulted in the formation of a dome-shaped occupational midden over time, which was used as a platform for residential purposes. In the upper part of the PMC, I identified an innovative cultural practice, that is, the presence of burials; some formally arranged such as the partial burial interred below the stone circle, whereas, the bone clusters located in other sectors of the block were less carefully treated. By the end of the PMC, mounds were not only used for residential purposes, but also began to be used for the interment of the dead.

The broad contemporaneity suggested by radiocarbon dates, artifact content, and similarities in stratigraphy among mounds Alfa, Delta and Gamma suggest that the process of early village formation started at Los Ajos with the placement of domestic areas articulated around a central open space, ca. 4,190 bp (see below) interpreted as a communal plaza.

### ***Ceramic Mound Component***

*Description.* In Mound Gamma, the Ceramic Mound Component consists of Layers 5 and 6. They show a difference with the Layer 4 in terms of their color, texture, and artifact content. The most relevant aspect is the appearance of ceramics and the deposition of gravel layers representing a series of capping episodes.

Layer 5 is composed of dark brown sediment bearing a medium concentration of gravel within a silt loam matrix. Its depth ranges from 215 cm in its lowest part to 155 cm in its highest part. Layer 6 corresponds to loose dark brown sediment, displaying a high concentration of gravel in a silt loam matrix mottled with burned clay, charcoal, and ash lenses. The gravel consists of angular decomposed rocks with no evidence of rolling. Within this layer, the gravel is irregularly distributed in concentrations that probably represent loads of gravel borrowed from the surrounding areas of the knolls, creating shallow depressions where the rock is exposed, called borrow areas (Figure 4.2, 4.23a-b). Vertically, this layer extends from a maximum depth of 195 cm to a minimum of 115 cm deep.

The CMC is characterized by the presence of clusters of disarticulated, fragmented, and possibly, deliberately placed human bones as well as isolated bones and severely shattered bone fragments. Unfortunately, the strong acid nature of the sediments in addition to the coarse texture and the extensive bioturbation in layers 5 and 6 prevents a full evaluation of the nature of these burials. In level 165-170 cm, sector 5/B, a bone cluster consisting of three fragments of skull and two fragments of long bones lying horizontally in NNW and E-W direction in addition to two long bones resting in a vertical position were found (Figure 4.12). Within the same level, several isolated bones were encountered. The following isolated bones were recovered from this level, notably, a fragment of calvarium from sector 6/C; a fragment of tibia from sector 3/B; and a fragment of pelvis from sector 6/B. In addition, five isolated human teeth were recovered from sector 6/B (3 molars) and from sector 6/B (two molars). Similarly, three fragments of long bones lying in a horizontal position were located in sectors 6/B and 5/B at 130 cm deep. The fragment located in sector 6/B is oriented NW and the other two were located in sector 5/B, oriented in an E-W and NNE. Distinctive areas of crushed bones were documented in the same area where these fragments were recovered. It is difficult to denominate these interments as “burials” in the ordinary sense of the term. All the interments in the CMC are partial and many of the individual bones were themselves incomplete. As will be considered below, it is not unlikely that these human bones represent captives or sacrificial victims whose bodies were dismembered and interred in the mound fill of the more important mounds (see similar examples in Spencer and Redmond 1994; Stark 1999). Similarly, Bracco and Pintos (1999) have documented in the Puntas de San Luis site, skulls with cut marks reminiscent of trophy heads.



Figure 4.12. Partial Burial, Mound Gamma, 165-170 cm Depth, Sector 5/B.



A stone structure was defined in arbitrary levels 130-140 cm deep, in sectors 5/D, 5/E, 6/D, and 6/E (Figures 4.13-14). The stone structure is mainly composed of three massive unworked stones. The two larger ones (36x25x17 and 45x20x18 cm) are located together in the southern portion of sector 5/D. The smaller one (25x25x14 cm) is located in the NE portion of sector 5/E. Three of them tend to form a semicircular arrangement. In addition to these large stones, other relatively large unworked stones were recovered from sectors 6/D (25x7x10 cm), 7/B (18x10x12 and 8x5x4 cm), 7/A (30x12x9 cm), 6/E (15x8x7 cm), 6/B (10x5x7 cm), 5/B (12x7x6 and 15x6x7 cm), 4/B (25x10x8 and 8x4x5 cm), and 3/E (10x4 x5 cm). It must be noted that in no other part of the mound such relatively large unworked stones were found, except for the ring of stones located above the burial, in level 190 cm deep. No burials were recovered from the levels 140-150 cm depth, immediately below the three major stones forming the stone structure. However, as described above, three isolated bones and bone fragments were recovered from sectors 5/B, 6/B, and 6/C at the same depth of the stone structure and below these levels at depth 165-170 cm, underneath the isolated relatively large stone, a bone cluster was found in sectors 5/B and 6/B. The last layer, Layer 7, corresponds to the surface humus that extends from the top surface to a depth of about 5 to 10 cm. It is a very disaggregated humic layer containing grass roots.

*Chronology.* No radiocarbon dates are available for this Ceramic Mound Component. The stratigraphic division delineated by Layer 5 and the relative position of the ceramics mark the beginning of this component. Roughly, Layers 5 and 6 could be dated between 3,000-2,500 bp and the period of contact. We extend the occupation of the site to the period of contact, based on the presence of a surface collected brushed decorated Tupi-Guarani ceramic (Figure 7.5d) at the site as well as at other sites in the region that probably date to the late Ceramic Mound Component (Cabrera 1992). In the artifact and ecofact analyses presented in the following chapters, all artifacts and ecofacts contained in Layers 5-7, between levels 190 and 115 cm deep were assigned to the Ceramic Mound Component.



A B C D E

Figure 4.13. Stone Structure, Mound Gamma, 130-140 cm Depth.

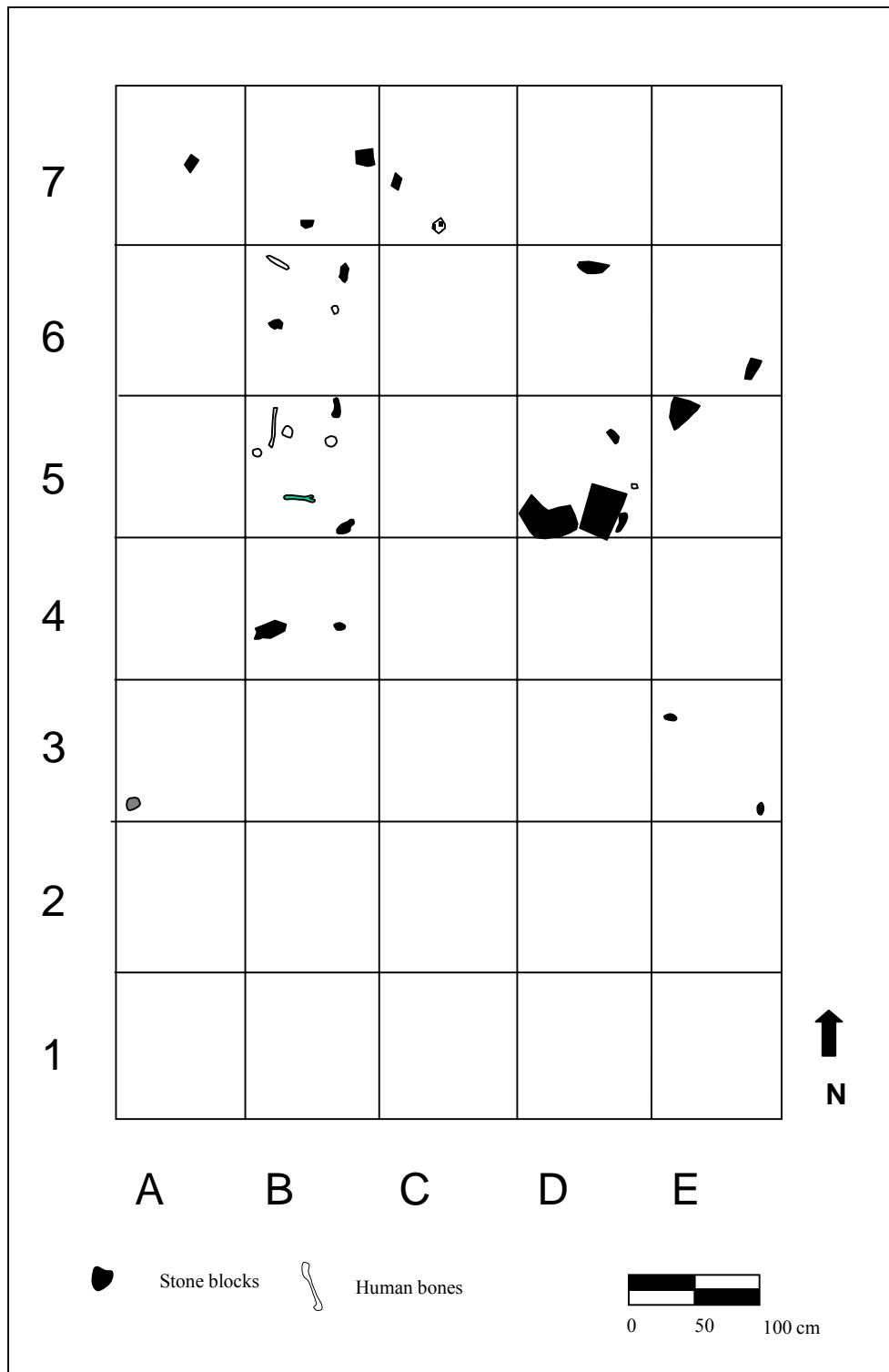


Figure 4.14. Plan Map of Mound Gamma, 130-140 cm Depth

*Interpretation.* The Ceramic Mound Component is characterized by the presence of burials in distinct parts of the component, the appearance of gravel capping episodes, and the presence of a large stone block structure, probably associated with burial practices.

Two aspects lend support to the idea that the stone structure, defined in levels 130-140 cm deep was not of residential nature. On the one hand, this kind of stone structure has been associated with burials, both at Los Ajos as well as at other sites in the region. Colonel López Piriz, the amateur excavator that dug Mound 4 in 1954-55, mentioned to me in a personal interview the presence of large blocks of stone on top of the central part of Mound 4, underneath which he encountered burials. At the Isla Larga site, Cabrera (1999; Cabrera et al. 2000) described the recovery of four burials in the upper central part of the mound. All of them were found underneath large stone blocks (ca. 30 and 40 cm in diameter), which the excavator described as forming a rock floor of ca. 1.20 m in diameter (Cabrera et al. 2000). In this regard, there are reasons to believe that the placement of stone structures on top of burials was a widespread practice in the region during the latest part of the CMP.

Two plant processing tools were recovered from this component: a milling stone base fragment (Tool 1, 175-180 cm deep, sector 4/C) and a milling stone (Tool 6, 150-155 cm deep, sector 3/E). The starch grain and phytolith analyses from these tools' residue indicate that both were used for the processing of maize (Chapter 6). In addition, the spatial distribution of lithic debitage (presented in detail in Chapter 8) in levels 130-140 cm deep also supports the idea that there is a difference with the levels of the mound clearly used as habitational areas. As briefly mentioned above, with some minor variations, all the debitage density distributions from the levels that do not contain burials are remarkably similar in that they all display a central area with very modest artifact densities with a major concentration of artifacts in the peripheral areas of the block excavation. In marked contrast, when lithic debitage density trends are plotted over the levels that bear burials or stone structures, such as the partial burial in level 190-195 (Figure 8.12) and the partial burials and stone structure at 130-135 cm deep (Figure 8.13), there is no clear pattern or any marked spatial configuration such as the one displayed in the other levels of Mound Gamma.

As a result of these deliberate filling episodes, during the CMC, the mound experienced extensive remodeling, as the combined stratigraphy of the block excavation and the trench revealed. The presence of a layer with medium to high concentrations of gravel in Mounds

Gamma (Layers 5 and 6, Figure 4.6), Delta (Layers 4 and 5, Figure 4.19), and Alfa (Bracco 1993) suggest that the remodeling of mounds not only took place in Mound Gamma, but also was an intentional practice in all the mounds that we see as flat-topped beveled edged, today. As will be considered below, these practices are led to an increased formalization and spatial differentiation of the inner precinct of Los Ajos. The evidence indicates that during the CMC, this central sector of the site was the locus of a major focus of public ritual activities.

### **Mound Gamma Trench**

In order to understand the articulation between Mound Gamma and the plaza area stratigraphies, a 1 x 10 m trench was placed from the center of the south border of Excavation Gamma (sector 1C) south to the center of the plaza area. The provenience map depicted in Figure 4.5, illustrates the location of the trench. Figures 4.15 and 4.16 show the stratigraphy of Mound Gamma's trench and the combined stratigraphies of Mound Gamma's west wall and the addition of the trench, respectively. The lack of a complete correspondence between the block excavation and the trench stratigraphic profile depicted in Figure 4.16, is due to the fact that the block excavation stratigraphy was defined based on the west wall of the block excavation corresponding to sector A, whereas, the trench stratigraphy is a continuation of sector C. However, the combination of the two stratigraphic profiles allows us to make some important inferences. In general, the trench displays the same layers that were defined in Mound Gamma and their horizontal and vertical dimensions have helped us understand the changes in mound formation processes through time. The examination of Layer 4, corresponding to the Preceramic Mound Component, suggests that during this period, Mound Gamma was a smaller, 0.6-0.8 m tall, dome-shaped mound. During the succeeding CMP, partly as a result of the accumulation of occupational refuse, but mainly through the deliberate deposition of capping events in Layers 5 and 6, Mound Gamma became larger, higher (1.40 m tall) and attained the present flat-topped, beveled-edged shape. The fact that this type of flat-topped, beveled-edged platform mounds are not ubiquitous in the region, but are restricted to larger sites and within the larger sites to central positions, may also indicate that during the CMC, the mound was a place for habitation and the placement of the dead, and possibly also for the display of social differences. I shall return to this point to discuss in detail in more detail in Chapter 9.

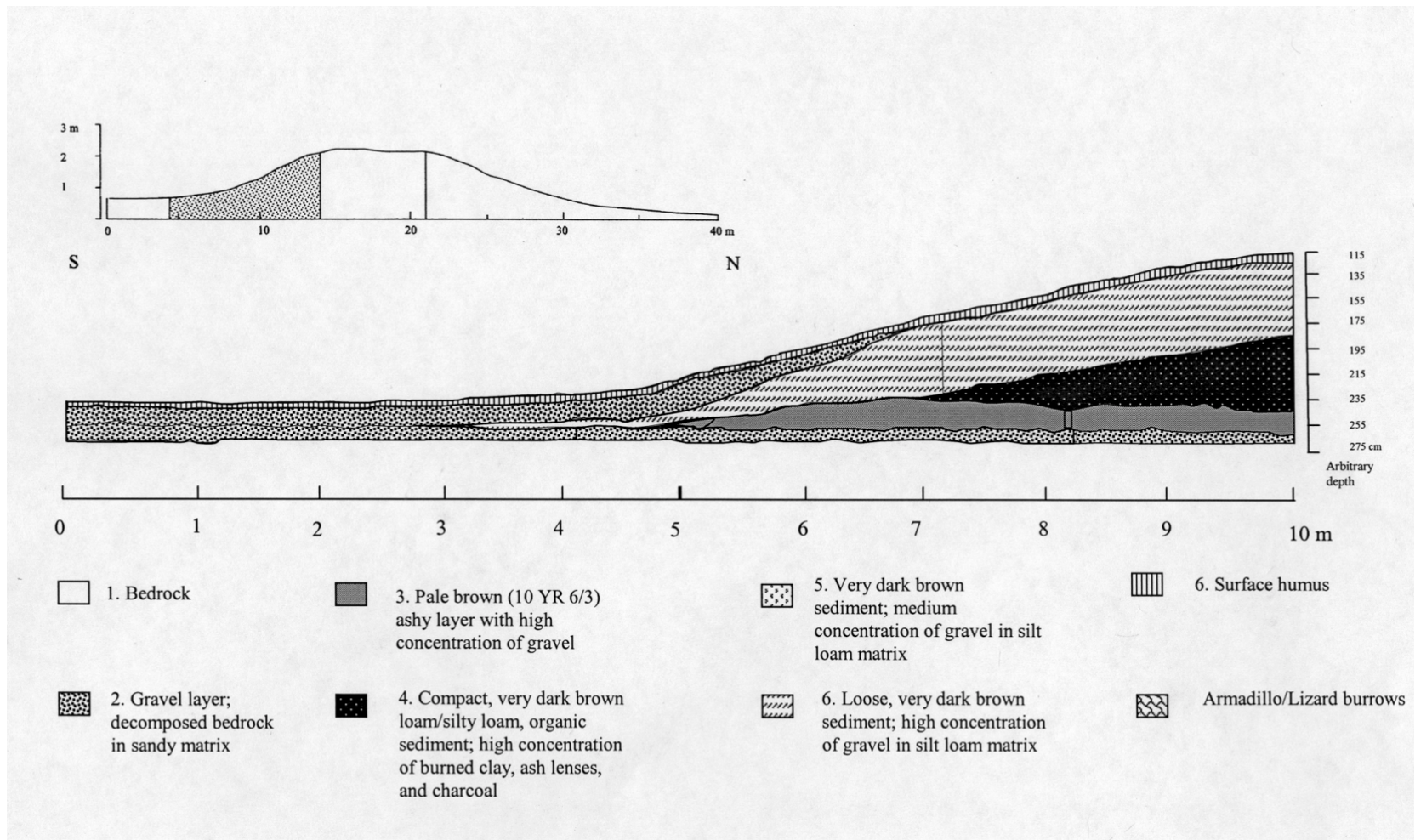


Figure 4.15. Mound Gamma Trench Excavation Viewed from West Wall.



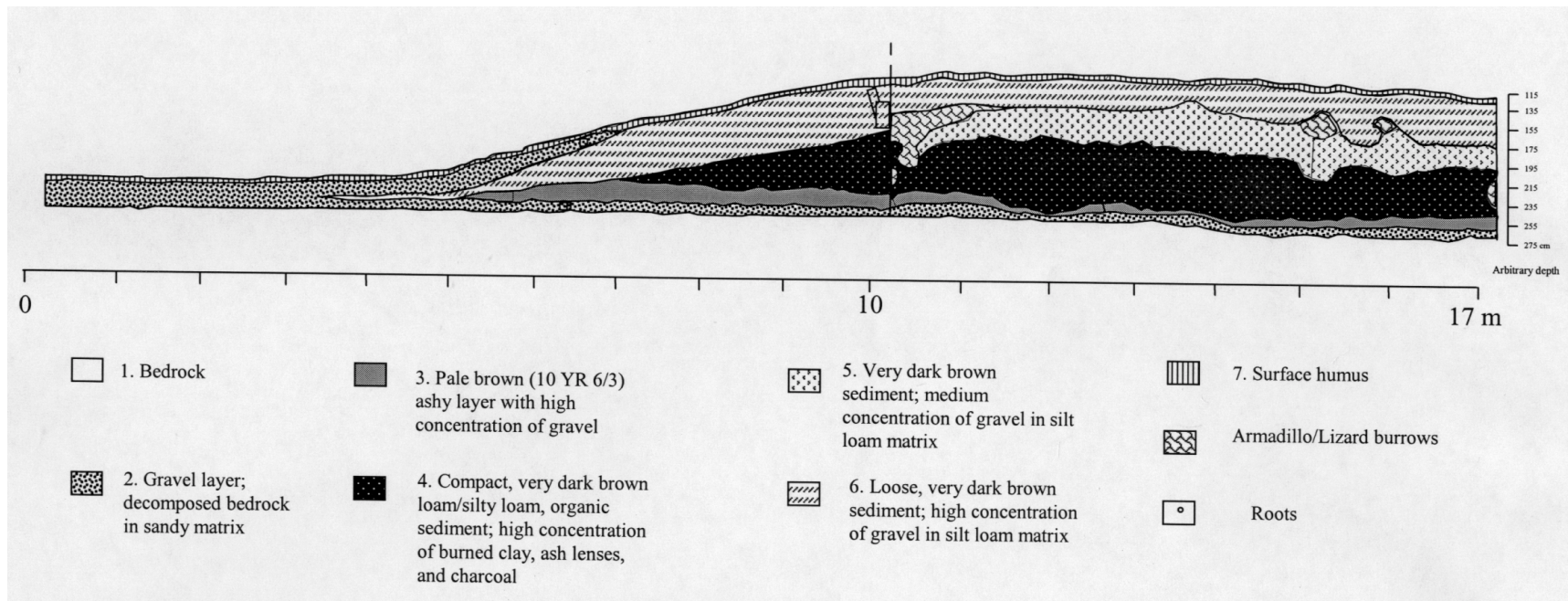


Figure 4.16. Mound Gamma Block and Trench Excavation Viewed from West Wall.

As a side note, it is interesting that in the lower slope of the mound, there is a concentration of gravel as a result of the gravitational down slope displacement of gravel from the upper levels of the mound edge. The same phenomenon was recorded in the test unit N 150 E 300, placed in the lower eastern slope of Mound Delta.

For added clarity, a back plot of the more diagnostic artifacts, radiocarbon dates and features from Mound Gamma block excavation and trench is presented in Figure 4.17. This graphic representation displays the actual dimensions of the north-south horizontal axis of the block excavation and duplicates the scale of the vertical dimension of the profile. The third dimension, the east-west axis (sectors A to E) is collapsed. The result is a display of the diagnostic artifacts and features in their horizontal position along the longest axis of the block and trench excavations.

### **Mound Delta**

Figure 4.3 and the provenience map depicted in Figure 4.18 show the location of the Mound Delta test unit, respectively. Following the TBN trench at 3 m to the south, a test unit of 2x2 m was placed in the upper slope of Mound Delta. The presence of eight trees and the extensive disturbance in the upper part of the mound, caused by numerous rodent and lizard burrows caves, precluded us from placing excavation units in its center top. The upper sector of the test unit lies at an arbitrary level of 135 cm deep and the excavation was carried down to an arbitrary depth of 235 cm. The excavation of this test unit proceeded at 10 cm artificial levels.

*Description.* From its base to the top, the stratigraphy is similar to Mound Gamma (Figure 4.19). The only difference with Mound Gamma is that Mound Delta did not present the buried A horizon and Layer 3 (which correspond to Layer 4 in Mound Gamma) lies directly above the gravel layer. Apparently, the PMC deposits start accumulating directly on top of the gravel that lies above the rhyolite bedrock. No features or any structures were encountered in this small test unit.



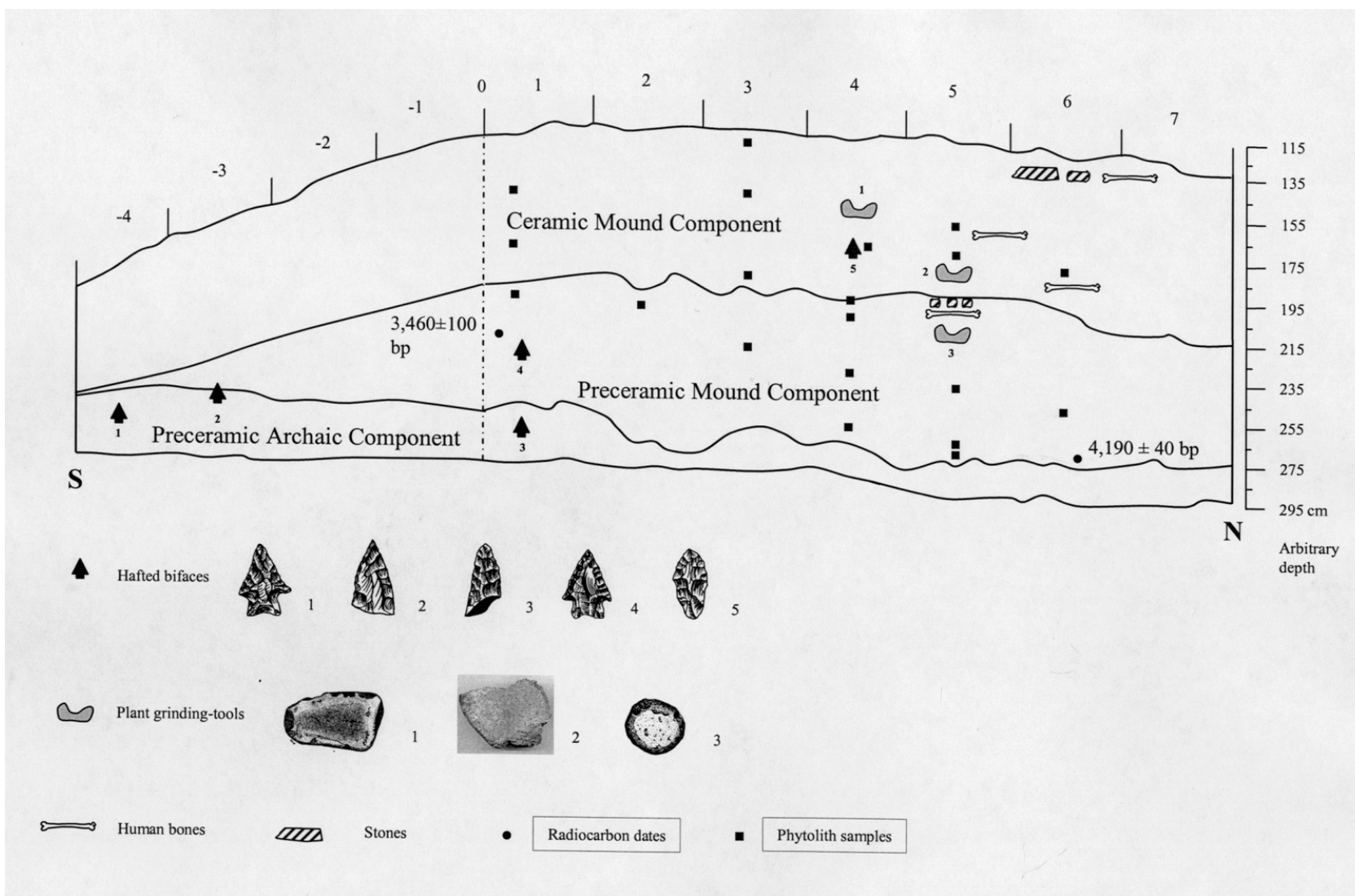


Figure 4.17. Backplot of Mound Gamma Block Excavation and Trench.

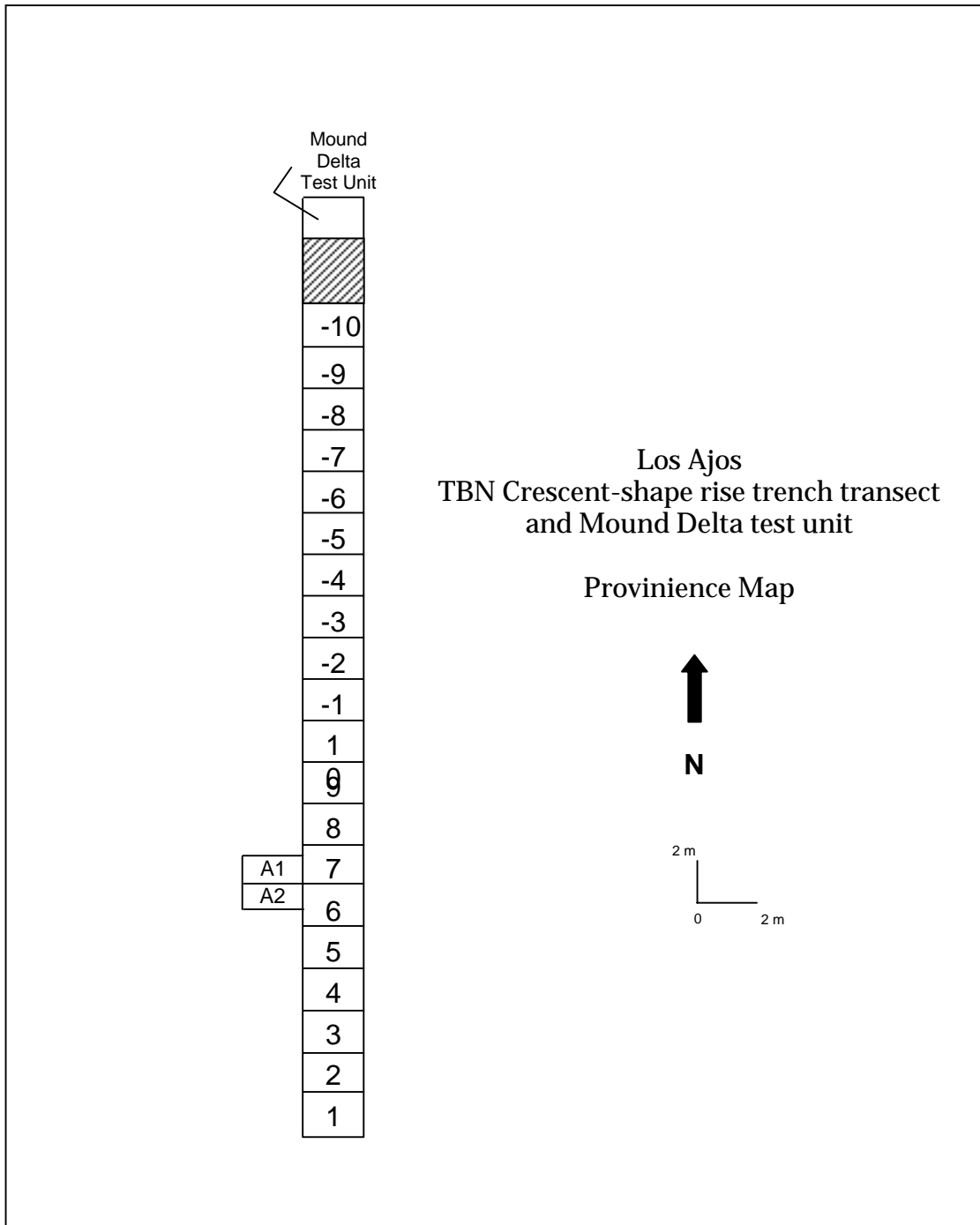


Figure 4.18. Provincience Map, TBN Crescent-Shape Rise Trench Transect Trench and Mound Delta Test Unit. Figure 4.3 Show the Location of the TBN Trench and Mound Delta Test Unit in the Central Sector of the Site.

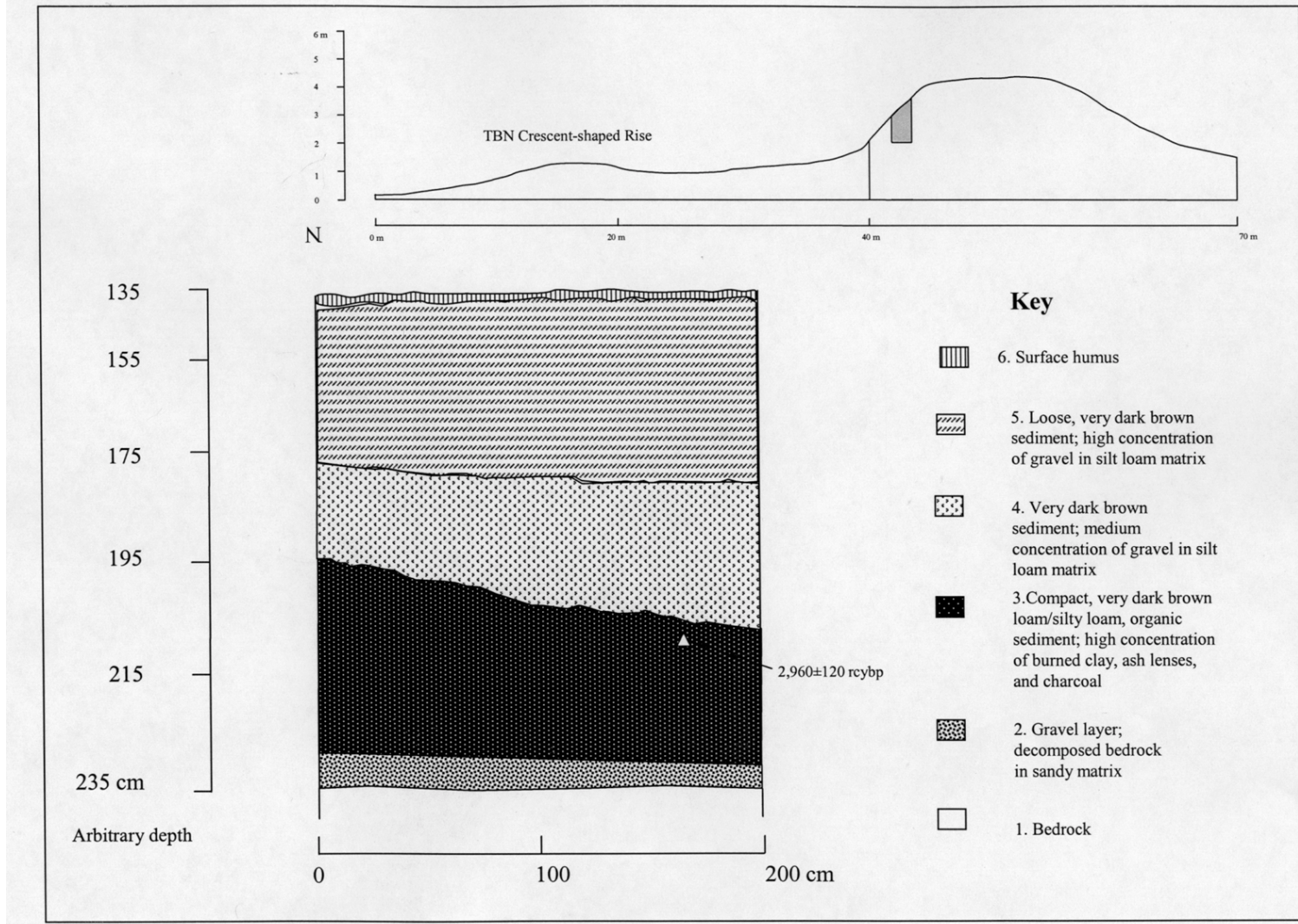


Figure 4.19. Mound Delta Test Unit Viewed from South Wall

*Chronology.* Despite intensive hand excavation and flotation of the lowermost levels in search of charcoal remains, no charcoal was recovered. A radiocarbon essay (Beta-158277) from the upper part of Layer 3, yielded a date, after extended counting, of  $2,960 \pm 120$  bp (ca. 3,140 cal.bp). This date, in conjunction with the date of ca. 3,460 bp in the upper sector of Mound Gamma PMC, and the dates from Mound Alfa obtained by Bracco (1993) indicates that the PMC in the site dates between ca. 4,190 (oldest PMC context at Los Ajos; Mound Gamma, 270-275 cm deep, sector 6/C) and ca. 2,960 bp (more recent PMC context at Los Ajos; Mound Delta 205-210 cm depth). No artifacts were recovered from the gravelly Layer 2. For the purposes of artifact classification into temporal components, the materials embedded in Layer 3, between 235 and 215 cm deep were assigned to the Preceramic Mound Component. Correspondingly, the artifacts contained in Layers 4 and 5, between 205 and 135 cm deep were assigned to the Ceramic Mound Component.

*Interpretation.* The similarities in stratigraphy and artifact content between Mounds Gamma and Delta suggest that they shared a common occupational history. The well-developed PMC component in both mounds indicates that both mounds were roughly contemporaneous and used for residential purposes. Similarly, the fact that both shared similar CMC layers is further indication that both mounds experienced remodeling episodes, transforming them into platform mounds during the Ceramic Mound Period.

### **Off-Mound Areas Excavations**

This section details the field excavations carried out in the off-mound areas of the site. It is beyond the scope of this study to present the detailed stratigraphy of the 57 test units carried out in the off-mound areas, in this chapter, I only present the detailed stratigraphy of the areas considered to be more relevant to understand the site's occupational history and community organization. In this respect, only a detailed description of TBN and TBS crescent-shaped rises, the intermediate area between the TBN and Mound Delta, and the plaza area are offered. A brief summary of the temporal assignment and artifactual content of the rest of the test units from other off-mound areas is provided in the section Other Off-Mound Areas, below.

### ***TBN – Northern Crescent-Shaped Rise Trench***

As described above, the TBN is a long crescent-shaped rise between 14 to 25 m wide and 150 m long that surrounds Mounds Delta and Alfa at a distance of approximately 15-20 m. The TBN trench constituted a 2 x 40 m trench, which bisected the northern slope of Mound Delta and the TBN crescent-shaped rise in a S-N direction (Figure 4.3, 4.18). The purpose of this trench was to assess the functional nature of the TBN, to obtain chronological information from the TBN and Mound Delta as well as to establish how Mound Delta and the TBN articulate with the intermediate area between them. The TBN was excavated using 2 x 2 m unit sectors in artificial levels of 5 cm. The highest point of the TBN lays at 150 cm of arbitrary depth. Hereafter, the part of the TBN trench where the crescent-shaped rise attains its maximum vertical expression is called its “central part”. This central sector of the TBN was expanded to seek features or structural remains. Two additional sectors of 2x2 m, “Ampliación 1” (A1) and “Ampliación 2” (A2) were dug. The central sector of the TBN consists of sectors 6, 7, A1, and A2.

*Description of the central sector of the TBN.* From the base to the top surface, the stratigraphy may be described as follows (Figure 4.20). The lowermost level, Layer 1, is constituted by a rhyolite bedrock. Layer 2 comprises a gravel layer that accompanies the slight upward slope in a N-S direction. It ranges from 5 to 15 cm in depth. In the central part of the TBN (sectors 6, 7, A1, and A2), this layer is represented by 8-12 cm from 200 to 210 cm of arbitrary depth. In contrast to the stratigraphy of Mound Gamma, the TBN stratigraphy does not present a distinct buried A horizon immediately above the gravel layer. This could be due to deflation of the A horizon before Layer 3 was deposited.

Layer 3 is constituted by a compact, dark brown silty loam, organic sediment. Although the matrix is the same as Layer 4 of Mound Gamma, this layer does not contain any hearths in place or great amounts of burned clay, ash, charcoal, and burned bone. As in Layer 4 of Mound Gamma, it contains homogeneous, rather undifferentiated deposits, which lack any intervening non-cultural sediments or other evidence of long-term abandonment, such as the development



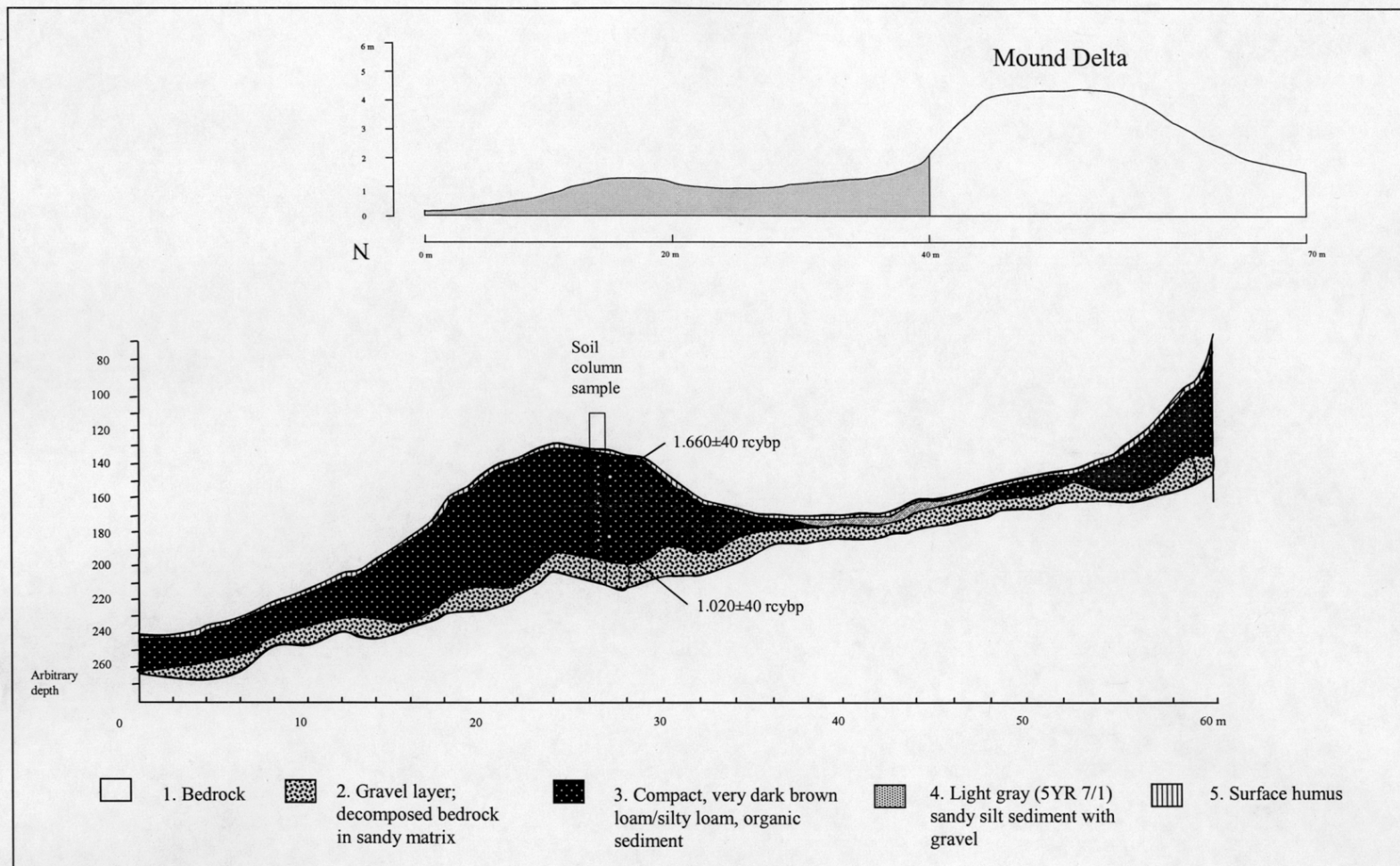


Figure 4.20. TBN Crescent-Shaped Rise Trench Viewed from East Wall.

of a soil horizon. The gradual accretional nature of the TBN Layer 3 is further corroborated by both soil chemistry analysis carried out in its central part (Appendix 7) that shows a continuous vertical chemical enrichment of the soil as well as by the gradual increase in the density of artifacts. These aspects are detailed in full in Chapter 8.

*Chronology.* No carbon was recovered from the lowest level despite the application of flotation techniques in all the lower level sediments of the central part of the TBN. A radiocarbon sample (Beta-158281) from level 190-195 cm deep, corresponding to the middle-lower part of Layer 3 yielded a date of  $1,660 \pm 40$  bp (ca. 1,550 cal.bp). Another radiocarbon essay (Beta-158278) was run from a light fraction composite charcoal assemblage from the upper part of Layer 3 (level 160-165 cm) yielding a date of  $1,020 \pm 40$  bp (ca. 985 cal.bp).

All materials contained in Layer 2 are generally assigned to the Preceramic Archaic Component. Layer 3 has been divided into two temporal components based on the relative position of ceramics in the stratigraphy. The first one consists of the lowermost levels of this layer between 190-200 cm deep, which due to a lack of ceramics, have been assigned a PMC age. The rest of Layer 3, between levels 190 to 135 cm deep, correspond to the Ceramic Mound Component.

In addition, the CMC has been further subdivided into two sectors. The inferior sector corresponding to levels 190 to 165 cm deep, consists of compact, dark brown loam/silty, organic sediment that contains ceramics. The upper part of Layer 3, levels 165-150 cm deep, comprises a somewhat looser, dark-brown loam/silty loam, organic sediment with inclusions of gravel, burned clay, ashes, and charcoal. The uppermost layer, Layer 5, corresponds to the surface humus that extends from the top surface to a depth of about 5 to 10 cm. It is a more disaggregated layer, which contains grass roots and no gravel.

*Interpretation.* Layer 2, the lowermost gravel layer, corresponds to the Preceramic Archaic Component. The lowermost level of Layer 3 (levels 190-200 cm deep) is interpreted as a tenuous accumulation of domestic refuse during the Preceramic Mound period times. The inferior stratigraphic division of CMC's Layer 3 (levels 190-165), composed of homogeneous, undifferentiated deposits, lacking internal significant structures or evidence of burning, is interpreted as a continuation of midden deposits that started to accumulate during Preceramic

Mound times. There is a long time gap between the beginning of the Ceramic Mound Period at ca. 3,000-2,500 bp and the lowermost level of the CMC in the TBN dated at ca. 1,660 bp. This indicates that either the deposition of CMC sediments in the TBN started relatively late during this period or that the charcoal dated was displaced from the upper levels.

Taken together, the soil chemistry data, which indicates chemical enrichment over time associated with human-produced soil accumulations and the gradual vertical increase in artifacts, both suggest that these areas grew through accretion by the accumulation of domestic refuse fairly rapid between ca. 1,660 and 1,050 bp.

In addition, the phytolith analysis from column samples in the TBN document a maize leaf phytolith signature, which starts at the PMC contexts (level 190-195 cm deep) and continues throughout the sequence, suggesting that maize was probably planted and/or husked in the TBN. The rich, fertile, organic soil of the TBN midden deposits may have served as compost soil to grow corn and squash. The combination of the silty loam texture with the high content of midden nutrients (see detailed description in Appendix 7) made these disturbed areas around settlements an especially attractive setting to experiment and plant these new cultigens. Early during the PMC, before the inner precinct acquired its strong public ritual character and also later, these midden refuse gardens may have served as house gardens, constituting experimental plots where these newly adopted plants were grown and evaluated for their use.

The upper part of Layer 3 contains evidence of burning (ash, soot, burned clay) in addition to the presence of a gravel layer. The presence of gravel layers indicate that late in time, the TBN was probably remodeled, which ultimately led to its actual formal appearance. This is likely related to the formalization and spatial segregation of the architecture of the site during the CMC. These aspects will be considered in Chapter 8 and 9.



### ***Intermediate Area Between the TBN Crescent Shape and Mound Delta***

The intermediate area between Mound Delta and the rise to the TBN displayed both low artifact densities and the absence of any soil alteration (Figure 4.21). As in other areas of the site, the location of habitational areas as well as of places where midden refuse were deposited are tightly circumscribed. The dearth of artifacts, the lack of soil alteration, and their location between mounded residential areas and the TBN and TBS crescent-shaped rises shows that Los Ajos' inhabitants made a continued effort to keep these areas clear of any debris, which in turn, contributed to add a more formal aspect to the inner precinct of the site.

### ***Central Plaza Area***

As described earlier, the central plaza area consisted of an oval cleared space of ca. 75 x 50 m in size. Given that only one test unit (N 100 E 250) corresponding to the systematic interval transect sampling strategy fell within the plaza area, another ten additional test units were targeted across the plaza area in order to get a deeper understanding of its stratigraphy (Figure 4.2-3). The description of the central plaza stratigraphy is based on a compilation of the stratigraphy of eleven test units and Mound Gamma trench. Vertical control of the plaza area test unit was carried out in reference to the ground surface and is expressed in centimeters below surface (B.S.).

*Description.* A general stratigraphy based on the entire test units for the plaza area from bottom to top can be described as follows (see Figure 4.21). Layer 1 is represented by a rhyolite bedrock. Layer 2 corresponds to the decomposed bedrock gravel layer embedded in a sandy matrix. This layer extends from 10 to 15 cm in depth. As in the rest of the areas of the site, this hard layer had to be excavated with a pick. This gravel lense is thicker in the plaza area, which is the higher part of the site where the bedrock is closer to the surface, and thus, the soil is more superficial. Towards the edges of the central part of the site, the gravel layer abuts becoming

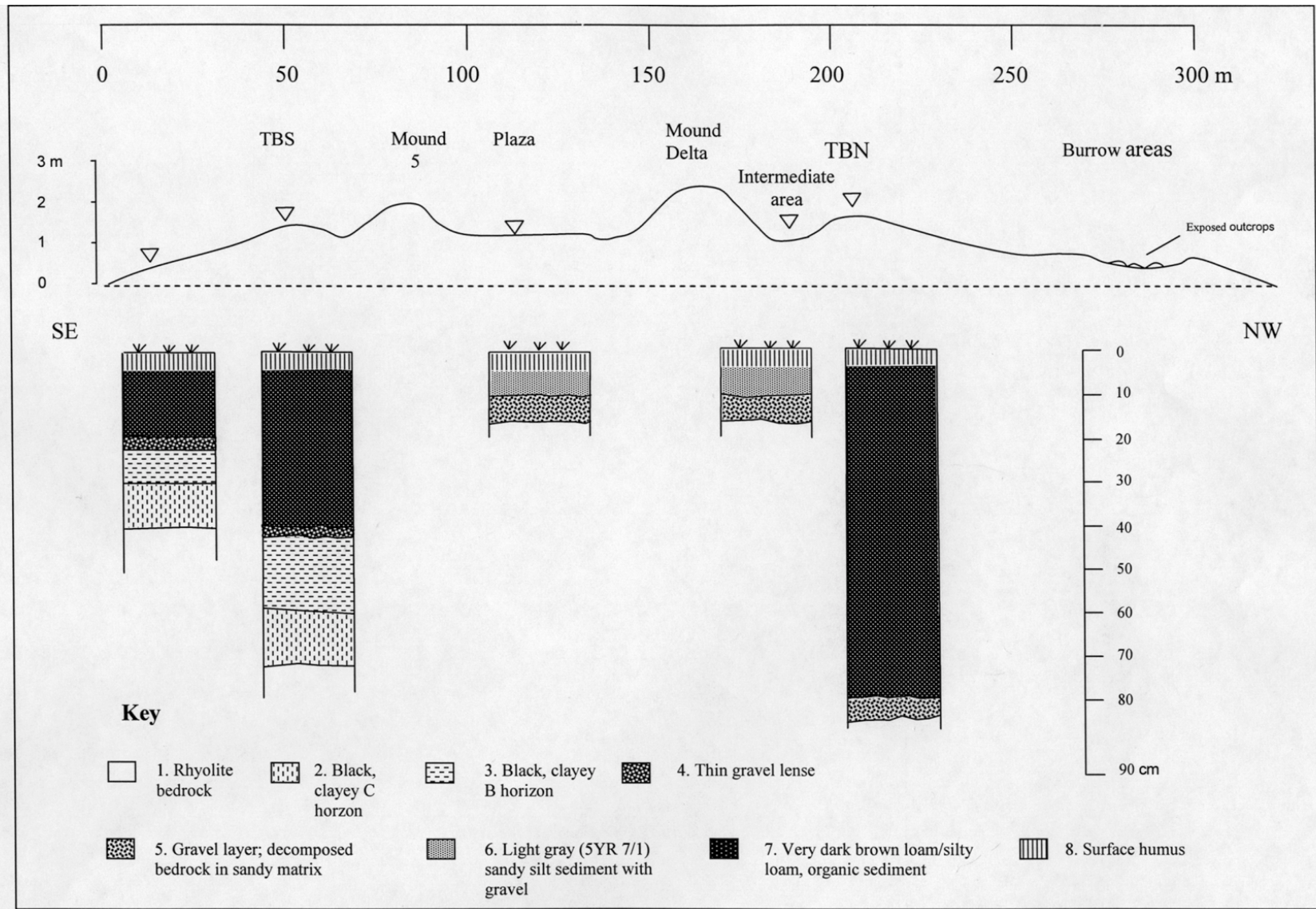


Figure 4.21. Transect SE-NW Central Sector of Los Ajos.

thinner in the slopes. The third layer, described as Layer 5 in Figure 4.21, corresponds to a slightly developed A horizon characterized by a gravelly light gray (5YR 7/1) sand silt sediment, extending ca. 7-12 cm in deep. The fourth and last, Layer 6, is composed of the surface humus that extends from 5 to 10 cm in depth from the ground surface.

*Chronology.* No charcoal was recovered from the test units in the plaza area to obtain radiocarbon dates. Therefore, the temporal assignment of the artifacts was done according to the stratigraphy and the presence/absence of ceramics. In the first place, all artifacts contained in the gravelly Layer 2 were assigned to the PAC. The levels of Layer 5 that lack ceramics were assigned to the PMC while the ones that contain ceramics were counted as pertaining to the CMC.

*Interpretation.* The central plaza area is located in the highest part of a flattened circular spur of Sierra de los Ajos. Its natural soil is the typical A-R Litosol. The presence of cultural materials embedded up to 15 cm within the gravel layer indicates that the soil has been deflated. It was deflated as a result of both natural and cultural processes. Two major natural factors account for its deflation (a) due to their topographical position these are slightly developed superficial soils that are easily subjected to deflation; and (b) the Mid-Holocene period of dryness described in detail in Chapter 3 and Appendix 2, may have aggravated this condition exposing the soil to further erosion due to a dramatic decrease of the vegetation cover. As a result of these factors, the finer sandy silty fraction of the A horizon of the soil where cultural materials were embedded, may have been blown or removed downslope by surface flow, allowing for the coarser stony material to accumulate. Thus, leaving a thick gravel layer with cultural materials embedded within it.

In addition, two major cultural practices may have contributed to the deflated and superficial nature of the central areas soils. First, was the extraction of soil borrowed from A horizon to build the mounds. Second, since the area is interpreted as a public space, it must have been subjected to continuous trampling, hence, reducing the vegetation cover and therefore, leaving this central surface of the site readily exposed to erosion (Juan Montaña, personal communication 2000). This is a phenomenon that can be observed nowadays in many circular villages of Amazonia (i.e., Heckenberger 1996) and Central Brazil (i.e., Wüst and Barreto 1999).

Its location in the central part of the site surrounded by residential areas, the paucity of cultural materials that it exhibits, and the absence of soil alteration, together indicate that during the Mound components, this clear central area was an enduring feature of village organization constituted by a plaza/ public space. The manifold implications of plaza/public spaces as key spatial settings for the performance of public interactions outside the domestic sphere will be elaborated in the concluding Chapter 9. Suffice is to say at this point, that during the PMC, the plaza area represented the integration of a central communal space to the emerging household-based community. Moreover, this type of incipient public architecture, symbolizing the tangible formalization of group-level integration, also represented a physical and metaphorical materialization and expression of community and identity. During the CMC, it became more clearly define and accompanied the transformation that the site layout experienced.

### ***TBS- Southwestern Crescent-Shaped Rise***

The TBS constitutes a semicircular rise that starts to the south of Mound 5 and continues for 150 m up to them, forming a ring that lies 20-50 m to the south of Mounds 5, 6, 8 and 9.

*Description.* The profile of the TBS is best developed in test unit N 50 E 150 and is described as follows (see Figure 4.22). Layer 1 is characterized by rhyolite bedrock. Layer 2 is composed of a black, clayey C horizon. Layer 3 is represented by a black clayey B-horizon. Layer 4 corresponds to a 2 to 7 cm gravel lense, which becomes thinner in the upper parts of the knoll slope. Layer 5 is characterized by an anthropic dark brown to black loam to silty loam organic sediment of variable depth, color, and texture. The sixth layer, Layer 8 consists of the surface humus.

*Chronology.* Although no radiocarbon dates were obtained for this sequence, the following observations could be made. The gravel lense is interpreted as a deflated A horizon resulting from the displacement of coarser materials of the soils during the aridity period of the mid-Holocene (Juan Montaña, personal communications 1999-2000). Accordingly, the artifacts embedded and lying above the gravel lense were assigned a PAC age. The layers between the gravel lens and the ceramic bearing levels were assigned a PMC age, and lastly, the layers .

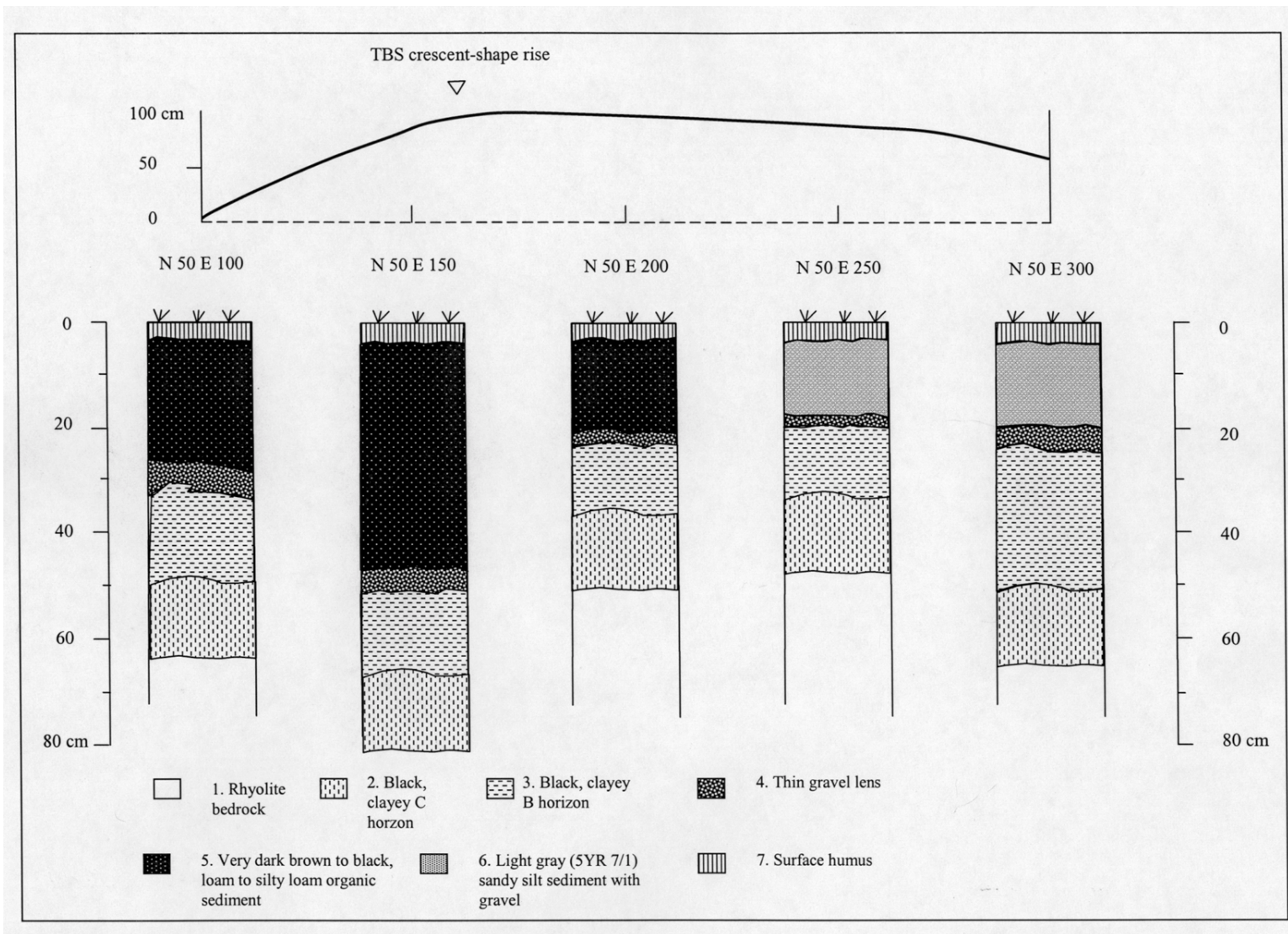


Figure 4.22. Transect W-E N 50 E 100-300.



containing ceramics were assigned to the CMC. The absence of ceramics in some of the lower layers above the gravel lens suggests that the accretion of this midden area started during the PMP and continued along the CMP. Like in TBN, the accumulation of domestic refuse was more important during the CMC.

*Interpretation.* Like the TBN, the TBS represent the gradual accumulation of domestic refuse. In comparison to the immediately adjacent soils, the TBS exhibits thicker, darker, more chemically altered sediments, and contains a higher density of artifacts.

Figure 4.22 sketches a toposequence that transverses in a W-E direction the TBS through test units N 50 E 100 to N 50 E 300. The following observations can be made about the anthropic nature of the TBS. First, as one approaches the TBS from the test unit N 50 E 100 in an eastward direction, the dark, organic, silty loamy layer becomes deeper and darker. When one moves away from this crescent shape rise both to the east and to the west, changes in color, texture, and depth occur. Starting in test unit N 50 E 100 as one approaches the highest part of the TBS, the color changes from dark brown (7.5 YR 2.5/1) to black. As one leaves the TBS toward the slope in an E direction, the color changes to a dark brown (7.5 YR 3/2) (N 100 E 200), to brown (7.5 YR 4/3) (N 100 E 250) and to dark gray (5YR 4/1) (N 100 E 300). These latter two layers are represented in Layer 6 in Figure 4.21. There is also a change in the texture of the soil, while the sediments of the organic, dark sediments of the TBS are loamy to silty loamy, the sediments from the adjacent test units are mainly composed of fine sand with gravel. In addition, a W-E artifact density transect along the N 50 transect from E0 to E300 clearly shows an increase in both lithic debitage and ceramic sherds within the midden ridges and viceversa, the artifact density decreases as one goes outward from the site. Detailed data of these aspects is presented in Chapter 9.

Another significant aspect of the TBS is the presence of the gravel lense described above. The gravel lense (Layer 4, Figure 4.22) abuts becoming thinner from the topographically higher sectors of the site towards the sloping areas of the knoll. In the stratigraphy of the southern sector, this gravel layer is located immediately above a clay layer corresponding to a buried B-horizon. It is constituted by a gravel lens of 4-7 cm in depth resulting from the deflation of the A horizon, which were due to the same processes explained above. This aspect provides indirect

evidence for the existence of drier climatic conditions evidenced in the paleoenvironmental record (Chapter 3, Appendix 2).

The presence of these extensive and relatively deep midden areas both in the TBN and the TBS suggests that the Los Ajos site was a residential site occupied for relatively long periods. This point will be discussed in detail in Chapter 8.

### ***Other Mounded Architecture, Flat Off-Mound Areas, and Borrow Areas at Los Ajos***

The more peripheral areas of the site with mounded architecture are fairly dispersed, present a more informal layout, and are characterized by low, dome-shaped, circular and elongated mounds. As mentioned above, to the east of the inner precinct occur the large, low, Mound 9 and the elongated Mound 8, which is oriented in N-S direction. To the N/NW of the site occur the low elongated Mound 10 oriented N-S and the other two low, circular mounds, Mound 11 and Mound 12. To the E/SE of the central precinct the low, circular Mound 14 and the elongated, dome-shape, Mound 15 are present.

In addition to these more informally laid out mounds in the peripheral area, the systematic interval transect sampling of test units documented a vast outer flat off-mound areas bearing domestic debris covering ca. 12 ha. The definition of the temporal components in the off-mound areas is coarse-grained. This is the result of the current lack of time-sensitive diagnostic artifacts exempt from the appearance of ceramics, the absence of radiocarbon dates in these areas, and the shallowness and compactness of their stratigraphy. The slightly developed rocky soils characteristic of off-mound areas make the stratigraphy more difficult to define. In mounded areas of the site, mound deposits sealed the slightly developed pre-mound soils and all materials contained in them could be easily assigned to the Preceramic Archaic component. This becomes a more difficult task in off-mound areas for the reasons that are explained below. The definition of the temporal components in the test units has been defined in the following terms. All the artifacts corresponding to the levels embedded or lying directed above the gravel layer or the gravel lense have been assigned to the Preceramic Archaic Component. The levels between the ones assigned to the Preceramic Archaic levels and the level that contain ceramics have been assigned to the Preceramic Mound Component. Last, the level bearing ceramic sherds has been assigned to the Ceramic Mound Component. In Chapter 8, Tables 8.1-2 present the detailed

artifactual content by unit and level according to the criteria defined in that chapter. These tables served as the raw material for the artifact density trends analysis carried out in this chapter. As we will see below these areas may be representing domestic precincts or more ephemeral occupations of the site by groups that periodically return to the site for domestic or ceremonial purposes.

Borrow areas are fairly extensive (up to 4000 m<sup>2</sup>) bowl shape depressions where the bedrock is exposed (see Figure 4.23b). Unlike the natural hill top A-R litosol soils, in the borrow areas both the gravel layer and the A horizon are lacking due to their extraction as filling material for the construction of the mounds. In contrast to the natural rock outcrops that occur in the higher part of the hills, which are convex in profile (see Figure 23a), in the borrow areas the bedrock is exposed within a slightly concave bowl shape depression (compare Figure 4.23a and 4.23b). Two test units fall within borrow areas: N 100 E 250 and N 250 E 250. In both of them, the bedrock was covered by 2-5 cm layer of sediment and no archaeological materials were found. Given the fact that capping/filling episodes become apparent in the record during the CMP, a tentative CMP age is given to these extraction areas. The following Chapters 5, 6 and 7 present the lithic, botanical, faunal and ceramic analysis, respectively.

Chapter 8 investigates community patters at Los Ajos through the study of artifact density trends, the distribution of anthropogenically altered soils, and artifact assemblage composition in the different sectors of the site. Chapter 9 synthesizes the research at Los Ajos, integrating both archaeological and paleoenvironmental data to explore how this evidence can illuminate the nature of these early Formative societies and their responses to the changing mid-Holocene landscapes. Within a more interpretative framework, it describes the historical trajectory of the early Formative societies of southeastern Uruguay, which are framed as intermediate-level societies.





**a**



**b**

Figure 4.23. a: Natural Hilltop Rock Outcrop; b: Borrow Area at Los Ajos Site

Integrating the archeological and paleoecological data, in the concluding chapter, particular emphasis is given to the transforming environment of the mid-Holocene, the process of early village formation, the appearance and formalization of public spaces, the formation of tribal societies, and the changes in site layout experienced by Los Ajos. It also summarizes the implications of the data obtained from this study in terms of the culture-history for southeastern South America, its environmental history, the early adoption and dispersal of cultigens into southeastern South America, and the conceptualization of the emergence and dynamics of intermediate-level societies. Finally, it concludes with some guiding questions for future research in the area.

## **Chapter 5**

### **Lithic Analysis**

#### **Introduction**

This chapter provides a descriptive overview of the lithic artifacts recovered at Los Ajos. Because lithics are the dominant assemblage in all the temporal components defined at the site, they provide us with a unique opportunity to trace the technological and subsistence changes that occurred over time at Los Ajos. The first section of this chapter introduces the main research questions of the lithic analysis along with the methodology used to answer them. Following methodology, a review of the lithic raw material sources available in the region is offered. Then, a brief review of the previous lithic analyses carried out in the region is given. After that, the results of the lithic study are presented; they begin with a description of debitage and core analyses divided by raw material and are followed by the description of the tool analysis, which includes the definition of formal flake tool-types and projectile points and its chronological distribution. Appendix 4 presents a preliminary use-wear analysis on a small sample of selected stone artifacts. Once the results of this study are presented, the concluding section of the chapter discusses lithic assemblage variability in relation to major changes in settlement and subsistence that occurred between the Preceramic Archaic and the Preceramic and Ceramic Mound components of the site that lead to the development of early Formative societies. A comparison of the Los Ajos lithic assemblage with other lithic industries from Uruguay and the region is also offered. Ground stone technology is presented in Chapter 6 (section on Phytolith and Starch Grain Analyses from Plant Processing Tools).

#### **Research Questions and Methodology**

As described in detail in the preceding and following chapters, the Preceramic Mound Component at Los Ajos was accompanied by changes in settlement patterns (beginning of village formation), subsistence (transition to a mixed economy), and changes in technology examined in this chapter. In this regard, a major aim of this study was to characterize the lithic industries at Los Ajos, with a particular emphasis on the transition from the Preceramic Archaic

Component to the Preceramic Mound one, and to assess how these changes are related to settlement, subsistence, and other technological changes (e.g. the appearance of plant grinding tools; see Chapter 6: Figures 6.9-12)<sup>13</sup>. To this end, this study is mainly concentrated on the following aspects: (a) to characterize the lithic assemblages of the different temporal components with particular attention to the expedient-curation continuum, (b) to determine if any particular tool types or technology are chronologically sensitive, and (c) to compare tool assemblage diversity between the different occupational components.

To achieve these objectives, this study integrates conceptual advances in the analysis of lithic technology, ones that have allowed archaeologists to look at the organizational implications of lithic assemblages. In particular, this study focuses on the archaeological correlates that have been developed in order to match different types of lithic assemblages, especially with regard to such issues as mobility (e.g., Andrefski 1991; Bamforth 1986; Binford 1977; Morrow and Jefferies 1989; Parry and Kelly 1987; Shott 1986) and subsistence (e.g., Ranere 1975; Richardson 1978; Rossen 1998). In doing so, these authors have made an important distinction between expedient, informal tools and curated, formal tools. Formal tools are those that have undergone a great amount of effort in their production and maintenance. As a result these tools are flexible, they can be easily rejuvenated, and have the potential to be redesigned for different functions (see Bamforth 1986). Formal tools usually include bifaces, some intentionally retouched flake-tools, and formally prepared cores. On the other end of the spectrum, informal tools are those with little effort expended in their production. They are generally made, used, and discarded over a relatively short period of time. This type of technology, usually called expedient technology, is wasteful with regard to the use of lithic raw materials and it tends to produce simple tools with less formal patterning, shape, or design.

Overall, these studies have linked formal, standard, curated tools with mobile hunter-gatherer populations, and in turn, have associated informal, non-standard, expedient tools with more sedentary populations. The rationale behind this argument is that mobile hunter-gatherers “on the move” need multifunctional, readily modifiable, and easily portable gear to avoid the risk of being unprepared for the task at hand (Torrence 1983, 1989). On the contrary, more sedentary populations do not have to expend extra effort in the maintenance of flexible, transportable tools.

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<sup>13</sup> Here we are strictly referring to the appearance of plant processing tools at the Los Ajos site. The presence of plant processing tools in Uruguayan prehistory extends back to the Early Holocene (Hilbert 1991).

They can safely manufacture, use, and discard tools according to the needs of the moment; more so if the lithic raw materials are locally abundant. This is the case at the Los Ajos site; a point to which I will return in the final section of this chapter.

In addition to correlating lithic technology with group mobility, many studies have successfully linked lithic technology with subsistence practices, in particular, in reference to generalized vs. specialized economies. Of major interest for this study is the proposition that a change from bifacial, formal, more curated technologies to unifacial, informal, more expedient ones is indicative of a shift to a more generalized, plant-oriented economy, connected to the beginnings of food-production intensification (Rossen 1991, 1998; Rossen and Dillehay 2001).

## **Methodology**

### ***Materials and Sampling***

As described in the preceding chapter, based on stratigraphy, artifact content, and radiocarbon dates, three main occupational components were defined at Los Ajos: Preceramic Archaic Component (PAC) (Early Holocene to ca. 4,190 bp), Preceramic Mound Component (PMC) (4,190 to 3,000-2,500 bp), and Ceramic Mound Component (CMC) (3,000-2,500 bp to Contact Period). These major temporal divisions provide a basic chronological framework to carry out artifact comparisons between the different components presented in this chapter.

Due to the sheer amount of by-products of lithic reduction, lithic debitage was sampled for intensive analysis as follows. The lithic debitage recovered from Mound Gamma totaled 15,356 items. This amount of lithic debitage goes beyond the time and labor constraints of this project and thus, the lithic debitage from Mound Gamma were column sampled. Samples for intensive debitage analysis were selected from 3 (out of 35) central sectors (2C, 4C and 6C) of every excavated 5 cm artificial level of Mound Gamma block excavation (see Figure 4.5). These sectors located in the center of the block unit were selected because it is in its central sector that the mound attains its maximal vertical representation and due to their central position, they are less subjected to vertical displacement caused by the sloping effect that occurs in the flanks of the mound. Therefore, they provided us with a more secure sample to examine diachronic differences between the different components of Mound Gamma. Overall, the total assemblage

from Mound Gamma added up to 15,356 pieces of debitage from which a total of 640 was analyzed constituting a sampling intensity of 4.17%.

In the case of the TBN crescent-shaped trench transect, lithic debitage was only analyzed from its central part corresponding to sectors 6, 7, A1 and A2 (see Figure 4.18), in which the crescent-shaped rise attained its maximum vertical expression (units). Due to the relatively low amount of debitage recovered from Mound Delta, the grid test units, and the plaza test units, all these test units were analyzed in their entirety. Altogether, the total lithic debitage assemblage sampled added up 4861 specimens. Tools were all analyzed and the entire assemblage of tools recovered from all the contexts totaled 293 specimens.

### *Debitage, Core and Tools Analyses*

The approach used for the analysis of debitage, was based on the stages of reduction (Amick and Mauldin 1989; Collins 1975; Shiffer 1976). Given the expedient nature of the lithic assemblage recovered from Los Ajos, only three stages of reduction were defined in terms of production goals: core preparation and initial reduction, primary reduction, and secondary reduction. This limited number of reduction stages is a clear indication of the relative simplicity of this unifacial industry when compared to more elaborate bifacial industries.

The analysis of the lithic reduction sequence was done through a combination of formal debitage types focused on individual artifacts and an attribute-variable analysis that characterizes the entire debitage assemblage in population terms. The definition of the debitage types associated with these stages of reduction is described in Appendix 3. Initial reduction comprises core preparation and its products consist of cores and cortical flakes. Primary reduction focuses on the extraction of primary flakes as blank-tools; its products are mainly primary flakes, many of which were directly used as tools. Secondary reduction results from the secondary trimming of flakes to produce specific tools and its products are secondary flakes and tools. In addition to these debitage types, two other main debitage types were included in this analysis: bipolar flakes and bifacial thinning flakes. An extended list of debitage attributes was recorded and processed. In this chapter, only the attributes that best discriminate the different stages of production, like platform type, cortical covering, and dorsal scar count are presented (Amick and Mauldin 1989; Magne and Pokotylo 1981; Shott 1994). The attributes analyzed for tools are described in

Appendix 3. The definition of the different flake-tools types and projectile points are described in detail below.

### **Raw Material Sources**

The information that is available with regards to the potential sources of lithic raw materials is diverse. On the “coarse” side there are low-resolution, large-scale geological maps that describe the location of each formation and its lithology. This is the case of the schematic geological map shown in Figure 5.1. Only a few areas like Sierra de San Miguel have been surveyed in detail for archaeological purposes by a geologist (Castro 1989). The remaining information has been marshaled from systematic and opportunistic archaeological surveys of the area as well as personal communications with other archaeologists working in the area (José López and Leonel Cabrera, personal communications 1999-2000).

In terms of geology, the area is one of profound structural contrasts (see also Chapter 3, Geomorphology and soils section). The flat wetland floodplains devoid of rock outcrops are abruptly interrupted by hills that transverse them in E-W direction. Two main rock geological formations in the area give rise to the lithic raw materials used by pre-Hispanic populations: the geological formation called “Grupo Rocha”, which forms part of the Pre-Cambrian crystalline basement and the Mesozoic lavas that form part of the Jurassic flood basalts (Clapperton 1993; Montaña and Bossi 1995; Preciozzi et al. 1985: 45-74; PROBIDES 1998, 2000). With respect to the lithic raw materials used at Los Ajos, “Grupo Rocha” is the potential source of quartz, phyllites, and siliceous metamorphic rocks like fine-grained quartzite; while the Mesozoic lavas mainly provided with rhyolite and opal.

“Grupo Rocha” is mainly constituted by granites and phyllites (see Figure 5.1). Granites occur along the Atlantic coast, surrounding the western border of Laguna Negra in Sierra de la Blanqueada and along the hilly area that extends along the south-west sector of Rocha Province. This latter forms part of the major “Cuchilla Grande” hilly chain. The first two areas have been intensively surveyed, both geologically (Castro 1989) and archaeologically (Curbelo and Martinez 1992; Iriarte 1993, 2000; López and Pintos 2000; López et al. 1994). This formation bears quartz and granite. In the Atlantic coast and the Laguna Negra, quartz appears in primary sources in the form of pegmatite dikes. Secondary sources of quartz are represented by small (up to 15 cm in diameter) water worn pebbles that occur near the primary sources described above.

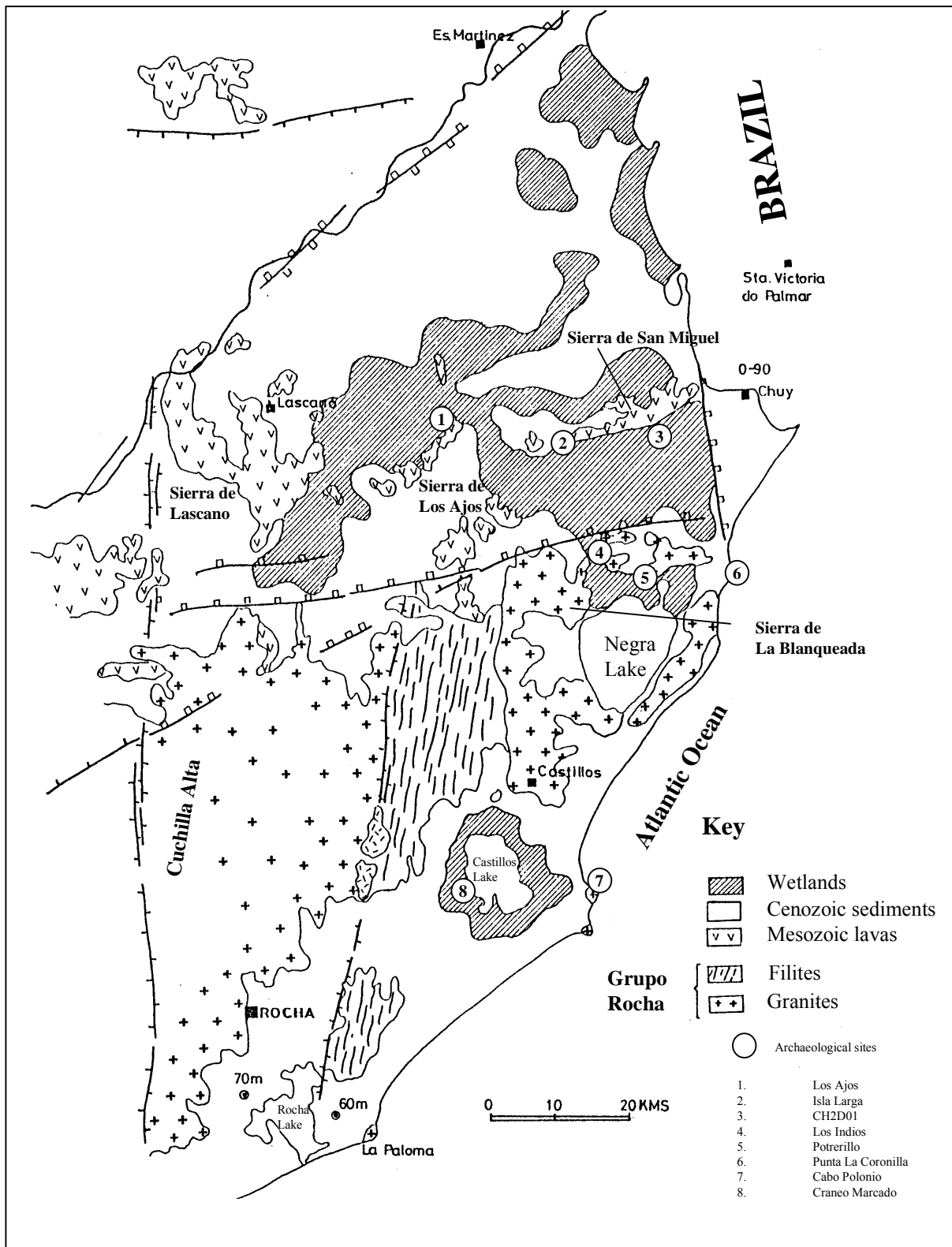


Figure 5.1. Schematic Geological Map Showing Location of Main Archaeological Sites Discussed in the Text (Modified from Montaña and Bossi 1995: Figure 2).



Along Sierra La Blanqueada, which encircles the western border of Laguna Negra, quartz also occurs in large blocks (José López, personal communication 2001). Granite, known as “Granito de Santa Teresa” appears in large blocks and rounded cobbles along the Atlantic coast and Laguna Negra. In relation to Los Ajos, quartz may have been procured from two potential sources. The first one is the granite formations that occur 25 km to the SSE of the site (Laguna Negra and the Atlantic Ocean). The second one occurs 40 km. to the SSW along the “Cuchilla Grande”.

Phyllites are encroached between the “Granitos”, which are located between Laguna Negra and the “Cuchilla Grande” hilly chain, shown as “Cuchilla Alta in Figure 5.1. The Filitas formation, located 30 km south from Los Ajos, gives rise to fine-grain, more homogeneous, isotropic varieties of siliceous metamorphic rocks, like fine-grained quartzite (José López, personal communication 2001). These outcrops are the potential sources of phyllites, black metamorphic rock, and fine-grained quartzites that were used at Los Ajos.

Mesozoic lavas, characterized by igneous rocks, are mainly located along the central part of Rocha Province and give rise to Sierra de San Miguel, Sierra de los Ajos, and Sierra de Lascano. This formation, on which Los Ajos lies, is characterized by a basaltic floor (Puerto Gomez Formation) over which rhyolites and granophyres lie (Arequita Formation). These two formations provided pre-Hispanic populations with rhyolites and basalts, as well as fine-grained opal and chalcedony. Sierra de San Miguel has been intensively surveyed both by geologists (Castro 1989) and archaeologists (Cabrera 1995; Curbelo and Martinez 1992). These surveys reported that rhyolite, basalt, and tuff occur as dikes and rock outcrops. Curbelo and Martinez (1992) reported the ubiquitous presence of rhyolite outcrops along Sierra de San Miguel and also located several dikes of opal within the rhyolite outcrops. Cabrera (1995), who did an intensive survey of Sierra de San Miguel, has reported seven rhyolite quarry sites, where the first stages of rhyolite lithic reduction were carried out. These authors further indicated the presence of two types of rhyolite: (a) grainy rhyolite, which is coarser-grained and present impurities like incrustations of quartz and porphyries and (b) fine-grained rhyolite, which is finer-grained, more homogeneous, and does not present impurities. This division in rhyolite types was followed in the classification of rhyolite in this study.

In an informal and limited survey along Sierra de los Ajos, the author located several outcrops that contain angular blocks of grainy rhyolite very similar to the ones used at Los Ajos. However, neither the fine-grained rhyolite nor the opals have been found in Sierra de los Ajos. In this regard, until additional survey of the Sierra de los Ajos is carried out and samples are submitted for petrographic analysis, it would be premature to assert conclusively that the rhyolite employed at Los Ajos comes from Sierra de los Ajos. More systematic and intensive survey of Sierra de los Ajos is needed to confirm this.

In summary, the pre-Hispanic groups of Los Ajos may have procured all the lithic raw materials used in their chipped stone industry at a distance of 20 to 45 km. In this respect, it can be concluded that the inhabitants of Los Ajos had regional accessibility to all the potential sources of lithic raw materials that were used at the site.

### **Summary of Previous Lithic Studies in the Region**

This section provides a brief summary of the lithic studies that have been carried out, to date, in the Uruguayan southern sector of the Laguna Merin basin. In general terms, the lithic analyses from several mound sites in the southern sector of Laguna Merin have characterized the lithic technology of the Mound Components as a simple, informal, and expedient technology. They have also documented a differential technological treatment of the various lithic raw materials with regards to the quality (in terms of flakeability), the distance, and the abundance of these lithic raw materials in the geological record. For example, the lithic analysis of the Ceramic Mound Component at site CH2D01, carried out by Curbelo and Martinez (1992), shows that lithic raw materials such as grainy rhyolite, basalts, and quartz, which are of low quality, highly abundant in the geological context, and located at a short distance of the sites produce lithic industries bearing the following characteristics: (a) expedient, minimally modified tools, bearing direct use of edges without secondary trimming; (b) comprise the great majority of tools and debitage assemblages (more than 90%); (c) bear terminal production (*sensu* Ericson 1984); and (d) are mainly reduced by direct and bipolar percussion. On the contrary, fine-grained lithic raw materials like opal and fine-grained quartzite, among others, which are of good quality but are of limited abundance in the geological record, display the following characteristics: (a) they are minimally represented both in the tools and debitage assemblages (less than 10%); (b) bear a

more elaborate technology, with more formal and sophisticated artifacts (preforms and bifacial projectile points), and debitage including bifacial thinning flakes; (c) display sequential production, that is only the final stages of tool manufacture are represented at the site (bifacial thinning flakes), suggesting that core reduction and blank preparation was carried out elsewhere; and (d) exhibit pressure flaking.

A similar type of differential technological treatment given to the various lithic raw materials was documented by the authors (Iriarte 1993, 2000) for the Atlantic coast sites. Accordingly, granite and quartz that are local and abundant raw materials in this locality received an expedient technological treatment. In contrast, fine-grained, non-local lithic raw materials exhibit a more curated technology. It must be noted that within these general trends, Caporale and her colleagues (1995) showed how occasionally, a few formal, elaborated unifacial and bifacial tools have been made from the locally abundant, low quality grainy rhyolites, basalts, and quartz.

In sum, previous lithic studies in the area have focused on the study of the differential technological treatment given to the various lithic raw materials. These studies have found significant correlations between quality, abundance, and distance to the geological source and the technological treatment received by the diverse lithic raw materials. The simplicity, expediency, and strong temporal continuity of the lithic technology characteristic of the Preceramic and Ceramic Mound Components in the region have precluded the aforementioned studies from defining chronologically sensitive formal tool types or technologies affiliated to any of the different temporal components of occupation.

In a recent summary of the archaeology of the region, López (2001) proposed a major chronological change in the lithic industries from the different archaeological periods of the southern sector of Laguna Merin. While he sees continuity between the lithic technology of the Preceramic Archaic Period and the Preceramic Mound Period, he argues that a major technological change occurred during the Ceramic Mound component. He states that the lithic assemblages from the Preceramic Archaic Component, recovered from buried soils below several mound sites (CH2D01 [Femenías et al. 1999]; Los Indios [López 1999, 2001], Potrerillo [José López, personal communication 2000]; Los Ajos, Mound Alfa [Bracco 1993]) (see Figure 2.3 and 5.1), show a more curated technology, one that is characterized by the presence of bifacial projectile points, bifacial reduction debris, and a major presence of fine-grained lithic

raw materials. According to this author, the main technological change occurred during the Ceramic Mound Component and it was characterized by a general shift to a more expedient technology, mainly expressed by a major reliance on quartz to the detriment of good quality lithic raw materials. Regrettably, the author did not provide an explanation to account for these changes. This study agrees with López (op.cit) that there was a gradual shift towards a more expedient technology, which was also characterized by a major reliance on local raw materials. Nevertheless, I disagree with López (op.cit.) on the timing of this change. As will be shown in the following sections, these changes in the lithic technology started to take place earlier during the Preceramic Mound Period.

## **Results**

### **Debitage and Core Analyses**

#### ***Distribution of Lithic Raw Materials***

Following the classification used by Proust and Lima (1990), I divided quartz into three varieties: (a) hyaline or transparent quartz; (b) translucent quartz, the variety that when opposed to the light allows light to pass through it but not images; and (c) milky quartz, the opaque variety, which only allows light to pass through the very thin edges. The translucent variety of quartz was by far the most used at Los Ajos (94%), followed by hyaline quartz (5%), and milky quartz (1%). As mentioned earlier, rhyolite was divided in two varieties: grainy and fine-grained rhyolite. Grainy rhyolite is coarser-grained and presents impurities like incrustations of quartz and porphyries, whereas, fine-grained rhyolite is finer-grained, more homogeneous, and does not contain impurities. The better grade, fine-grained, homogeneous, isotropic raw materials like fine-grained rhyolite, fine-grained quartzite, chalcedony, the unidentified black fine-grained black metamorphic stone, and phyllite will be considered together as a whole due to the fact that all of them have received similar technological treatment and that they are minimally represented.

The tables presented below comprise all lithicdebitage sampled from all excavation units and are presented according to the temporal components defined in Chapter 4. Because of the sheer amount of Ceramic Mound Componentdebitage recovered from off-mound test units, thisdebitage is considered separately and called TU CMC (Test Units Ceramic Mound Component).

Table 5.1 depicts the distribution of raw materials at Los Ajos. Taking together all the temporal components from all the excavation units across the site, quartz (51.5%) and grainy rhyolite (41.2%) are the predominant lithic raw materials used at the site, adding up to 92.7% of all the debitage. All the other fine-grained lithic raw materials comprise the remaining 7.3%.

However, when considering the differential use of lithic raw materials, the fact that different reduction techniques produce different types and quantities of debitage should be taking into account. For example, though quartz is the most abundant raw material, it must be considered that almost a third (28%) of quartz debitage is constituted by very small angular shatter (size category 1A1) (Table 5.6) abundantly produced during the initial stages of bipolar flaking, which results from unsuccessful blows on the core. It should be bear in mind, that this fact produces overestimations on the importance of quartz as a raw material. This fact is corroborated by the fact that although quartz debitage is present in higher quantities than rhyolite debitage, rhyolite tools (64% of total tools) greatly outnumbered quartz tools (14.5% of total tools).

Among the three varieties of quartz, translucent quartz was the most used one, representing 48.0% of all the lithic raw materials combined. The use of hyaline (3.1%) and milky (0.4%) quartz was very limited, showing a marked preference for translucent quartz over the other two varieties. With respect to the two varieties of rhyolite, grainy rhyolite (41.2%) was extensively used in comparison with fine-grained rhyolite, which was used in very small amounts (2.2%).

Turning to the comparison of the utilization of the various lithic raw materials between the different temporal components, it is readily apparent from Table 5.1 that there are no major differences. Quartz slightly increases from 42.2% in the PAC to 46.1% in the PMC and 53.9% and 55.7% in the levels corresponding to the TUCP and CMC, respectively. The difference in the use of quartz is only statistically significant between the PMC and the CMC ( $z= 1.79, p>0.05$ )<sup>14</sup>. There is no significant difference between the PAC and the PMC.

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<sup>14</sup> When comparing artifacts from these different contexts we used the test of proportions (Drennan 1996: to assess the statistical significance of the differences between different components).

Table 5.1. Distribution of Debitage Raw Material

Component	Quartz				Grainy rhyolite	Homogeneous isotropic raw materials							Subtotals	Totals
	Translucent	Hyaline	Milky	Subtotals		Fine-grained rhyolite	Quartzite	Opal	Chalcedony	Phyllite	Black metamorphic	Other		
Ceramic Mound Component (CMC)	958	42	6	1006	748	45	20	4	7	1		35	112	1866
	51.3%	2.3%	0.3%	53.9%	40.1%	2.4%	1.1%	0.2%	0.4%	0.1%	0.0%	1.9%	6.0%	
Preceramic Mound Component (PMC)	195	21	6	222	233	15	11	1	2	1		12	27	482
	40.5%	4.4%	1.2%	46.1%	48.3%	3.1%	2.3%	0.2%	0.4%	0.2%	0.0%	2.5%	5.6%	
Test Units Ceramic Mound Component (TU CMC)	878	63	7	948	642	22	51	5	11	1	3	19	112	1702
	51.6%	3.7%	0.4%	55.7%	37.7%	1.3%	3.0%	0.3%	0.6%	0.1%	0.2%	1.1%	6.6%	
Preceramic Archaic Component (PAC)	340	27	2	369	416	26	33	6	14	3	5	22	109	894
	38.7%	3.3%	0.2%	42.2%	46.7%	2.5%	3.7%	0.5%	1.5%	0.1%	0.4%	2.4%	12.2%	
Totals	2371	153	21	2545	2039	108	115	16	34	6	8	88	360	4944
	48.0%	3.1%	0.4%	51.5%	41.2%	2.2%	2.3%	0.3%	0.7%	0.1%	0.2%	1.8%	7.3%	

Like quartz, grainy rhyolite does not show statistically significant differences among the different components of occupation ranging from the lowest value of 40.3% in the CMC to its major value of 47% in the PMC. It must be noted that there are statistically significant differences between the PAC and PMC when compared to the MCP ( $z= 3.34$ ,  $p>0.05$ ;  $z= 3.29$ ,  $p>0.05$ , respectively). However, the differences between the PAC and PMC are not statistically significant ( $z= 0.57$ ,  $p>0.05$ ).

With regards to the fine-grained lithic raw materials, there is a slight and steady decrease in their use from the older PAC, where they add up to 12.2% to 6.6% in the PMC and 6.0% during the most recent MCP. In relation to these figures, it should be noted that there are statistically significant differences between PAC and both the PMC and CMC ( $z= 3.82$ ,  $p>0.05$ ;  $z= 5.45$ ,  $p>0.05$ ; respectively). However, the differences between the PMC and the CMC are not statistically significant ( $z=0.33$ ,  $p>0.05$ ).

On balance, there are two major patterns observed: (a) in the older occupational components, the PAC and the PMC, rhyolite is better represented than quartz, and in turn, quartz is better represented than rhyolite during the most recent occupation of the site and (b) there is a gradual decrease in the use of fine-grained raw materials over time from the PAC to the CMC. These patterns combined indicate that during the earlier temporal components rhyolite and fine-grained raw materials were more used, and in turn, quartz was more employed during the later component.

Turning to the main research questions of this study, one was to look for differences in raw material preferences between the different temporal components at Los Ajos. One particular objective of this study was to test López's (2001) assertion that during the Mound Ceramic Component there was an impoverishment of the technology characterized by (a) a decline in the use of high quality lithic raw materials and (b) a major reliance on quartz during the CMC. With regards to (a), the distribution of lithic raw materials at Los Ajos shows a small but statistically significant change to a minor reliance on this higher quality lithic raw materials from the oldest Preceramic Archaic Component to the more recent Preceramic and Ceramic Mound components. In relation to (b), the data evidences a minor but statistically significant change toward a major reliance on quartz during the most recent CMC when compared to the PAC and PMC. In addition, during the CMC there is a slight but significant decline in the use of grainy rhyolite.

Taken as a whole, the changes in the use of different lithic raw materials between the different occupational components are statistically significant but occurred in minor percentages (Table 5.1). The general patterns seen at Los Ajos corroborates López's (op.cit.) proposition that over time there is a decrease in the use of fine-grained lithic raw materials and an increase in the use of quartz. However, Los Ajos lithic analysis shows that these changes started to take place earlier, during the PMC, and not during the CMC as López (op.cit.) has proposed.

### ***Grainy Rhyolite Cores and Debitage***

The analysis of cores, debitage, and resulting tools indicates that grainy rhyolite was part of an expedient technology mainly used for the production of very simple, informal, non-standardized tools as well as the manufacture of unifacial projectile points.

*Raw material acquisition.* Grainy rhyolite was either locally acquired from primary sources in the form of blocks that occur in Sierra de los Ajos or it could have been procured from Sierra de San Miguel 20 km to the ESE. Microscopic petrographic studies need to be carried out in order to securely pinpoint the source of grainy rhyolite used at Los Ajos; however, it seems reasonable to propose that the pre-Hispanic populations that lived at Los Ajos exploited the local rhyolite. Once acquired it was probably stockpiled in the site. At the site, all stages of reduction including core reduction, initial reduction, primary and secondary reduction as well as tool use, resharpening, and discard took place.

*Core reduction and blank preparation.* Rhyolite was unipolarly reduced by direct percussion. The reduction of rhyolite blocks from a number of natural and single-facet prepared platforms resulted in the production of amorphous (N=55) (Figure 5.2a and b; Figure 5.3a) and globulose (N=28) (Figure 5.2c) core types (usually exhausted) (Table 5.2). Flakes were removed in no patterned sequence from a number of different striking platforms producing cores that are not necessarily regular in shape. In general, platform preparation was limited to the detachment of a flake to produce a flat surface, which was subsequently used as a striking platform. As a consequence, cores lack prepared, multiple facet platforms (Table 5.2) and the more formal pyramidal (N=1) and discoidal core types are rare (N=2). This simple core technology is reflected in the dominance of cortical (22-26%) and single-facet flakes (67-80%) and in the near



absence of rhyolite flakes with multiple facet platforms (1-4%) (see Table 5.4). The expediency of this technology and the abundance of rhyolite are also expressed by the presence of more than 50% in all the faces of cores, which still have mass potential to extract flakes (Table 5.2). The high percentage of amorphous and globulose rhyolite cores with flake removals from multiple, non-opposing platforms results in the production of a variety of flake shapes and sizes; a technique that is particularly suited to produce expedient tools. Most of the cores present between three and five striking platforms and at least nine complete flakes were extracted from the majority of them (Table 5.2). In addition to the use of blocks as cores, very large flakes were also used as cores. These large flakes, called macro-flakes, were probably extracted from blocks at the quarry using the “bloc sur bloc” technique (Brezillon 1978) and transported to the site to be further reduced for the production of tool blanks.

Overall, grainy rhyolite technology could be characterized as terminal production (*sensu* Ericson 1984), that is, all the stages of reduction but procurement were carried out at the site. This is indicated by the following characteristics. All debitage types including cortical, primary, and secondary flakes are well represented in all the occupational components of the site. The same is true if we analyze the assemblage as a population taking into account the individual reduction stage diagnostic attributes like size categories, platform type, percentage of cortex, and scar count in the dorsal surface. In this regard, all types of platforms are present, but the better represented are single-facet (67-80%) and cortical platforms (22-26%). The scant amount of multiple facet and crushed platforms characteristic of advanced stages of reduction indicates that the reduction of rhyolite was primarily unifacially and restricted to obtain flake blanks. This is further corroborated by the near absence of grainy rhyolite bifacial thinning flakes. Besides, all dorsal face cortex categories are represented, with a predominance of non-cortical flakes. This is in accord with the high percentage of secondary flakes. Last but not least, all dorsal scar count as well as all size categories are well-represented at the site (Table 5.4) further corroborating the terminal production of rhyolite.

Table 5.2. Morphological and Technological Characteristics of Grainy Rhyolite Core

Component	Core morphology						Platform type			Platform count					Scar count					Subtotal	Cores from macro-flakes With Mass Potential							
	Amorphous	Globulose	Prismatic	Pyramidal	Discoidal	Bipolar	Subtotal	Natural/Cortical	Noncortical single facet	Natural and single facet	Subtotal	1	2	3	4	5	Subtotal	1	3			4	6	6	9	9+	Subtotal	
CMC	22	10					32	11	20	32		9	10	3	10	32		7	8	17					32	4	19	32
	69%	31%						34%	63%			28%	31%	9%	31%			22%	25%	53%						13%	59%	
PMC	3	7			1		11	6	4	11		1	1	5	1	3	11			2	9				11	2	8	11
	27%	64%			9%			55%	36%			9%	9%	45%	9%	27%				18%	82%					18%	73%	
TU CMC	16	5					21	5	15	21		4	7	3	7	21		1	4	4	12				21	4	15	21
	76%	24%						24%	71%			19%	33%	14%	33%			5%	19%	19%	57%					19%	71%	
PAC	14	6		1	1		22	7	11	22		4	5	7	2	4	22		2	7	8	5			22	1	13	22
	64%	27%		5%	5%			32%	50%			18%	23%	32%	9%	18%			9%	32%	36%	23%				5%	59%	

Table 5.3. Metric Attributes of Grainy Rhyolite Debitage by Temporal Component in all Contexts of the Site

Component	Size categories (cm)									Totals	Thickness (mm)		
	1A (1x1)	1A1 (2x1)	1B (2x2)	2B1 (3x2)	2C (4x4)	2C1 (2x4)	3D (6x6)	3D1 (6x4)	4D1		X	STD	Range
CMC	93	74	199	126	128	45	16	65	2	748	5.9	4.7	2_50
	12%	10%	27%	17%	17%	6%	2%	9%	0%				
PMC	40	42	56	36	37	12	6	4		233			
	17%	18%	24%	15%	16%	5%	3%	2%	0%				
TU CMC	60	55	184	81	151	50	34	21	6	642			
	9%	9%	29%	13%	24%	8%	5%	3%	1%				
PAC	45	52	100	67	71	36	18	23	4	416			
	11%	13%	24%	16%	17%	9%	4%	6%	1%				

Note: Alldebitage was measured including fragmented flakes and angular debris

Table 5.4. Technological Attributes of Grainy Rhyolite Debitage

Component	Debitage stage categories						Subtotal	Platform type				Subtotal	Cortical covering				Subtotal	Scar Count					Subtotal
	Angular	Cortical	Primary	Secondary	Bifacial thinning flakes	Rejuvenation Flakes		Cortical	Single facet	Multiple facet	Crushed		100%	>50%	<50%	0%		0	1	2	3	4	
CMC	238	119	125	257	7	2	748	131	334	6	28	499	91	60	60	290	501	91	122	135	87	52	487
	31.8%	15.9%	16.7%	34.4%	0.9%	0.3%		26.3%	66.9%	1.2%	5.6%		18.2%	12.0%	12.0%	57.9%		18.7%	25.1%	27.7%	17.9%	10.7%	
PMC	43	13	40	137			233	38	125		13	176	21	17	19	122	179	21	38	65	31	24	179
	18.5%	5.6%	17.2%	58.8%				21.6%	71.0%	0.0%	7.4%		11.7%	9.5%	10.6%	68.2%		11.7%	21.2%	36.3%	17.3%	13.4%	
TU CMC	137	49	112	342	2		642	66	365	11	16	458	45	41	68	315	469	48	97	152	98	73	468
	21.3%	7.6%	17.4%	53.3%	0.3%			14.4%	79.7%	2.4%	3.5%		9.6%	8.7%	14.5%	67.2%		10.3%	20.7%	32.5%	20.9%	15.6%	
PAC	51	60	101	195	8	1	416	67	215	13	12	307	29	32	55	192	308	33	47	124	64	45	313
	12.3%	14.4%	24.3%	46.9%	1.9%	0.2%		21.8%	70.0%	4.2%	3.9%		9.4%	10.4%	17.9%	62.3%		10.5%	15.0%	39.6%	20.4%	14.4%	
Totals							2039					1440					1457						1447

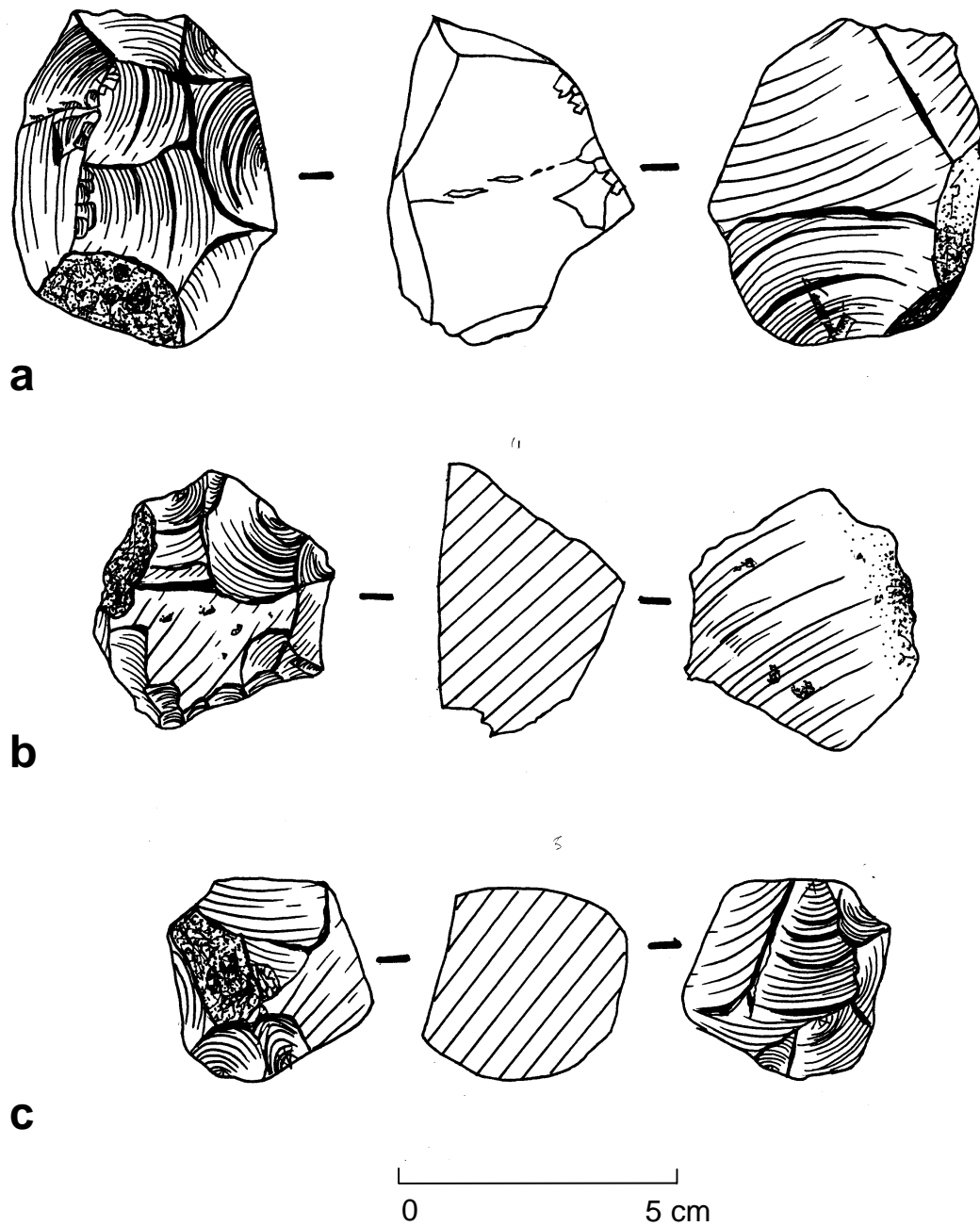


Figure 5.2. a and b: Amorphous Grainy Rhyolite Cores (Mound Gamma,, 145-150 cm Depth, Sector 5/E and Test Unit N 50 E 150, 20-25 cm Depth, Respectively); c: Globulose Grainy Rhyolite Core (Mound Gamma, 145-150 cm Depth, Sector 3/A ).

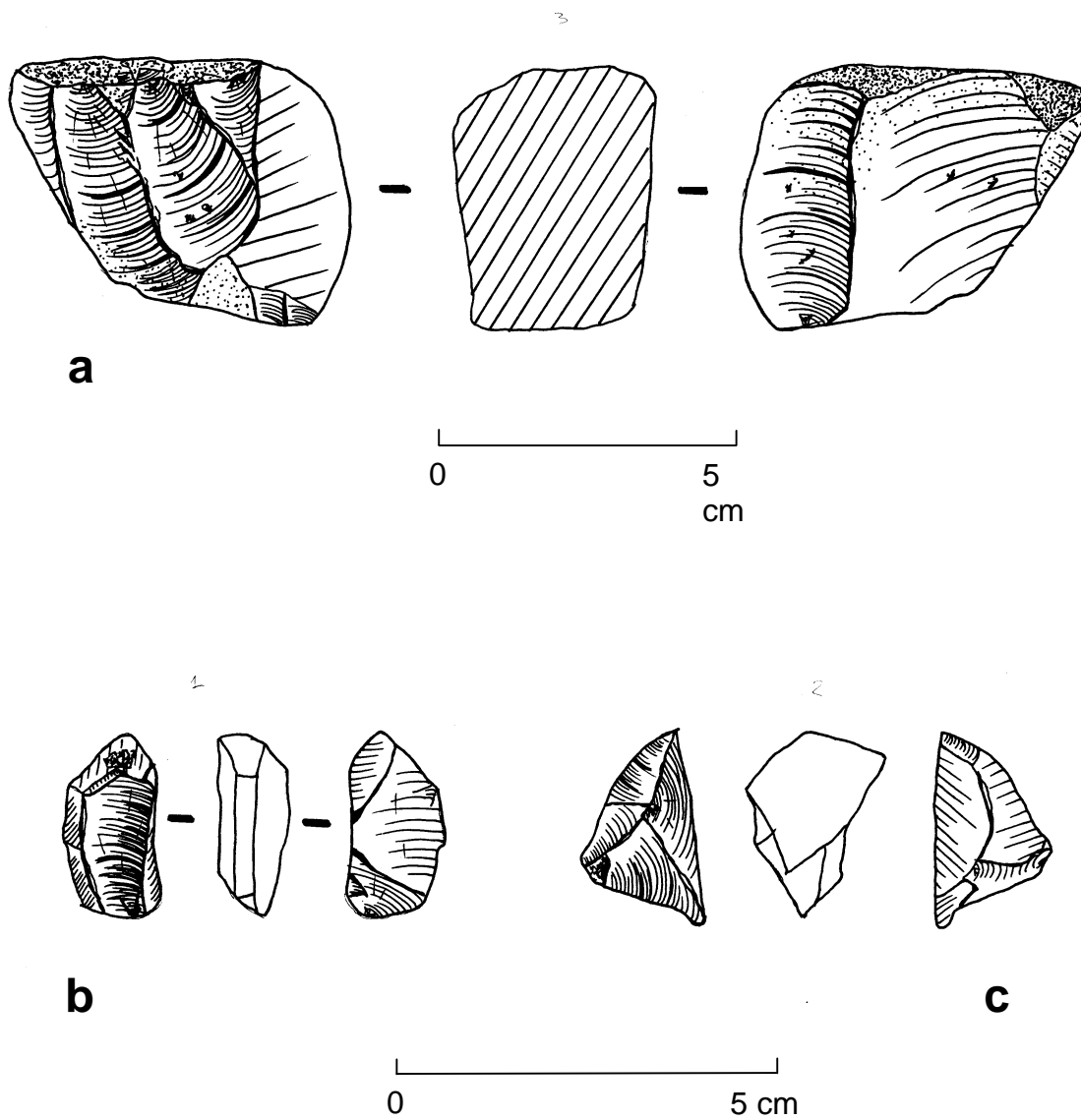


Figure 5.3. a: Grainy Rhyolite Core (Test Unit N 250 E 150, 5-10 cm Depth); b and c: Bipolar Quartz Cores (Test Unit N 50 E 150, 30-35 cm Depth and Test Unit N 100 E 450, 15-20 cm Depth, Respectively).

## *Quartz Cores and Debitage*

*Characteristics of quartz and bipolar flake industries.* Though little attention has been paid to the quartz lithic industries mainly due to their lack of formal, diagnostic tool types (Sussman 1985), quartz has been extensively used in Eastern South America from Paleoindian times through the period of contact (e.g., Bryan and Gruhn 1993; Curbelo and Martinez 1992; Prous 1984; Prous and Lima 1990; Ruthschilling 1989, 1990).

Vein quartz is a raw material of poor quality in terms of flakeability. It usually breaks along the many crystal facets and flaw planes that are present in the material. Hence, pre-Hispanic artisans had limited control over the results of the unipolar reduction of quartz. In this respect, most experts (e.g., Flenniken 1980; Prous 1984), who have experimentally replicated bipolar flaking of quartz, agree that the bipolar technique provides a way to have better control over the flaking of quartz and helps obtain long and straight flakes from small nodules and chunks of veins quartz.

Technically, bipolar reduction is characterized by wedging initiation, compression-controlled propagation, and a variety of flake terminations (Cotterell and Kamminga 1987). Several authors have described the characteristics of bipolar quartz flakes since they can be very difficult to identify from its fracture-surface features (Cotterell and Kamminga 1987; Flenniken 1980; Prous 1984; Prous and Lima 1990). This is in part because bipolar flakes are usually chunky, lack prominent conchoidal features, and tend to retain distinctive fracture damage from hammer impact, which have made them difficult to be securely identify. As a result, as Jeske and Lurie (1993) have pointed out that the visibility of bipolar industries is underrepresented since only few stereotypical bipolar flakes are highly visible for the archaeologist, while the majority of the byproducts produced by this technique cannot be distinguished from other manufacturing technologies like unipolar flaking.

Following Cotterell and Kamminga (1987) and Prous and Lima (1990), the major criteria used to identify bipolar flakes of quartz are the presence of crushed, battered, ridged, and pointed platforms. The platform usually presents a cascade of small step scars. Some “typical” bipolar flakes are characterized by the presence of two positive bulbs of percussion on the same or different surfaces or the existence of one positive bulb of percussion at one end of the artifact and a negative scar originating from the opposite end of the same or different surface. However,

they usually represent a minimal portion of the assemblage (Jeske and Lurie 1993). Battered platforms are the result of unsuccessful blows applied to the bipolar core before a flake is struck. This results in the detachment of small flakelets around the point of percussion. The initiation angle is usually  $90^{\circ}$  and lacks a bulb of percussion, creating flakes with flat interior faces. Due to the nature of quartz that tends to break through “fracture planes” and the bipolar technique that exerts force on the two ends of the cores, bipolar flakes commonly have a flat face and their overall shape resembles a “gore”, commonly called by Brazilian archaeologists as “gomo” (Portuguese word for “gore”) (Prous 1984, Prous and Lima 1990).

In addition, quartz industries lack formal types, that is, a large part of the lithic assemblages composed of quartz embrace expedient tools with no evidence of being shaped into diagnostic tools. Nonetheless, as noted by several replicative analyses, unmodified bipolar flakes present a variety of useful edges that can be readily used for different tasks without further modification for cutting, scraping, and gribbling, among other functions. In this regard, most of the researches agree that the flakes resulting from bipolar flaking are mainly chosen for the usefulness of their natural working edges, rather than being intentionally retouched<sup>15</sup>. The ethnographic observations of Miller (1979) among a Xeta group in the state of Paraná, Brazil, which describes the non-standardized bipolar core reduction and the direct use of unretouched quartz flake tools, represent an example of this expedient use of quartz. Last but not least, experimental studies carried out by Bryan and Ghrun (1993) showed that quartz is superior in terms of hardness and durability to almost all other lithic raw materials. As a result, it shows minimal evidence of use retouch in its working edges, especially when applied to soft materials like vegetal tissue of meat, and therefore, it does not leave any visible evidence of use (see also Sussman 1988). This is an aspect that results in an underestimation in the identification of quartz tools in macroscopic studies, like the one carried out in this study, and should be taken into account when pondering the importance of quartz in the tool assemblage.

*Quartz debitage and cores.* As described in the geological context section, quartz occurs in primary form in the Granite formations that are located between ca 25-40 km of the site. The most feasible way to remove primary chunks from vein quartz is probably through direct percussion by smashing or throwing another rock onto it, the “block sur block” technique

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<sup>15</sup> It must be noted that more elaborate quartz instruments, like unifacial projectile points presenting bifacial marginal pressure retouch are present in southern Brazil and Uruguay.



(Brezillon 1978). Once the vein quartz has been removed and transported to the site, unipolar and bipolar reduction techniques were utilized to obtain the desirable end products. As suggested by Prous and Lima (1990), unipolar flaking was probably used in the initial stages of reduction. Bipolar reduction was used when flakes could no longer be detached by direct percussion from the small “unipolarly exhausted” cores.

In comparison with the other lithic raw materials, quartz flakes are relatively small. Without taking into account the tiny angular shatter produced by the initial reduction, only 3% of the quartz flakes (both bipolar and unipolar) exceed 4 cm in length (see Table 5.6). Within quartz flakes it is interesting to note that the major percentage of unipolar flakes are roughly quadrangular flakes falling into the 1B size category (2x2cm). In contrast, bipolar flakes tend to be longer than narrower, falling for the most part into the 2B1 size category (4x2 cm). In terms of thickness, in agreement with experimental replication techniques of quartz flaking, unipolar flakes are thicker than bipolar flakes. In addition, and as expected, bipolar flakes mostly present crushed platforms (52%) and single-facet platforms (39%). Conversely, unipolar flakes are dominated by single-facet platforms (62%) and cortical platforms (29%) (Table 5.6).

The combined presence of all size categories, platform types, dorsal cortex percentage, scar count categories in addition to the presence of both bipolar and unipolar cores, indicate that all stages of reduction but the acquisition of raw material were carried out at the site.

Unipolar cores are mainly of amorphous or globulose shapes, while bipolar cores tend to be thinner and longer. As it should be expected from a non-local, brought-in lithic raw material, quartz was further reduced than the local grainy rhyolite. Only a minor percentage (10-33%) of quartz cores still have mass potential, especially when compared to the large portion of grainy rhyolite cores (59-73%) that still have mass potential (Table 5.5).

### ***Fine-Grained Lithic Raw Materials***

Overall, the fine-grained, homogeneous, isotropic lithic raw materials (hereafter called fine-grained lithic raw materials) are minimally represented embracing all together 7.3% of all the lithic raw materials. Within them the best represented is quartzite (2.3%), followed by fine-grained rhyolite (2.2%), chalcedony (0.7%), opal (0.3%), and black metamorphic rock and phyllite (0.2 and 0.1%, respectively) (Table 5.1). In contrast to grainy rhyolite and quartz that present terminal production, fine-grained lithic raw materials are mainly characterized by a

staged production, in which only the final stages of reduction are present. The first stages of reduction are minimally represented and they are evidenced by the presence of a few small amorphous and globulose cores (N=5) that were brought to the site and worked intensively, extracting from them all the possible flakes (Table 5.7).

Staged production is represented by bifacial thinning flakes, which are the product of the bifacial reduction of larger bifacial cores elsewhere. Fine-grained lithic raw materials present a major frequency of bifacial thinning flakes in comparison with grainy rhyolite, as well as a major percentage of multiple facets and crushed platforms characteristic of the advanced stages of bifacial reduction (Table 5.7). However, taken into account the large amount of bifacial thinning flakes that bifacial reduction produces (e.g., Patterson 1990), the small amount of bifacial thinning flakes recovered at Los Ajos indicates that the bifacial reduction carried out at the site was extremely low. There are statistically significant differences between the proportions of bifacial thinning flakes recovered in the PAC (34/894, 3.6%) when compared to the PMC (3/639, 0.47%) and CMC (17/3475, 0.48%) ( $z= 4.11$ ,  $p>0.05$ ;  $z=8.03$ ,  $p>0.05$ , respectively). This indicates that though very limited, bifacial reduction was more prominent during the PAC. Recalling the preceding discussion on the organization of technology and group mobility, the decrease in the proportion of bifacial thinning flakes that took place during the Mound components is another line of evidence suggesting that these populations reduce their mobility.

Table 5.5. Morphological and Technological Characteristics of Quartz Cores

Component	Core morphology						Platform type			Platform count					Scar count				Subtotal	With Mass Potential			
	Amorphous	Globulose	Prismatic	Pyramidal	Discoidal	Bipolar	Subtotal	Natural	Noncortical single facet	Natural and single faceted	Subtotal	1	2	3	4	5	Subtotal	1-3			4-6	6-9	9+
CMC	3					8	11	9	2	11	2	7	1	1		11	1	7	2	1	11	2	11
	27%					73%		82%	18%			64%	9%	9%			9%	64%	18%	9%			18%
PMC	2					1	3	1	2	3	2		1			3		2	1		3	1	3
	67%					33%		33%	67%		67%		33%					67%	33%	0%			33%
TU CMC	4	2				6	12	1	6	1	8	2	3	1	2	8	1	4	4		9	2	8
	33%	17%				50%		13%	75%	13%			38%	13%	25%		11%	44%	44%	0%			25%
PAC	1	6				7	14		6	4	10	1	5	3	1	10	1	4	3	2	10	1	10
	7%	43%				50%		60%	40%			10%	50%	30%	10%		10%	40%	30%	20%			10%

Table 5.6. Metric and Technological Attributes of Bipolarly and Unipolarly Flaked Quartz

Size Categories (cm)									THICKNESS (mm)		Platform type				Cortical covering				Scar Count							
1A	1A1	1B	2B1	2C	2C1	3D	3D1																			
(1x1)	(2x1)	(2x2)	(3x2)	(4x4)	(2x4)	(6x6)	(6x4)	X	STD	RANGE	Cortical	Single facet	Multiple facet	Crushed	100%	>50%	<50%	0%	0	1	2	3	4			
Bipolar		5	17	42	23	5		11	6	2_29	7	32		43		11	15	61	15	42	22	8				
		5%	18%	46%	25%	5%					9%	39%		52%		13%	17%	70%	17%	48%	25%	10%				
Unipolar		10	34	158	64	47	27	4	6	9	6	6_48		45	97	1	12	48	51	59	344	45	150	169	71	18
		3%	10%	45%	18%	13%	8%	1%	2%					29%	62%	2%	7%	10%	10%	12%	68%	10%	33%	37%	16%	40%

Note: Only flakes with can be securely identified as bipolar or unipolar were taken into account for this table.

Table 5.7. Morphological and Technological Characteristics of Isotropic Raw Materials Cores

Component	Core morphology						Platform type			Platform count					Scar count				Subtotal	With Mass Potential						
	Amorphous	Globulose	Prismatic	Pyramidal	Discoidal	Bipolar	Subtotal	Natural	Noncortical single facet	Natural and single facet	Subtotal	1	2	3	4	5	Subtotal	1			3	4	6	6	9	9+
CMC	3	1			1		5		2	3	5		2	1		2	5						2	3	5	5
	60%	20%			20%				40%	60%			40%	20%		40%							40%	60%		100%
PMC	2			1			3		2	1	3			1	1	1	3			1				2	3	2
	67%			33%					67%	33%			33%	33%	33%					33%				67%		67%
TU CMP	3	1					4		1	3	4		1	1	1	1	4			1	1		2	4	2	
	75%	1%							25%	75%			25%	25%	25%	25%				25%	25%		50%		4	50%
PAC	3	1			1		5		3	2	5	1	1	2		1	5						1	4	5	3
	60%	20%			20%				60%	40%		20%	20%	40%		20%							20%	80%		60%

Table 5.8. Metric Attributes of Isotropic Raw Materials Debitage

Component	Size categories (cm)									Thickness			
	1A (1x1)	1A1 (2x1)	1B (2x2)	2B1 (3x2)	2C (4x4)	2C1 (2x4)	3D (6x6)	3D1 (6x4)	4D1	Totals	(mm) x	std	range
CMC	24 21%	1 1%	42 38%	22 20%	13 12%	6 5%		4 0%	4 0%	112	4.45	3.9	1_32
PMC	15 36%	6 14%	16 38%	1 2%	3 7%	1 2%				42			
TU CMC	16 15%	20 19%	49 46%	9 8%	9 8%	3 3%				106			
PAC	6 7%	9 10%	40 43%	11 12%	13 14%	8 9%	3 3%	2 2%		92			

Table 5.9. Technological Attributes of Isotropic Raw Materials Debitage

Component	Debitage stage categories							Platform type					Cortical covering				Scar Count						
	Angular	Cortical	Primary	Secondary	Bifacial thinning flakes	Rejuvenation flakes	Subtotal	Cortical	Single facet	Multiple facet	Crushed	Subtotal	100%	>50%	<50%	0%	Subtotal	0	1	2	3	4	Subtotal
CMC	17	8	23	56	5	1	110	20	55	4	8	87	9	9	11	55	84	8	28	29	12	12	89
	15%	7%	21%	51%	5%	1%		23%	63%	5%	9%		11%	11%	13%	65%		9%	31%	33%	13%	13%	
PMC	5	7	8	21	2		43	4	12	1	1	18	3	2	3	18	26	3	7	11	3	2	26
	12%	16%	19%	49%	5%			22%	67%	6%	6%		12%	8%	12%	69%		12%	27%	42%	12%	8%	
TU CMC	12	7	13	67	8		107	12	45	0	33	90	6	8	5	72	91	6	15	31	26	13	91
	11%	7%	12%	63%	7%			0	50%	0%	37%		7%	9%	5%	79%		7%	16%	34%	29%	14%	
PAC	7	2	8	46	28	1	92	8	49	1	4	62	2	4	10	56	72	2	14	34	12	10	72
	8%	2%	9%	50%	30%	1%		13%	79%	2%	6%		3%	6%	14%	78%		3%	19%	47%	17%	14%	

## Tool Analysis

### *Definition of Formal Flake-Tool Types*

Tool typology was constructed on the basis of the following criteria. First, tools were divided into two major categories: unmodified utilized flakes and tools that presented unifacial retouch. The first category corresponds to tools that are not intentionally manufactured, but that present continuous, patterned use retouch along one edge (generally equal or smaller than 2mm). Within this broader category, three tool types were defined: unmodified utilized flakes with acute working edge angles lower than 45<sup>0</sup>, unmodified utilized flakes with steeper angles higher than 45<sup>0</sup>, and utilized bifacial thinning flakes.

The second broader category of tools includes those that present unifacial retouch. This category embraces tools whose edges have been modified to produce specific edge characteristic in terms of edge angle and morphology. The formal definition of each tool type within this broader category was based on a combination of morphological and technological attributes including size, edge angle, and edge morphology. Given the expedient, simple nature of these tool types, the degree of standardization within types varies considerably. However, in terms of morphological sub-groupings, their boundaries are well defined and the types are easily recognizable from one another.

Table 5.10 displays the distribution of lithic raw materials and the metric attributes of the different tool types. Table 5.11 shows the working edge attributes as they are distributed among the various tools. Figures 5.4-5.8 illustrate representative specimens of each tool-type. All drawings were made by Licenciado Rafael Suarez (Comisión Nacional de Arqueología – Uruguay). For convenience, most of the tools are given traditional functional names (e.g. flake-knives, scrapers, projectile points), however, this does not imply any functional attribution to any of these tool types.



Table 5.10. Distribution of Raw Materials and Metric Attributes Among Different Tool Types.

	Raw materials								Total	Length (mm)			Width (mm)			Thickness (mm)			Weight (gr)		
	quartz	grainy rhyolite	f-grained rhyolite	opal	phy/lite	quartzite	chalcodony	others		X	Std	Range	X	Std	Range	X	Std	Range	X	Std	Range
unmodified u. flakes <45°	13 14%	64 67%	13 14%	2 2%	3 3%	1 1%	2 2%	4 4%	102 36.0%	35.4	10.1	17-75	30.8	10.4	5_62	11.1	3.8	4_23	11.8	9.2	1.6-48
unmodified u. flakes >45°	6 20%	28 93%	3 10%						37 13.1%	35.9	11.7	10_63	33.3	8.8	21-56	14.3	4.7	7.9-32	14.8	6.6	3.6-27.1
raederas	3 18%	7 41%		1 6%	3 18%	3 18%		2 6.7%	19 6.7%	31.5	11.0	8_51	31.0	12.8	15-59	10.9	3.5	5.8-17.9	11.0	8.3	0.4-27.7
notches	2 5%	35 90%	1 3%	1 3%	1 3%		1 3%		41 14.5%	34.8	9.6	9_54	31.1	11.1	16-59	13.1	4.4	5.5-23.3	14.2	10.1	33-42.9
scraper-planes		10 100.0%							10 3.5%	56.2	21.1	30-83	51.7	9.1	39-68	23.2	6.5	16-39			
medium scrapers		18 100%			1 6%				19 6.7%	41.9	7.2	29-52	34.4	5.8	26-45	18.1	4.1	11.0-23.6	28.2	10.0	12.5-46.2
flake-scrapers	16 39%	18 44%	4 10%	2 5%		2 5%		2 15.5%	44 15.5%	34.8	8.4	19-65	31.8	8.9	19-58	14.9	4.0	5.1-25	16.8	8.8	3.2-35.2
points	2 67%			1 33%					3 1.1%	17.0	3.0	14-19	10.0	3.0	6_13	6.0	2.0	4_8	3.8	1.3	2.0-4.3
wedges		1 50%		1 50%				1 1.1%	3 1.1%	34.0	3.0	32-36	28.0	2.8	26-30	10.0	1.4	9_11	9.5	2.1	37479.0
utilized bifacial thinning flakes			3 75%	1 25%	1 25%				5 1.8%	29.7	10.5	21-47	26.8	7.7	21-40	6.6	6.5	2.7-18	4.4	4.8	2_13
Totals	42 14.9%	181 64.2%	24 8.5%	9 3.2%	9 3.2%	6 2.1%	3 1.1%	9 3.2%	283												

Table 5.11. Distribution of Tool Edge Attributes Among the Different Tool Types

	Edge Angle			Tool angle			Morphology					Location				Surface				N
	X	Std.	Range	X	Std.	Range	denticulate	concave	convex	straight	irregular	lateral	distal	lateral/distal	Indeterminate	Dorsal	Ventral	Dorsal/Ventral	Indeterminate	
unmodified u. flakes <45°	36.5	8.93	20-45				1	4	26	51	10	74	10		8	78	10	4		92
							1%	4%	28%	55%	11%	80%	11%		9%	85%	11%	4%		
unmodified u. flakes >45°	56	10	45-80					1	8	22	2	23	4	3	3	32	1			33
								3%	24%	67%	6%	70%	12%	9%	9%	97%	3%			
raederas	63.5	7.47	50-80	32.1	8.4	20-50	7		3	3		5	3	2	1	11	2			13
							54%		23%	23%		38%	23%	15%	8%	85%	15%			
notches	66.8	9.5	50-85	46.4	12.8	20-70						15	6	15		33	1		2	36
												42%	17%	42%		92%	3%		6%	
scraper-planes	74.5	6.4	65-80	50.5	13.3	35-65	3		3	1	3	4	1	3	2	10				10
							30%	0%	30%	10%	30%	40%	10%	30%	20%	100%				
medium scrapers	72.7	5.9	65-85	41.1	10.8	10_55	5		6	3	4	3	1	6	8	18				18
							28%		33%	17%	22%	17%	6%	33%	44%	100%				
flake scrapers	70.14	8.53	50-85	49.2	13.1	20-80	27		7	2		14	9	4	9	36				36
							75%		19%	6%		39%	25%	11%	25%	100%				
utilized bifacial thinning flakes	21	2.24	20-25	31	4.8	25-35			1	3	1	4			1	4	1			5
									20%	60%	20%	80%			20%	80%	20%			

### **Unmodified Utilized Flakes (N=144)**

This tool category comprises three classes of tools: unmodified used flakes with edge angles lower than  $45^{\circ}$ , unmodified used flakes with edge angles higher than  $45^{\circ}$ , and utilized bifacial thinning flakes.

Taking into account the macroscopic nature of this analysis and the various post-depositional factors that may mimic use-scars like trampling, excavation, and post-excavation handling, we restricted the criteria to identify use-scars. Every used edge was systematically scanned at 10X magnification using a binocular microscope to assess its characteristics. Taking into account the cautionary notes of Bamforth (1986) and following Ebert (1992), use-scars are defined as scars equal or less than 2 mm that are evenly distributed along the working edge of a tool. Only systematic, contiguous, patterned scarring were considered as evidence of use. This restriction may result in an underestimation of the amount of unmodified utilized flakes that are part of the tool assemblage. More so, in the lithic assemblage recovered from Los Ajos, in which minimally modified stones are a major part of its lithic industries. However, given the macroscopic nature of this analysis, the secure identification of specimens was privileged.

*Unmodified used flakes with edge angles lower than  $45^{\circ}$  (N=102).* Unmodified used flakes with edge angles lower than  $45^{\circ}$  have been manufactured mostly on grainy rhyolite (73%) and quartz (13%), but also occurred in fine-grained lithic raw materials like chalcedony, phyllite, fine-grained rhyolite, quartzite, and opal. The blanks chosen for these tools are mainly thin, light, medium-size secondary flakes (90%) although cortical and primary flakes have also been used in very low proportions (less than 10%) (Table 5.10, Figure 5.4a). Used edges are mainly located on the lateral side of flakes (90%) and present acute angles ( $x=36^{\circ}$ ; range  $20-45^{\circ}$ ). The general morphology of the used edge is predominantly straight (53%) and slightly convex (30%), but they also occur with irregular or slightly concave edges (Table 5.11). In terms of the overall morphology, this tool category presents great variation; flake-knives with straight working edge are typically triangular, rectangular or pentagonal flakes, while the ones that bear convex working edge are crescent-shaped in form.

*Unmodified flakes with edge angle higher than  $45^{\circ}$  (N=37).* This class of tools is represented by unmodified flakes with use-edge scars along a rather steep edge higher than  $45^{\circ}$ . This artifact category is mostly made in grainy rhyolite (77%), quartz (13%), and fine-grained rhyolite (10%).

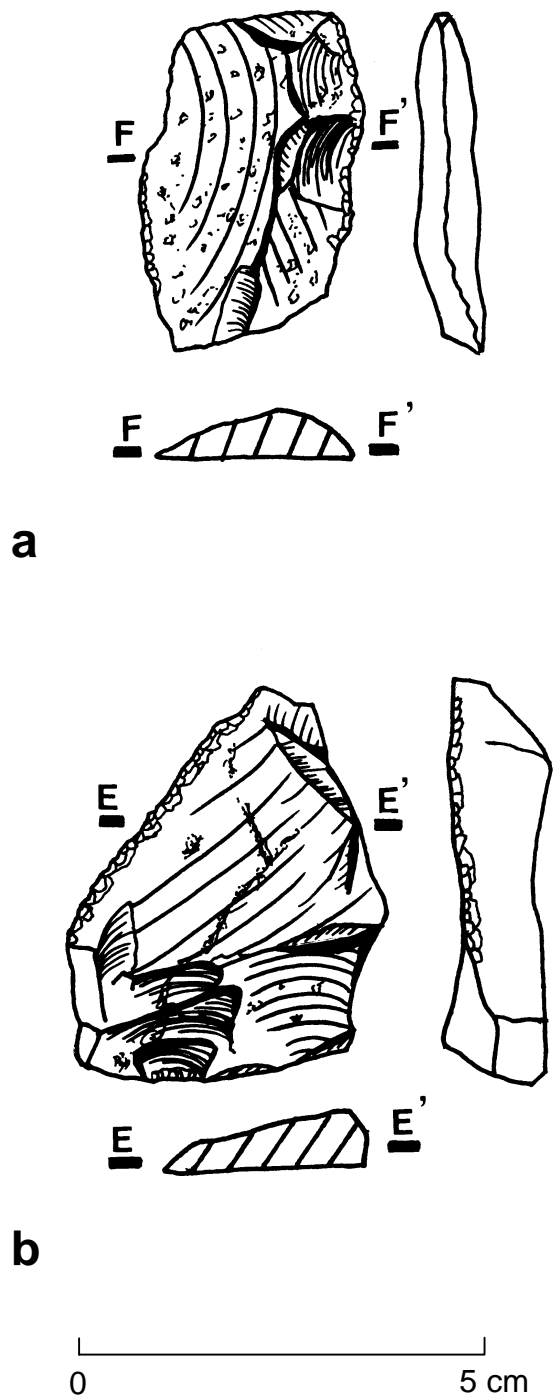


Figure 5.4. Unmodified Utilized Flakes. a: Unmodified Utilized Flake With Acute Edge Angle  $< 450$  (Mound Gamma, 200-205 cm Depth, Sector 3/E); b: Unmodified Utilized Flake with Steep Edge Angle  $> 450$  (Mound Gamma, 210-215 cm Depth, Sector 1/D).

Like flake-knives, tool blanks chosen for these tools are medium-size, light, thin –slightly thicker than flake knives- secondary flakes (see Table 5.10, Figure 5.4b), though cortical and primary flakes were also selected in very small proportions. Used -edges are predominantly located on the lateral side of the flakes (77%), but in some cases they are located in the distal (13%) or both lateral and distal part of the flake (10%). The angle of the working edge ranges between 45 and 80° with a mean of 55°. The morphology of the edge is for the most part straight (67%), but convex (25%), irregular (5%), and slightly concave (3%) also occur (Table 5.11).

*Utilized bifacial thinning flakes (N=5).* This tool category comprises bifacial thinning flakes characterized by long, thin curved flakes with many dorsal scars, ventral lipping, multifaceted platforms, and absence of cortex, which have been directly used. They present very acute ( $x=31^{\circ}$ ) straight edge angles located for the most part in the dorsal surface of flakes (Figure 5.9c).

Unmodified utilized flakes have been traditionally interpreted as cutting and scraping tools (e.g., Gould 1971; Hayden 1979; White 1969). However, due to the macroscopic nature of this analysis, only edge scarring was perceived and therefore, flakes used to cut soft materials were undetected in the analysis. This particularly affected the detection of quartz tools that present hard and durable edges. As a result, unmodified utilized flakes used to work on soft material are underrepresented.

In general, the use-wear analysis indicates that utilized flakes had wear patterns indicating probable use on softer materials like the soft plant material or cutting/slicing of meat.

## **Tools With Unifacial Retouch**

### ***“Raederas” (N=19)***

This class of tools is characterized by flakes with unifacial marginal retouch in which acute tool edges are marginally modified through a series of short contiguous parallel flakes. This is usually carried out on the dorsal face over the edge of an incomplete scar (N=8) or over the acute termination on the ventral side of a flake (N=3) to produce an abrupt, vertically short, working angle of convex morphology. Raederas are mainly manufactured in grainy rhyolite (41%) followed by quartz, phyllite, quartzite (all three 18%), and opal (4%). The blank forms

selected for this tool category mainly comprises thin, light, medium size secondary flakes, which are characterized by a very low tool angle ( $x=30^0$ ), in comparison with the working edge angle that averages  $61^0$  (range  $45-80^0$ ) and a restricted vertically short nature of the retouch scars. The modified edge angle morphology is denticulated (54%), straight (23%), and convex (23%) (Tables 5.10-11). Here I used the Spanish denomination “raederas” due to the absence, to my knowledge, of an appropriate designation for these tools in English.

### ***Notches or Incurvate Scrapers (N=41)***

All scrapers with one or more concave scraping edges were placed in this category. This tool category is mainly characterized by medium-size, secondary flakes where the pre-Hispanic artisan produced one “blow” along a lateral edge creating a notch (Table 5.10). The macroscopic use-wear that is usually seen within the notch is characteristically dulled and battered. The diameter of the concavity of the notch averages 13.6 mm (std =4.8mm; range=9-31 mm). Most of the measures fall within 10 and 15 mm. The edge angle averages  $66^0$  and ranges between  $50$  and  $85^0$  (Table 5.11; Figure 5.5a, b, c). By far, the preferred raw material to manufacture these tools was grainy rhyolite (85%). Quartz, fine-grained rhyolite, opal, phyllite, and chalcedony were selected in very minor percentages. The use-wear analysis on a utilized flake with a notch (Appendix 4, Figure 2d) suggest this specific part of the artifact was used for working wood or hard plants. In addition, the long convex edge (Aspect 2) suggests some scraping and cutting action, indicating that this tool was used for different activities.

### ***Scraper-Planes (N=10)***

Scraper planes correspond to large, heavy tools, which have been unifacially flaked along the entire perimeter. All the tools in this category were made in grainy rhyolite. They are made of large, heavy and thick flakes that have become domed or keeled due to the invasive retouch (Table 5.10). This tool category is characterized by steep edge angles produced by large flake scars over the edges, which averages  $74^0$  and ranges between  $65$  to  $80^0$ . The overall morphology of the edges is a coarse denticulate. The working edge “toothed” appearance is due to the large retouch scars detached from the edges (Table 5. 11; Figure 5.6a).

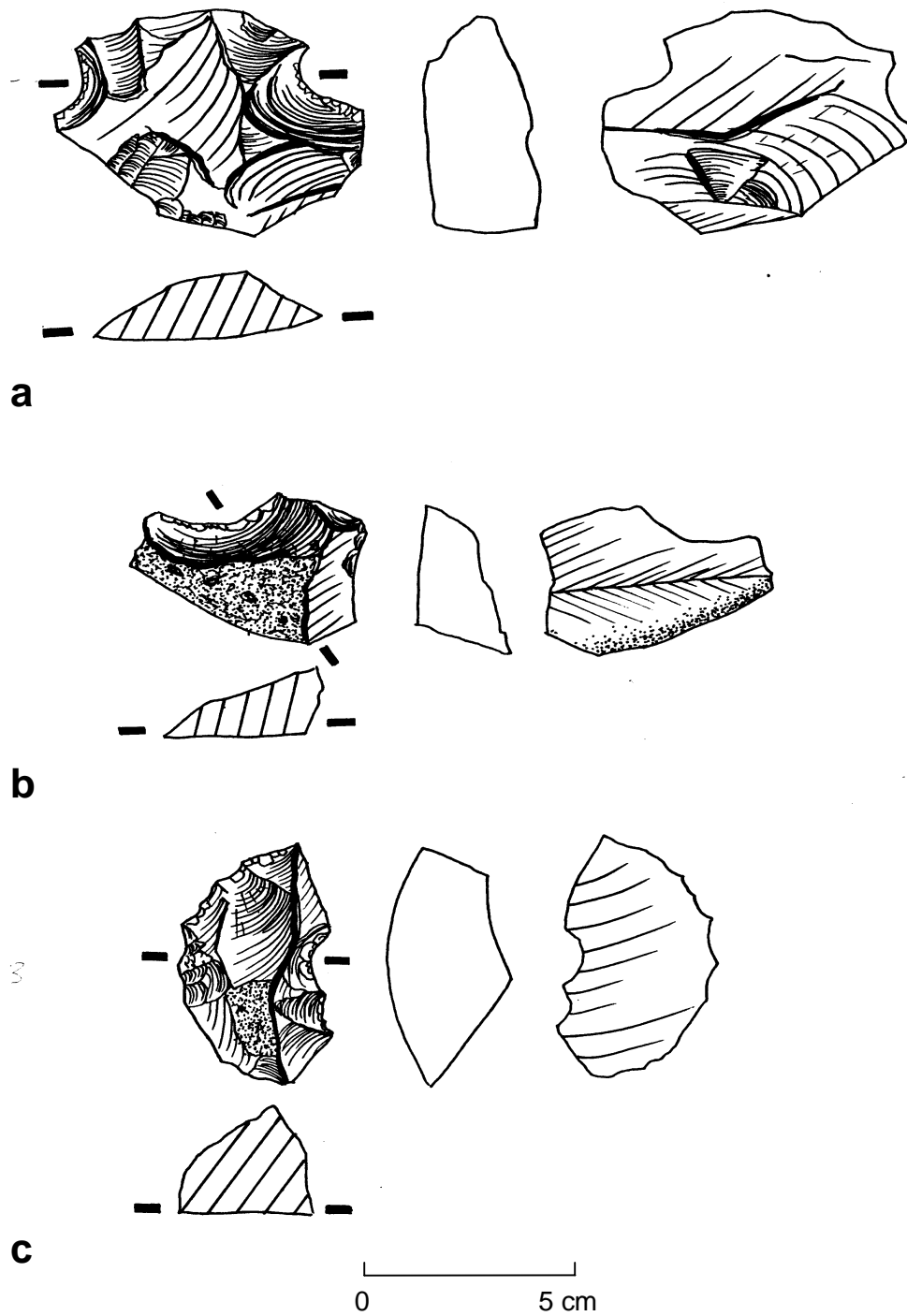


Figure 5.5. Notches or Incurvate Scrapers (a: Mound Gamma, 195-200 cm Depth, Sector 4/E; b: Mound Gamma, 150-155 cm Depth, Sector 4/A; and c: Mound Gamma, 205-210 cm Depth, Sector 3/A).

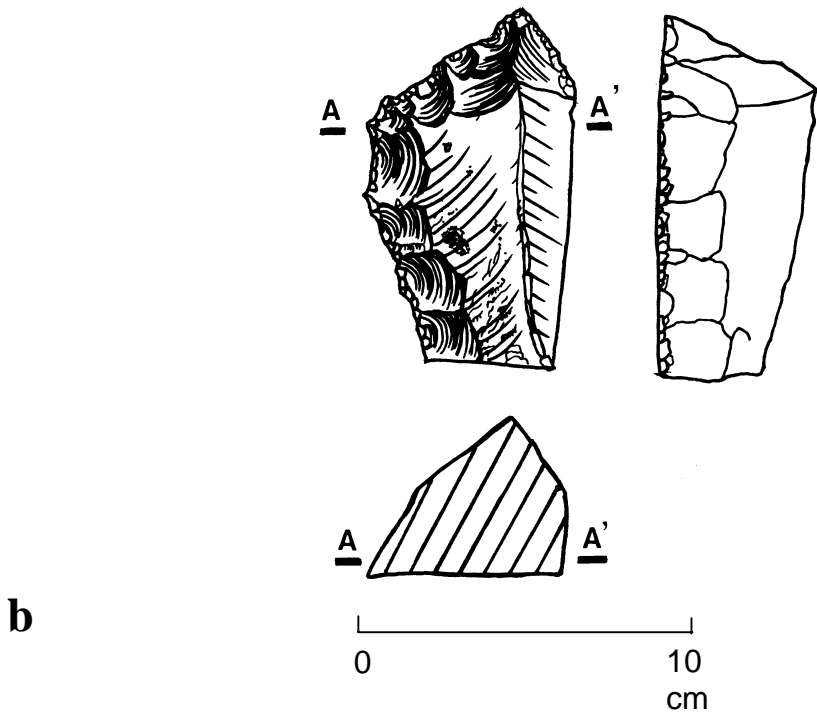
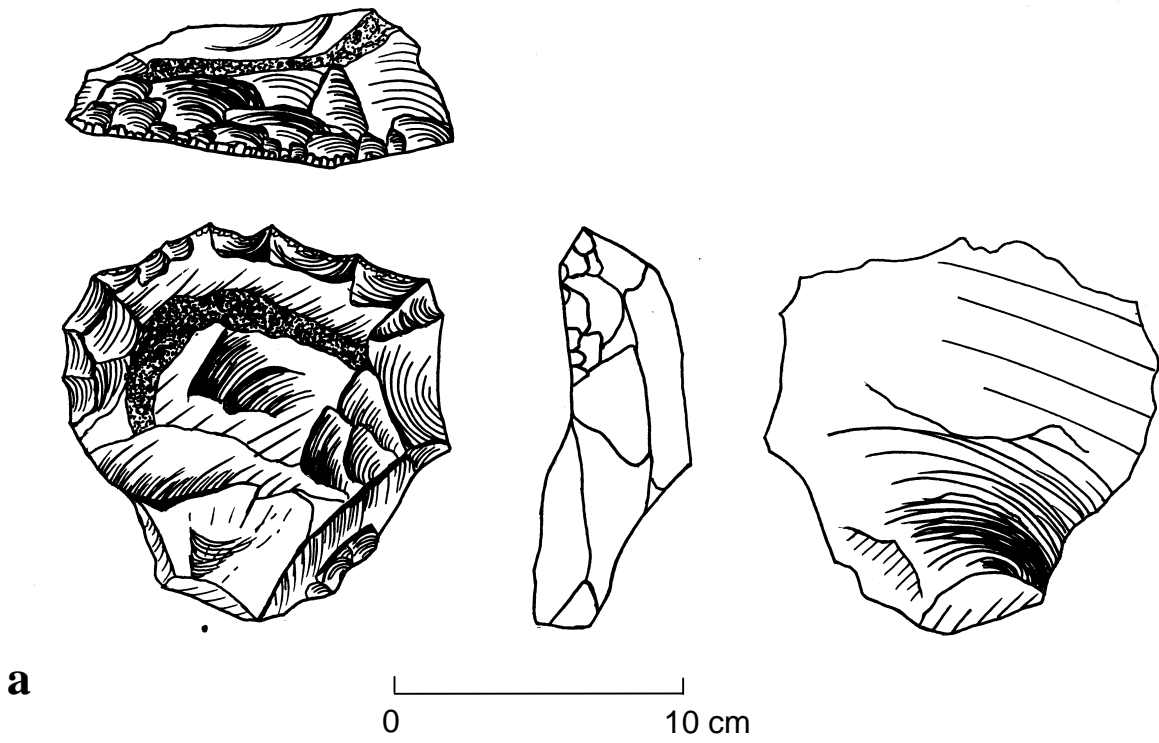


Figure 5.6. a: Scraper Plane (Mound Delta, 195-205 cm Depth; b: Medium Scraper (Mound Gamma, 205-210 cm Depth, Sector 6/D).



### ***Medium-Scrapers (N=10)***

This tool category corresponds to medium-sized flakes, smaller than scrapers planes, but larger than flake scrapers that have been unifacially flaked along most of the perimeter. As a result they show keeled cross-section and the overall morphology in most of them is circular to elliptical (Table 5.10-11; Fig. 5.6b, 5.7a). The blank forms selected for these tools are mainly medium size, relatively heavy and thick flakes of grainy rhyolite. Like the scraper-plane, the working edge angles are characteristically steep ( $x=72.9^{\circ}$ ;  $std=5.9^{\circ}$ ; range  $55-85^{\circ}$ ), primarily located on the dorsal side of flakes and presenting mainly denticulate, convex as well as an irregular morphology.

### ***Flake Scrapers or Steep Scrapers (N=44)***

This tool class corresponds to flakes, in which one edge has been purposely chipped to form a steep-angled scraping edge. The working edge angle is steep ( $x=70^{\circ}$ ;  $std=8.5^{\circ}$ ; range  $50-85^{\circ}$ ), located mainly on the lateral and distal end of the dorsal side of flakes and presents a denticulated morphology (Figure. 5.7 b and c). Blank forms selected for flake-scraper are usually smaller, thinner, and lighter flakes than the ones used for scraper-planes and medium scrapers. Unlike scraper-planes and medium scrapers that are mostly made of grainy rhyolite, flake-scrapers are also made of quartz.

The microscopic use-wear analysis indicate that scrapers in general were probably used as planes, chisels and whittling tools for working wood such as the manufacturing of wooden implements and also for scraping hide and bone. In particular, flat, straight edge scrapers were interpreted as tools used to cut vegetable fiber, thin bark, skin, sinew and/or flesh. Concave and nosed scrapers had wear patterns suggesting woodworking.

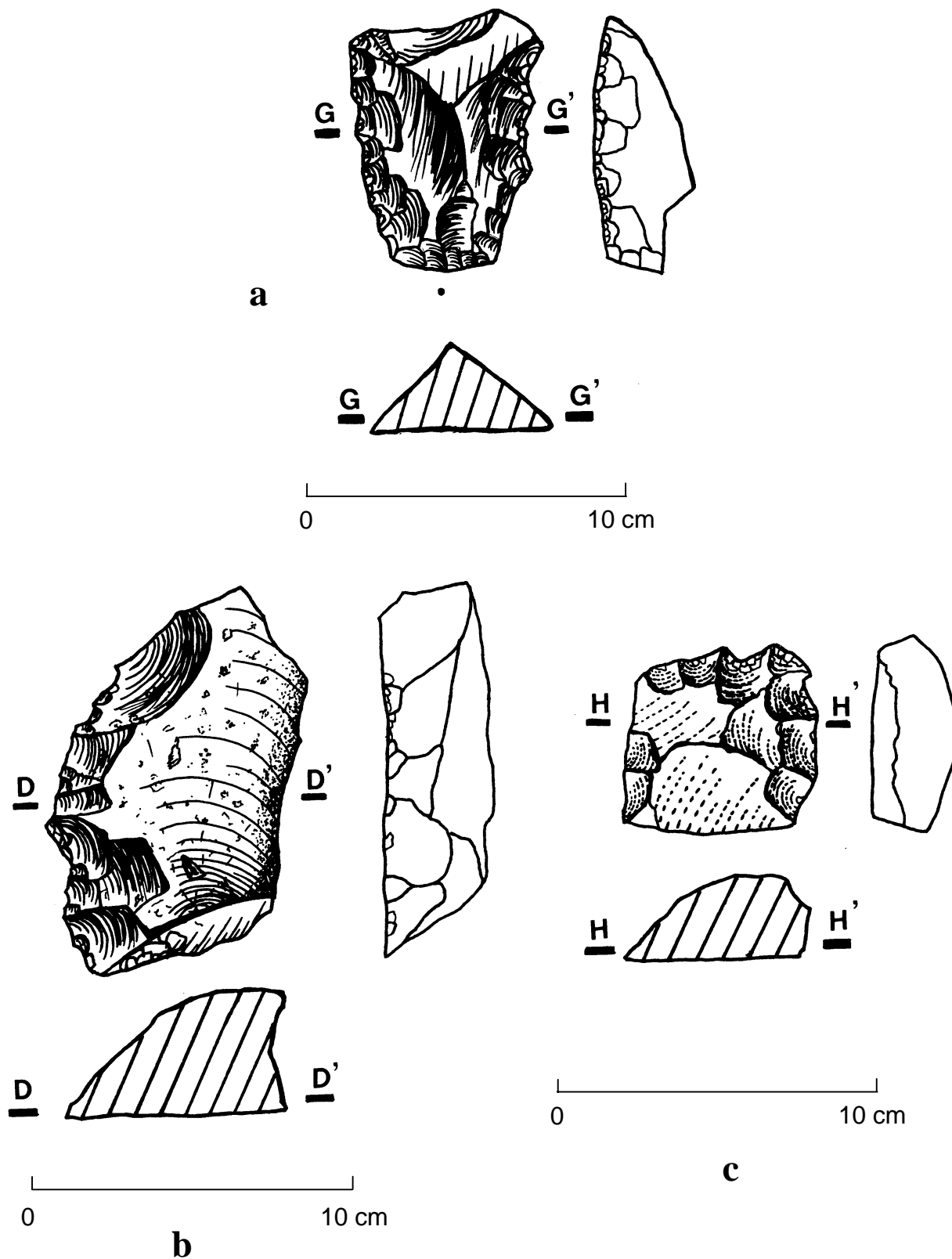


Figure 5.7. a: Medium-Scraper (Mound Gamma, 165-170 cm Depth, Sector 5/B); b and c: Flake-Scrapers (Mound Gamma, 135-140 cm Depth, Sector 3/D and Mound Gamma, 155-160 cm Depth, Sector 6/D, Respectively).

***Wedges (N=3) and Pointed Triangular Flakes (N=3)***

While only a few specimens of these tools types exist, their characteristics are sufficiently distinct to warrant separate artifact categories. Wedges are defined as tools in which flakes were removed from the opposite ends of the artifact and from both faces, creating a wedge or chisel-shaped edge at one end of the artifact. This is the only type of tool that presents alternating marginal bifacial retouch in both ventral and dorsal faces (Figure 5.9b). Pointed triangular flakes are characterized by small flakes with triangular or sub-triangular outlines, presenting fairly thick, multiple facet points, showing pronounced wear and triangular-shaped cross-section (Figure 5.8 a and b).

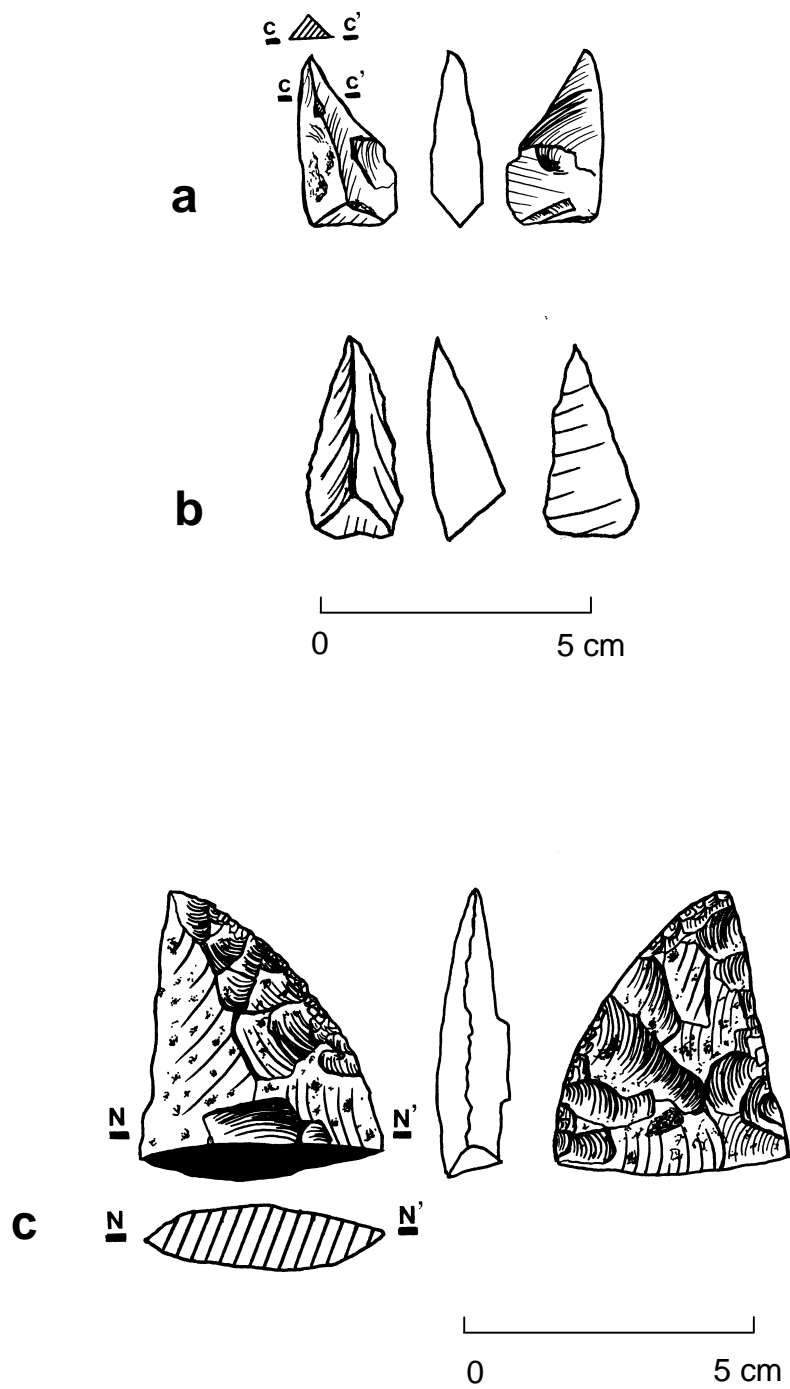


Figure 5.8. a and b: Triangular Pointed Flakes (Mound Gamma, 120-125 cm Depth, Sector 4/B and Mound Gamma, 130-135 cm Depth, Sector 4/B, Respectively); c: Broken Bifacial Knife (TBN, 200-205 cm Depth, Sector A1).

## **Projectile Points**

This section describes the projectile points recovered at Los Ajos, which are illustrated in the following pages. The illustrations are accompanied by detailed information on provenience, morphology, completeness, raw material, as well as metric and technological attributes.

For convenience, in this study, hafted bifaces and hafted unifaces with marginal bifacial retouch are called projectile points without implying any specific function. Several micro-wear analyses (e.g., Ahler 1971; Nance 1971) have demonstrated that hafted bifaces have been used as cutting and butchering tools in addition to their use as projectiles. This is reflected in the preliminary use-wear analysis, which indicates that some hafted bifaces were used only as projectile points, other may have been broken on impact and then reutilized as scraper and/or cutting tools for processing hide and possibly meat (Specimen Plaza Test Unit 2, 5-10 cm deep), while others may only have been used as cutting/slicing tools (Grid Test Unit N 100 E 200, 5-10 cm).

The projectile point assemblage consists of nine specimens including six whole specimens, two point tips, and one peduncle. Three of them correspond to the Preceramic Archaic Component and were recovered from the plaza area (N 100 E 200, 5-10 cm depth and TU 6, 10-15 cm depth) and the sector between Mound Delta and the TBN crescent shape-rise (TBN, 165-170 cm deep, sector -9). Five of them correspond to the Preceramic Mound Component. Four of them were recovered from Mound Gamma (260-265 cm deep, sector 1/C; 250-260 cm deep, sector 4/C ; 240-250 cm deep, sector 3/C; and 220-225 cm deep, sector 1/E ) and TU 2 – 5-10 cm depth). One was recovered from the plaza area TU 2 – 5-10 cm depth. Only one projectile point was recovered from Ceramic Mound Component contexts corresponding to Mound Gamma, 165-170 cm deep, sector 3/E.

Although the sample size is very small, when comparing the projectile points from the different components of occupation, there is a tendency that shows that the projectile points from the PAC are more carefully made. Unlike the projectile points from the Mound components, the projectile points from the PAC are bifacially manufactured; present thin biconvex longitudinal and transverse sections, and their final formatting scars are flat, regular, continuous, smooth lamellar, and conchoidal resulting in very even edges. In contrast, the projectile points from the Mound components are usually less carefully made and unifacial. As a result they tend to have thicker, plano-triangular, plano-convex longitudinal, and transverse sections, and present deep, irregular, rather discontinuous large conchoidal scars. In addition a broken, unhafted biface,

made of grainy rhyolite was recovered from the PAC levels of the TBN trench (TBN, sector A1, 200-205 cm depth) (Figure 5.8c). This type of biface is commonly called bifacial knife by the lithic analysts working in the region (Miller 1987; Ribeiro 1990; Schmitz 1987). We follow this denomination without attributing any specific function to this tool. This biface is broken in the middle and presents a finely retouched crescent-shaped edge. It is also characterized by fairly thin biconvex longitudinal and transversal cross sections as well as an even outline.

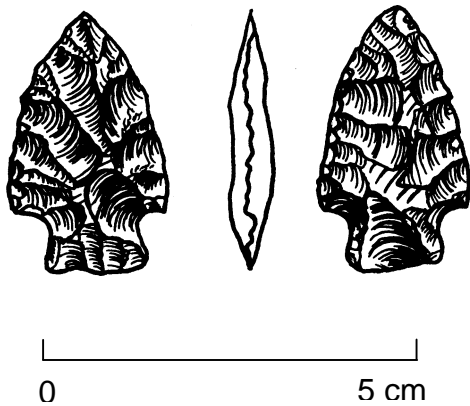
Overall, although the small sample size does not allow us to reach definite conclusions, it could be perceived an impoverishment of the projectile point technology characterized by an abandonment of finely manufactured projectile points and bifaces during the Mound temporal components. It is interesting to note that this change takes place concurrently (and coherently with other technological changes) with a decline in the presence of bifacial thinning flakes, a decrease in the number of utilized bifacial thinning flakes, and the introduction of plant-processing tools (see Chapter 6: Figures 6.9-12) during the Mound components in addition to major changes in settlement and subsistence practices that will be discussed in the next section.

Unfortunately, the lack of projectile point typologies in the region does not allow us to compare the projectile point assemblage recovered at Los Ajos with other sites in the region. The projectile points pertaining to the Umbu Tradition points have been broadly defined as stemmed projectile points and to date there is no chronological typology of them (Rodriguez 1992; Schmitz 1978). Ribeiro (1999:77) proposed that over time Umbu Tradition projectile points became more sophisticated presenting more concave shoulders, bifurcated peduncles, serrated forms, and an overall increase in the diversity of shapes. However, no distinct temporal types have been defined.

In addition, none of the projectile points recovered at Los Ajos resemble the projectile point types defined from the Middle Negro River by Iriarte and Femenías (2000). Despite of this fact, some general observations could be made. In the first place, like in Mound Alfa (Bracco 1993) and other sites of the region such as CH2D01 (Femenías et al. 1996), Los Indios (López 1999, 2001), Potrerillo (López 2001), the majority of projectile points have been recovered from the Preceramic Archaic Component and the lower levels of the Preceramic Mound Component. This indicates a pattern characterized by a greater abundance of finely made projectile points located in Preceramic Archaic Period and lower levels of the Preceramic Mound Period, and in turn, less abundant and less-carefully made projectile points retrieved from Mound Components.

Based on this fact, it seems reasonable to suggest that these changes reflect the change to a more generalized subsistence which place less emphasis on specialized hunting. However, this is a working hypothesis that needs to be confirmed with more studies.

Secondly, the projectile points recovered from the Ceramic Mound Component (Mound Gamma, sector 3/E, 165-170 depth) compares favorably with the Polonio type defined by Baeza and his collaborators (1974) and Hilbert (1991) from surface collected projectile points in the Atlantic region. These points are small (1.5 and 3 cm long), grossly manufactured, and characterized by a slightly marked notch that separates the peduncle from the blade. Due to the relative stratigraphic position of this Polonio type point in the Ceramic Mound Component of Mound Gamma, it can be tentatively argued that the Polonio type projectile points are chronologically diagnostic of the Ceramic Mound Component. However, these needs to await confirmation as new studies from well-dated stratigraphic context in the area are carried out. It is hoped that this study contributes to the much needed creation of a projectile point typology for the region, that in the future help us relatively date contexts at a regional level (see also Iriarte and Femenías 2000 for a similar approach and discussion of this problem).



Provenience: Test Unit N 100 E 200 5-10 cm

Component: Preceramic Archaic Component

Completeness: complete

Unifacial/Bifacial: bifacial

Raw material: fine-grained quartzite

Metric attributes:

Length (mm):

Maximum: 35

Stem: 8

Blade: 27

Width (mm):

Shoulder: 20.6

Neck: 11.7

Base: 13.4

Thickness (mm): 5.6

Weight (gr): 3.6

Morphological attributes:

Blade shape: slightly excurvate

Base shape: straight

Shoulder shape: straight

Sections:

Longitudinal: biconvex

Transverse: biconvex

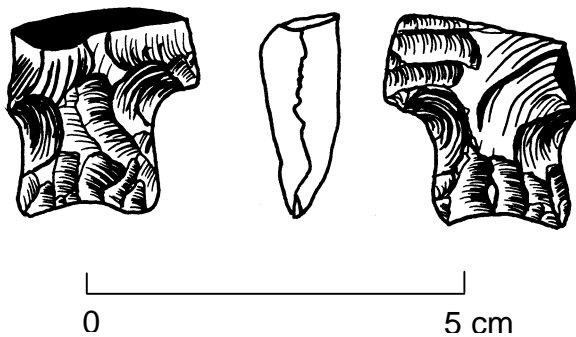
Blade technical attributes:

Present flat, regular, continuous, smooth lamellar and conchoidal scars that are placed bifacially bilaterally creating an even shaped edge

Base technical attributes:

Present continuous, unifacial, longitudinal scars





Provenience: TBN -9 165-170 cm

Component: Preceramic Archaic Component

Completeness: incomplete, peduncle with broken shoulder

Unifacial/Bifacial: bifacial

Raw material: fine-grained rhyolite

Metric attributes:

Length (mm):

Stem: 15.5

Width (mm):

Neck: 16.4

Base: 18.4

Thickness (mm): 11

Weight (gr.): 7.1

Morphological attributes:

Base shape: subconvex

Shoulder shape: straight

Sections:

Longitudinal: biconvex

Transverse: biconvex

Blade technical attributes:

The remnant part of the blade presents flat, regular, continuous, smooth lamellar scars that suggest that this was a carefully made point

Base technical attributes:

Present flat, regular, continuous, lamellar and conchoidal longitudinal scars.



Provenience: Test Unit 6 10-15 cm

Component: Preceramic Archaic Component

Completeness: both shoulders are broken

Unifacial/Bifacial: bifacial

Raw material: fine-grained quartzite

Metric attributes:

Length (mm):

Maximum: 21

Stem: 9.6

Blade: 11.4

Width (mm):

Shoulder: 13.6

Neck: 10.1

Thickness (mm): 4.1

Weight (gr): 1.2

Morphological attributes:

Blade shape: slightly excurvate

Base shape: straight

Shoulder shape: obtuse

Sections:

Longitudinal: biconvex

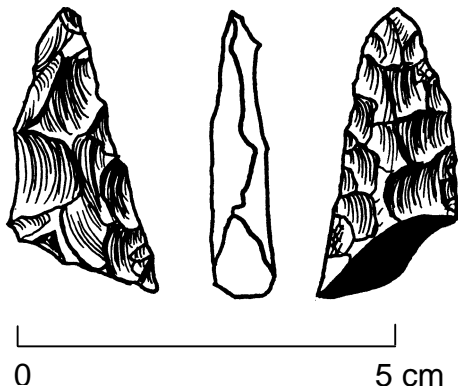
Transverse: plano-convex

Blade technical attributes:

Presents flat, irregular, continuous, conchoidal and smooth lamellar scars bifacially bilaterally placed

Base technical attributes:

Present bifacial, continuous, longitudinal scars



Provenience: Gamma 260-265 cm 1/C  
Component: Preceramic Mound Component

Completeness: Incomplete, tip

Unifacial/Bifacial: unifacial

Raw material: fine-grained rhyolite

Metric attributes:

Thickness (mm): 8.8

Weight (gr): 4.7

Morphological attributes:

Blade shape: triangular

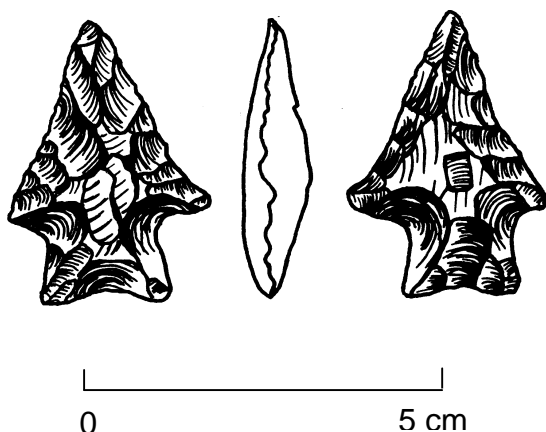
Sections:

Longitudinal: asymmetrical biconvex

Transverse:

Blade technical attributes:

The remaining part of the tip presents deep, irregular, discontinuous, conchoidal scars



Provenience: Gamma 250-260 cm -4/C

Component: Preceramic Mound Component

Completeness: complete

Unifacial/Bifacial: Unifacial from flake

Raw material: Fine-grained quartzite

Metric attributes:

Length (mm):

Maximum: 38.3

Stem: 12.4

Blade: 25.9

Width (mm):

Shoulder: 28.1

Neck: 15.2

Base: 17.6

Thickness (mm): 10.1

Weight (gr): 7.0

Morphological attributes:

Blade shape: slightly incurvate

Base shape: subconcave

Shoulder shape: straight to obtuse shoulder

Sections:

Longitudinal: biconvex asymmetrical

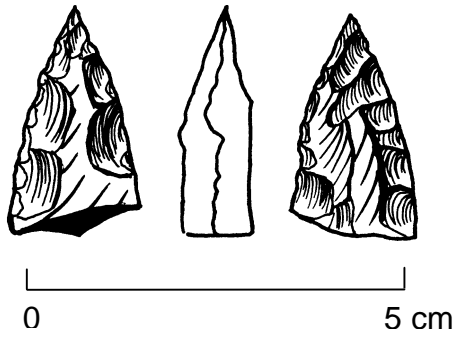
Transverse: plano-triangular

Blade technical attributes:

Present deep, irregular, discontinuous, large conchoidal and stepped lamellar scars which are placed bifacially bilaterally creating an irregular edge

Base technical attributes:

Basal edge with scar notches occurring in a non-symmetrical pattern



Provenience: Gamma 240-250 -3/C

Component: Preceramic Mound Component

Completeness: incomplete, tip

Unifacial/Bifacial: unifacial

Raw material: fine-grained rhyolite

Metric attributes:

Thickness (mm): 9.1

Weight (gr): 3.9

Morphological attributes:

Blade shape: triangular

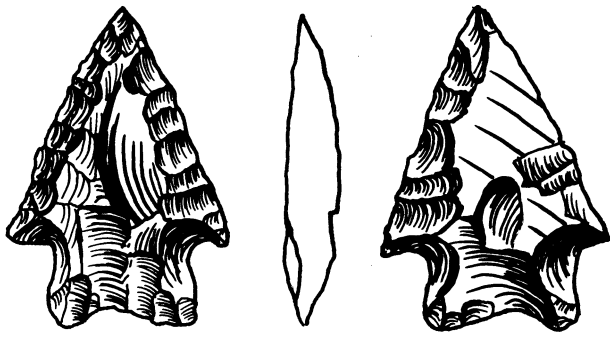
Sections:

Longitudinal: biplano

Transverse: convexo-triangular

Blade technical attributes:

The remaining part of the tip presents deep, irregular, discontinuous conchoidal scars bifacially bilaterally placed



Provenience: Gamma 220-225 1/E

Component: Preceramic Mound Component

Completeness: complete

Unifacial/Bifacial: unifacial from flake

Raw material: grainy rhyolite

Metric attributes:

Length (mm):

Maximum: 42.2

Stem: 11.8

Blade: 30.4

Width (mm):

Shoulder: 29.2

Neck: 17.9

Base: 19.6

Thickness (mm): 7.4

Weight (gr): 7.2

Morphological attributes:

Blade shape: triangular

Base shape: subconvex

Shoulder shape: straight

Sections:

Longitudinal: plano-convex

Transverse: helicoidal

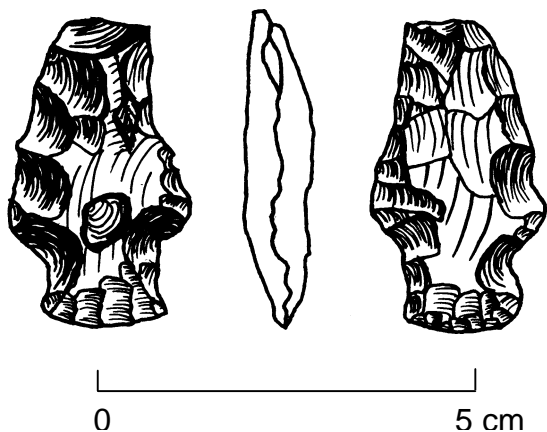
Blade technical attributes:

Present flat, regular, continuous, expanding and lamellar scars placed bifacially unilaterally.

Beveled edge.

Base technical attributes:

Present unifacial, irregular, discontinuous longitudinal scars



Provenience: Test Unit 2 5-10 cm

Component: Preceramic Mound Component

Completeness: incomplete, broken tip

Unifacial/Bifacial: unifacial

Raw material: fine-grained quartzite

Metric attributes:

Length (mm):

Maximum: 41

Stem: 11

Blade:

Width (mm):

Shoulder: 23.8

Neck: 13.4

Base: 16

Thickness (mm): 9

Weight (gr): 8.5

Morphological attributes:

Blade shape: excurvate asymmetrical

Base shape: subconvex

Shoulder shape: obtuse

Sections:

Longitudinal: biconvex asymmetrical

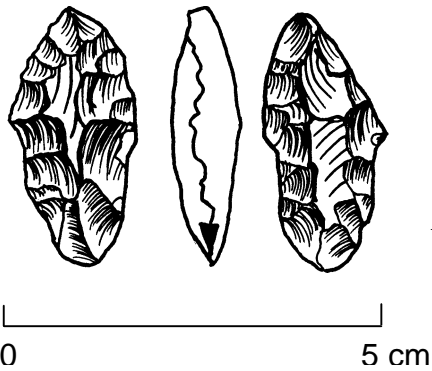
Transverse: convexo-triangular asymmetrical

Blade technical attributes:

Present deep, irregular, discontinuous, conchoidal scars

Base technical attributes:

In contrast to the blade, the base present bifacial, continuous, lamellar longitudinal scars that make an even shaped base



Provenience: Gamma 3/E 165-170  
Component: Ceramic Mound Component  
Completeness: complete  
Unifacial/Bifacial: unifacial  
Raw material: fine-grained quartzite  
Metric attributes:

Length (mm):

Maximum: 33.4

Stem: 15

Blade: 18.4

Width (mm):

Shoulder: 17.1

Neck: 13.7

Base: 13.5

Thickness (mm): 8.8

Weight (gr): 4.6

Morphological attributes:

Blade shape: excurvate

Base shape: convex

Shoulder shape: 7.1

Sections:

Longitudinal: biconvex

Transverse: convexo-triangular

Blade technical attributes:

Present invasive, deep, irregular, conchoidal scars placed bifacially bilaterally



## Summary of Tool Assemblage Characteristics

### *Tool Types and Raw Materials*

As Table 5.10 shows, grainy rhyolite was the dominant (64%) raw material selected for the production of tools, followed by quartz (14.5%), fine-grained rhyolite (8.5%), opal (3.2%), phyllite (3.2%), among the other fine-grained lithic raw materials (<3%). As the graph depicted in Figure 5.9 shows, grainy rhyolite represents a major part of all the flake-tool types constituting all the scraper-planes, the majority of unmodified utilized flakes with edge-angle higher than 45° (93%), notches (90%), and flake-knives (67%). Quartz is mainly represented in flake scrapers (N=16), flake-knives (N=13), and unmodified utilized flakes with an edge-angle higher than 45° (N=6). The rest of the lithic raw materials are present in very minor quantities distributed among the various tool types.

### *Chronological Distribution of Formal Tool Types*

When considering the whole assemblage of tools combining all occupational components, the majority of the tools are composed of flake-knives (36%) and unmodified utilized flakes with an edge-angle higher than 45° (13.1%) adding up to 49.1%. The other tool types, which are represented in minor proportions, comprise flake scrapers (15.5%), notches (14.5%), medium scrapers (6.7%), raederas (6.7%), scraper-planes (3.5%), utilized bifacial thinning flakes (1.8%), and points and wedges (both with 1.1%).

Tables 5.12-15 show the distribution of tool types among the different excavation units of Los Ajos. Figure 5.10 displays a percentage graph of the tool types among the different occupational units when combining all excavation units for each occupational component. When comparing the tool assemblages among the different occupational components, there are no major differences in the representation of the different tool types associated with each occupational component. However, some differences though minor could be observed<sup>16</sup>. The Preceramic Archaic Component is characterized by major percentage of projectile points, utilized bifacial thinning flakes, and raederas, and in turn, by a minor percentage of unmodified utilized flakes, in addition to, a complete absence of plane-

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<sup>16</sup> (+) indicates that the difference is statistically significant, while (-) indicates that the difference is not statistically significant.

Table 5.12. Distribution of Chipped Stone Artifacts from Gamma Mound

Component	Cores					Tools											Debitage								Total			
	Quartz bipolar	Quartz percussion	Rhyolite	Regional raw materials	Subtotal	Unmodified used flake <45	Unmodified used flake >45	U. bifacial thinning flake	Plane-scrapers	Medium keeled scrapers	Flake scrapers	Incurvate scrapers	Raederas	Wedges	Points/Borers	Projectile Points	Subtotal	Artificial fragments	Cortical flakes	Primary flakes	Secondary flakes	Bifacial thinning flakes	Bipolar flakes	Bifaces		Rejuvenation flakes	Subtotal	
CMC																												
Levels																												
120		2	1		3	3				1	1	1					6	38	2	7	16		2			65	74	
130	2				2	2	2			2	5	2	2		1		16	25	5	17	15	1	1			64	82	
140	1		2		3	4		1		1	3	6	3		1		19	29	4	5	16		2			56	78	
150		1	3		4	3	4		1		2	1	1				12	20	5	5	8					38	54	
160	1				1	6			1	1	3	3	1			1	16	30	7	7	25	1	3		2	75	92	
170			4	1	5	1	4			2	2	4					13	14	2	4	16		2		1	39	57	
180						3	3			1	2	3					12	7	1	2	12	1				23	35	
190						2						1	1				4	5	1	4	10					20	24	
Subtotal	4	3	10	1	18	24	13	1	2	8	18	21	8	0	2	1	98	168	27	51	118	3	10	0	3	380	496	
PMC																												
200			3		3	10	2	2				2	3				19	22		7	18	1			3	51	73	
210	1		2		3	4				2		1					7	9	1	9	13		1			33	43	
220					0	8	4		1		3	1	1		1	19	8	4	9	9	2	1				33	52	
230			2	1	3	4	1			1	2						8	17	6	5	20				1	49	60	
240			2		2	6					3	1	1			1	12	11		7	13		1	1		33	47	
250			3		3	4	1					1				1	7	7	4	8	10					29	39	
260			2		2	1					1	1				1	4	5	3	6	8					22	28	
Subtotal	1	0	14	1	16	37	8	2	1	3	9	7	5	0	0	4	76	79	18	51	91	3	3	1	4	250	342	
PAC																												
270			1		1	1					1	1					3	3	1	2	4					10	14	
Total	5	3	25	2	35	62	21	3	3	11	28	29	13	0	2	5	177	0	250	46	104	213	6	13	1	7	640	852

Table 5.13. Distribution of Chipped Stone Artifacts from Delta Mound Test-Unit

Component	Cores					Tools										Debitage							Subtotal	Total				
	Quartz bipolar	Quartz percussion	Rhyolite	Fine-grained raw materials	Subtotal	Unmodified used flake <45	Unmodified used flake >45	U. bifacial thinning flake	Plane-scrapers	Medium keeled scrapers	Flake scrapers	Incurvate scrapers	Raederas	Wedges	Points/Borers	Projectile Points	Subtotal	Artificial fragments	Cortical flakes	Primary flakes	Secondary flakes	Bifacial thinning flakes			Bipolar flakes	Bifaces	Rejuvenation flakes	Subtotal
CMC																												
Levels																												
135							1				1						2											2
145			2	2						1							1	71	5	19	24				1	120	123	
155	1		1	2													1	74	5	12	28		3			122	125	
165											1						1	30	6	6	24		8			74	75	
175						1			1		2						4	58	6	10	21					95	99	
185			1	1			1										1	14	3	7	10					34	36	
195	1		1	2		1			1								2	16	1	5	9		2			33	37	
205			2	2		1			1								2	6	1	5	19					31	35	
Subtotal	2		7	9		3	2		3	1	3	1		1			14	269	27	64	135	0	13	0	1	509	532	
PMC																												
215			2	1	3	1											1	17	7	5	26					55	59	
225			1	1	2													21	4	7	16					48	50	
235			2	1	3					1							1	6	3	6	21					36	40	
Subtotal	0	2	3	3	8	1				1							2	44	14	18	63	0	0	0	0	139	149	
Total	2	2	10	3	17	0	4	2	0	3	1	4	1	0	1	0	16	313	41	82	198	0	13	0	1	648	681	

Table 5.14. Distribution of Chipped Stone Artifacts from TBN Trench

Component	<i>Cores</i>					<i>Tools</i>										<i>Debitage</i>							Total					
	Quartz bipolar	Quartz percussion	Rhyolite	Fine-grained raw materials	Subtotal	Unmodified used flake <45	Unmodified used flake >45	U. bifacial thinning flake	Plane-scrapers	Medium keeled scrapers	Flake scrapers	Incurvate scrapers	Raederas	Wedges	Points/Borers	Projectile Points	Subtotal	Artificial fragments	Cortical flakes	Primary flakes	Secondary flakes	Bifacial thinning flakes		Bipolar flakes	Bifaces	Rejuvenation flakes	Subtotal	
CMC																												
Levels																												
150					0												0	14	1	3	3		2			23	23	
160			1		1		1										1	114	9	38	31		5			197	199	
170			4	2	6												0	173	40	33	70	2	3			4	325	331
180	1		2	1	4	4	2				2	1					9	164	43	45	74	2	10			1	339	352
Subtotal	1		7	3	11	4	3				2	1					10	465	93	119	178	4	20			5	884	905
PMC																												
190					0												0	37	18	14	24						93	93
PAC																												
200-210	1	1	3		5	7	7		2	4	2	4	2				28	75	26	47	72	4	9			6	239	272
Totals	2	1	10	3	16	11	10	0	2	4	4	5	2				38	577	137	180	274	8	29			11	1216	1270

Table 5.15. Distribution of Chipped Stone Artifacts from Test Units

		Cores					Tools											Debitage											
		Quartz bipolar	Quartz percussion	Rhyolite	Regional raw materials	Subtotal	Unmodified used flake <45	Unmodified used flake >45	U. bifacial thinning flake	Plane-scrapers	Medium keeled scrapers	Flake scrapers	Incurvate scrapers	Raederas	Wedges	Points/Borers	Projectile Points	Subtotal	Artificial fragments	Cortical flakes	Primary flakes	Secondary flakes	Bifacial thinning flakes	Bipolar flakes	Bifaces	Rejuvenation flakes	Subtotal	Total	
Levels																													
PAC	Counts	7	7	16	5	35	9	2	2		2	5	3	4			3	30	294	38	62	201	29	20	1	0	645	710	
	%	20%	20%	46%	14%		30.0%	6.7%	6.7%	0.0%	6.7%	16.7%	10.0%	13.3%	0.0%	0.0%	10.0%		45.5%	5.9%	9.6%	31.1%	4.5%	3.1%	0.2%	0.0%			
TU	Counts	6	6	19	4	35	16	2		2	1	4	3		2		1	31	916	82	132	524	10	38			1702	1768	
CMC	%	13%	13%	41%	9%		51.6%	6.5%	0.0%	6.5%	3.2%	12.9%	9.7%	0.0%	6.5%	0.0%	3.2%		53.8%	4.8%	7.8%	30.8%	0.6%	2.2%					
Totals		13	13	35	9	70	0	25	4	2	2	3	9	6	4	2	0	4	61	1210	120	194	725	39	58	1	0	2347	2478

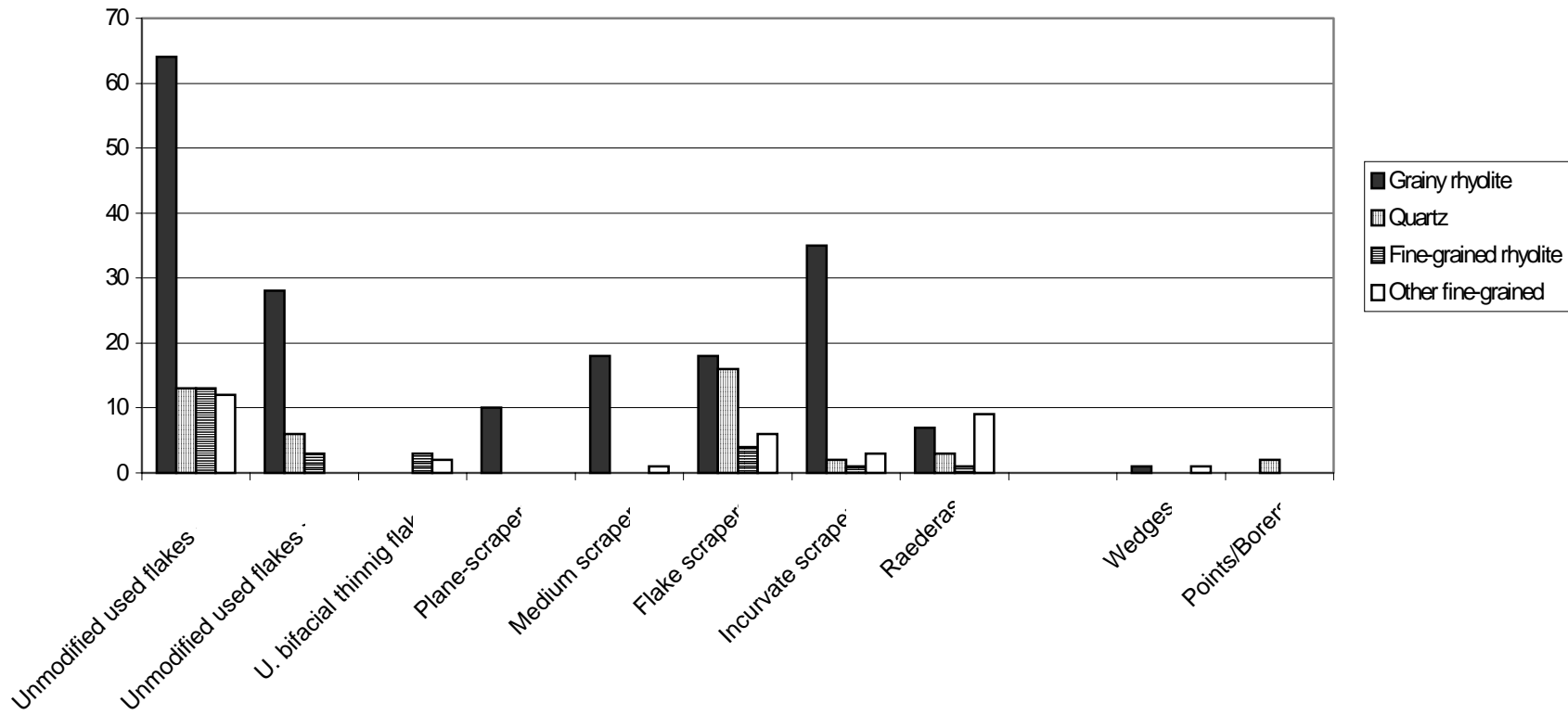


Figure 5.9. Distribution of Raw Material Types Among the Different Tool Types for all Temporal Components.

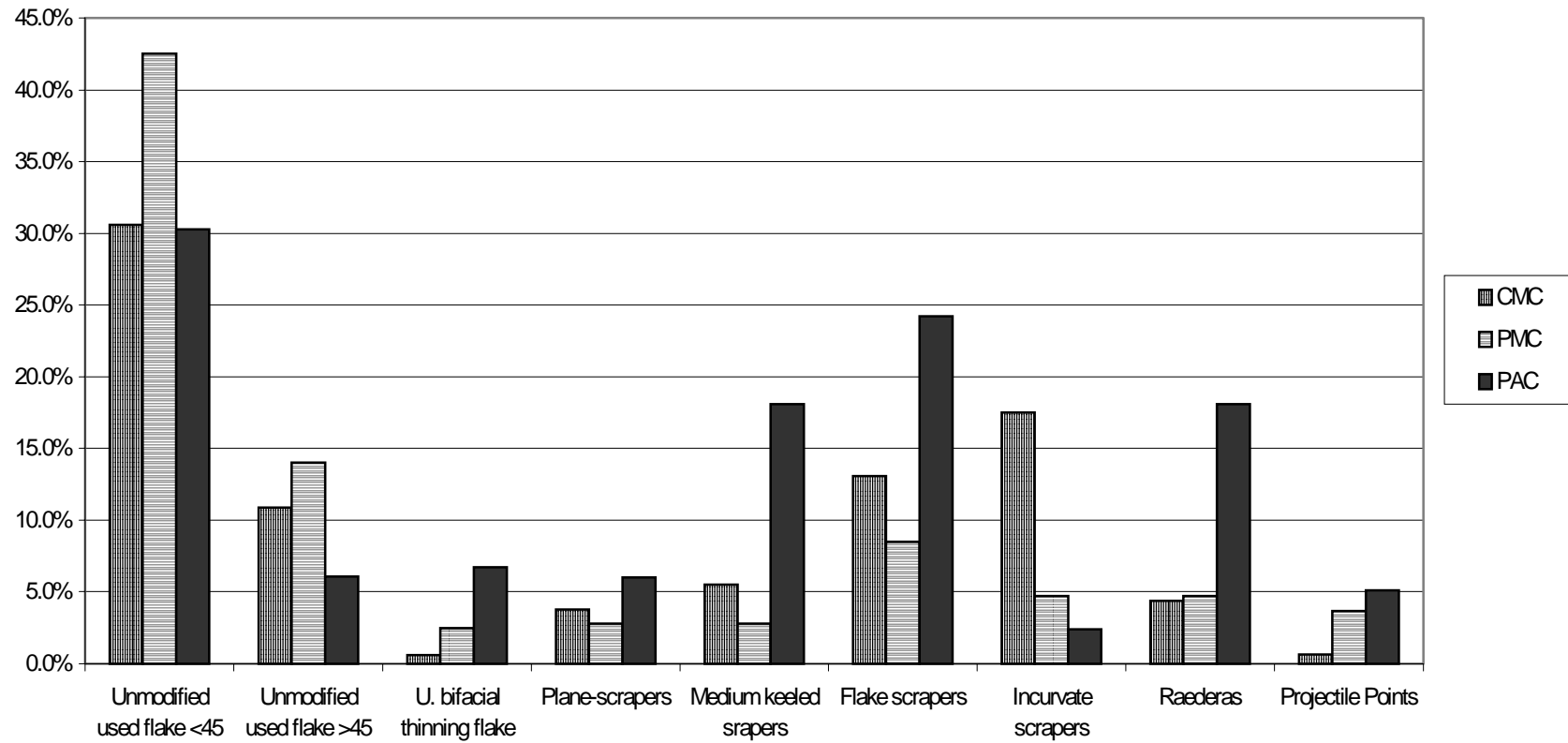


Figure 5.10. Percentage of Tool Types by Temporal Component.

scrapers, wedges, and point-borers. However, only the differences in raederas are significant ( $p < 0.01$ ).

A comparison between the Mound components reveals the following differences. With respect to the more recent CMC, the PMC presents a major percentage of flake-knives, projectile points, and utilized bifacial flakes, minor percentages of unmodified utilized flakes with an edge angle higher than  $45^{\circ}$ , scraper-planes, flake-scrapers, and notches. Only the major percentage in flake-knives and the decrease in notches are significant ( $p < 0.01$ ). These differences will be considered in detail in the final section of this chapter.

Overall, the tool assemblage recovered from the different components of Los Ajos is very diverse. This is particularly true for the Mound components that show more tool types. The tool assemblage of the Mound components is constituted by a generalized, non-specific assemblage that includes a broad range of different tool types displaying a wide variety of edge angles. This suggests that during the Mound components, Los Ajos was a residential settlement in which a wide range of activities were carried out; this aspect is further corroborated by the appearance of plant processing tools. I will return to this aspect in the next section.

## **Summary and Discussion**

### **Summary of Lithic Assemblage**

In spite of the large quantity of debitage and the fairly large number of tools recovered from Los Ajos excavations, the chipped stone tool industry is not a complicated one. Overall, throughout the sequence, the lithic industry at Los Ajos could be described as a simple and expedient one, constituted by a generalized assemblage, which includes a wide assortment of flake-tool types displaying a wide variety of working edge characteristics. The tool assemblage is mainly constituted by unmodified utilized flakes and minimally retouched flake-tools. The result of the preliminary use-wear analysis also indicates that Los Ajos assemblage was mainly characterized by expedient local production associated with limited use of tools and discard within the site area.

In terms of raw material procurement, all the lithic raw materials used at Los Ajos were regionally accessible and could be obtained at a distance no further than 45 km. Grainy rhyolite was abundant and locally available and both quartz and fine-grained raw materials could be



procured at a distance between 25 and 40 km from Los Ajos. Taking into account the debitage of all excavation units across all temporal components, quartz (51.5%) and grainy rhyolite (41.2%) are the predominant lithic raw materials employed at the site, adding up to 92.7%. All of the other raw materials comprise the remaining 7.3%.

The analysis of cores, debitage, and resulting tools indicates that grainy rhyolite was part of an expedient technology mainly used for the production of very simple, informal, non-standardized tools as well as the manufacture of bifacial and unifacial projectile points. At the site, all stages of reduction took place, including core reduction, initial reduction, primary and secondary reduction as well as tool use, resharpening, and discard. Grainy rhyolite presents a simple core technology in which rhyolite blocks were unipolarly reduced in a fairly unpatterned sequence from a number of natural and single-facet platforms, which resulted in the production of amorphous cores and the production of mostly single-facet and cortical flakes. All dorsal count and size categories are well represented, further corroborating that all stages of reduction of rhyolite took place at Los Ajos. Bifacial thinning flakes are extremely rare, further corroborating that the reduction of rhyolite was primarily unifacial and targeted to obtain flake blanks to be directly used directly or slightly modified into flake tools. The majority of flake tools were manufacture on grainy rhyolite (64%), comprising all scraper-planes, the majority of unmodified utilized flakes with edge-angle higher than  $45^{\circ}$  (93%), notches (90%), and unmodified utilized flakes with edge-angle lower than  $45^{\circ}$  (67%).

Quartz was both unipolarly and bipolarly reduced. Unipolar flaking was probably used in the initial stages of reduction, whereas bipolar reduction was used when flakes could not longer be detached by direct percussion from the small “unipolarly exhausted” cores. Unipolar cores are mainly amorphous and globulose in contrast to bipolar cores that are thinner and longer. Similarly, unipolar flakes are quadrangular, thicker, and exhibit primarily cortical and single-facet platforms. In contrast, bipolar flakes are longer, thinner and for the most part display crushed platforms. On balance, the combined presence of all size categories, platform types, dorsal cortex percentage, and scar count categories in addition to the presence of both bipolar and unipolar cores, indicate that all stages of reduction but the acquisition of raw material were carried out at the site. Quartz flake-blanks were mainly employed to produced flake scrapers (39%), unmodified utilized flakes with an edge-angle higher than  $45^{\circ}$  (20%), and unmodified utilized flakes with an edge-angle lower than  $45^{\circ}$  (14%). It must be remember that given the

hardness and durability of quartz edges and the macroscopic nature of this analysis, the use of quartz on soft to medium materials probably went undetected in this analysis, and therefore, is underrepresented in the sample.

In contrast to grainy rhyolite and quartz that present terminal production, fine-grained lithic raw materials are mainly characterized by a staged production, in which only the final stages of reduction are present. The first stages of reduction are minimally represented and they are evidenced by the presence of a few small amorphous and globulose cores that were brought to the site and worked intensively, extracting from them all the possible flakes. Staged production is represented by bifacial thinning flakes, which are the product of the bifacial reduction of larger bifacial cores elsewhere. Fine-grained lithic raw materials present a major frequency of bifacial thinning flakes in comparison with grainy rhyolite, as well as a major percentage of multiple facets and crushed platforms characteristic of the advanced stages of bifacial reduction. However, taken into account the large amount of bifacial thinning flakes that bifacial reduction produces (e.g., Patterson 1990), the small amount of bifacial thinning flakes recovered at Los Ajos indicates that bifacial reduction carried out at the site was extremely low.

### **Chronological Trends**

When looking at chronological trends, in particular between the Preceramic Archaic Component and the Preceramic Mound Component, the major changes found could be summarized as follows. There is (a) a minor but significant decrease in the use of non-local but regionally available fine-grained lithic raw materials, (b) an impoverishment of the projectile point technology characterized by an abandonment of finely manufactured projectile points during the Mound components, (c) a small but significant decline in the presence of bifacial thinning flakes, (d) a decrease in the percentage of projectile points, (e) a decrease in the number of utilized bifacial thinning flakes, (f) a greater diversity of tool types, and (g) the appearance of plant-processing tools. It should be remembered that these general patterns have also been documented at several sites containing buried Preceramic Archaic components below Mound components such as CH2D01 (Femenías et al. 1999), Los Indios (López 1999, 2001), and Potrerillo (López 2001).

It is the contention of this study that these gradual changes in lithic technology are associated with changes in settlement and subsistence experienced by the Preceramic Archaic

groups during the Mid-Holocene in southeastern Uruguay, which ultimately lead to the development of early Formative societies.

In terms of subsistence, as the phytolith and starch grain analysis presented in Chapter 6 will make clear, there is a shift to a mixed economy characterized by a combination of hunting and gathering practices and the adoption of cultigens like maize, squash, beans, and tubers. This is consistent with the appearance of plant processing tools in domestic contexts at the site. The importance of plant use was also reflected in the use-wear analysis of stone artifacts. Plant processing was evident on most edges of the tools analyzed probably to extract starch (Appendix 4). Taken together, the change to a mixed, more generalized economy prompted the change to a more expedient technology, an impoverishment of the projectile point technology, and the appearance of plant grinding tools. This pattern has been observed in other areas of South America, where similar changes in lithic technology occurred associated with a subsistence shift toward a more generalized, plant-oriented economy (e.g., Bryan and Gruhn 1993; Ranere 1980, Richardson 1978; Rossen 1991, 1998). The fact that wild faunal resources continue to play an important role during the Preceramic Mound Component subsistence strategy (see Chapter 6) may explain, in part, the gradual change that the lithic industry experienced throughout the sequence.

With regard to settlement patterns, as will be explained in the following chapters, the Preceramic Mound Component experienced the beginning of the process of early village formation with the placement of domestic areas range around a central cleared plaza area, which is symptomatic of more permanent occupations. In this regard, the gradual change to a more expedient technology and a major reliance on local raw materials associated with a more permanent residence at Los Ajos is in agreement with the expectations of conceptual advances in the analysis of lithic technologies (Binford 1977; Bamforth 1986; Parry and Kelly 1987; Shott 1986; Torrence 1989). As reviewed earlier, these studies have related formal, standard, curated tools with more mobile hunter-gatherer populations, whereas, informal, non-standard, expedient tools are usually employed by more sedentary populations. The rationale behind this argument is that mobile hunter-gatherers “on the move” need multifunctional, readily modifiable, and easily portable gear to avoid the risk of being unprepared for the task at hand (Torrence 1983, 1989). Accordingly, it is reasonable to suggest that these non-local, good quality raw materials would be more readily available to the more mobile Preceramic Archaic groups. In contrast, more

sedentary populations do not have to expend extra-effort in the maintenance of flexible, transportable tools. They can safely manufacture, use, and discard tools according to the needs of the moment; more so if the lithic raw materials are locally abundant. In this respect, the gradual abandonment of this more elaborated Preceramic Archaic technology, like finely made bifacial hafted bifaces and knives is consistent with a more permanent and intense occupation of Los Ajos.

### **Los Ajos Lithic Industry in Regional Context**

When comparing the lithic assemblage of Los Ajos in its entirety with other lithic assemblages from the region, such as site CH2D01 (Curbelo and Martinez (1992), Isla Larga (Cabrera et al. 2000), Los Indios (López 2001), we see that Los Ajos assemblage is very similar to them in both its overall simplicity and the differential technological treatment that the various lithic raw materials received. In agreement with the patterns found by Curbelo and Martinez (1992) and the author (Iriarte 1993, 2000), the more local and highly abundant grainy rhyolite comprises the majority of the debitage and tool assemblage. It was used to produce expedient, minimally modified tools, bearing direct use of edges, and displays terminal production. On the contrary, fine-grained lithic raw materials like opal and fine-grained quartzites, among others, which are of good quality but of limited abundance in the geological record, are minimally represented both in the tool and debitage assemblage, exhibit staged reduction and present a more elaborated technology characterized by pressure flaking and bifacial projectile points.

However, the chronological trends found in this study are in disagreement with the propositions both of Brazilian archaeologists (e.g., Ruthschilling 1989; Schmitz 1987; Schmitz et al. 1991) and López (2001) that argue for continuity and similarity between the Preceramic Archaic Component and the Preceramic Mound Component lithic industries. The interpretation of Brazilian archaeologists conforms well to their view of the Preceramic Mound Component of Mound as a continuation of the Archaic Umbu Tradition. Although, López (2001) envisioned the Preceramic Mound Period as distinct from the Preceramic Archaic one, he sees continuity in the lithic assemblages from the Preceramic Archaic Component with the Preceramic Mound.

As mentioned earlier, this analysis agreed with López (2001) in the general tendencies toward a change to a more expedient technology over time, however, we are not in accord with the timing

of these changes, which we argue took place at the very start of the Preceramic Mound Period and not later during the Ceramic Mound Period.

### **Assemblage Variability and Site Function**

The lithic assemblage at Los Ajos consists of a wide, varied assortment of flake-stone tool types. This indicates that a wide range of activities took place at the site, providing another line of indirect evidence lending support to the residential nature of Los Ajos. This is further corroborated by the preliminary microscopic use-wear analysis (Appendix 4) on a small sample of selected tools that documented several activities, which represent the range of simple domestic activities including the working of soft plant materials probably to extract starch, hard-wood working most likely related to the manufacturing of wooden implements, butchering of animals, and the scraping fresh hide and bone working possibly related to the maintenance of organic equipment such as spears, clothing and animal gutting tools, were carried out at the site.

Also, consistent with this interpretation is the fact that all stages of lithic reduction including core reduction, tool manufacture, use and discard are represented at the site. Last but not least, the higher density of artifacts during the Mound Components further supports an increased intensity of occupation of the site, which is also related to more prolonged permanence.

As a final note, it is interesting to note that during the mid-Holocene many archaeological cultures in southeastern South America also exhibit a tendency to change to more expedient lithic technologies. Although basic understanding of chronology and the nature of settlement is still lacking for many areas for this time period in this part of the continent, some patterns are starting to emerge. In a synthesis of the lithic industries of the Middle Uruguay River, Cabrera and Curbelo (1990) observed that around 7,000 bp, the lithic industries of this region start to change to (a) include a major variety of tool types, (b) tools that are less elaborate and more expediently manufactured with a major increase in the presence of unmodified utilized flakes, and (c) a major reliance on coarse-grained raw materials like grainy quartzite to the detriment of fine-grained igneous rocks like opal and chalcedony. In southeastern Brazil, projectile points pertaining to the Umbu Tradition changed from finely bifacially manufactured ones to expediently, bipolarly ones around 4,000 bp (Klaus Hilbert, personal communication 2002). In the same region, Ruthschilling (1989) when comparing the Preceramic Mound Component to the

Ceramic Mound Component in the mounds of the Camaqua region noted that the Ceramic phases presented a less elaborated more generalized technology including more diverse tool types concomitant with a major reliance on quartz to the detriment of fine-grained raw materials. In the Preceramic Mound Component of the mound complexes located in the Middle Paraguay River in the region of Corumba dating to around 4,400 bp, Schmitz and his colleagues (1998) describe a very expedient lithic industry mainly characterized by unmodified utilized flakes and quartz bipolar flakes with a total absence of bifacial reduction. Last but not least, in the Argentinean Pampas, few studies have looked at the Mid-Holocene changes in lithic technology. However, is interesting that Orquera (1987) noted that during the Mid-Holocene around 5,000 bp lithic tools become more informal. These changes in lithic technology along with others in settlement and economy suggest that during the Mid-Holocene many archaeological cultures in southeastern South America were experiencing major organizational changes is mobility and subsistence becoming more sedentary and adopting a more generalized economy. I will return to the significance of these patterns in the final chapter.

## **Chapter 6.** **The Subsistence Economy of Early Formative Societies**

### **Introduction**

This chapter provides an overview of the early Formative economy based on botanical and faunal analyses carried out at the Los Ajos site. The chapter is divided in three main parts. The first part of the chapter describes and discusses the micro-fossil botanical analyses carried out on plant grinding tools and selected archaeological sediments from Los Ajos. The second part, presents a basic faunal analysis of the bone assemblage recovered from Mound Gamma at Los Ajos. The third and concluding section of the chapter integrates both data sets to elucidate the nature of the economy of the early Formative societies that emerged around 4,190 bp in the wetlands of India Muerta.

### **Plant Subsistence Inferred from Phytolith and Starch Grain Analyses**

This section begins with a general discussion of the role of micro-fossil botanical analysis in the archaeology of southeastern Uruguay. A brief review of previous micro-fossil studies carried out in the region is then presented, followed by a description of the field and laboratory procedures used in the archaeo-botanical analysis. Next, the results of the phytolith analysis of selected archaeological sediments are offered. This is followed by the presentation of the results of the starch grain and phytolith residue analysis from plant-processing tool along with a detailed description of the tools that were examined. The methodology and results of the starch grain residue analysis carried out by Dr. Dolores Piperno and Irene Holst are presented in Appendix 5. In the final section of this chapter, a brief summary and consideration of the wider implications of the phytolith and starch grain data for the characterization of Early Formative subsistence are presented. A more complete discussion and integration of this data set with the others of the Los Ajos site gathered during this study is offered in Chapter 8.

## Why Micro-Fossil Botanical Analysis?

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 (e.g., Brown and Vierra 1983; Carr and Gibson 1997; Sandweiss et al. 1999). Research shows that cultural complexity has emerged under extremely different environmental settings based on coastal (e.g., DeBlasis et al. 1998; Gaspar 1998; Moseley 1985; Stothert 1985, 1992;) and inland (e.g., Dillehay et al. 1989a; Heckenberger 1998; Pearsall 1999; Roosevelt 1999) economies, the majority of which relied on both domesticated and wild resources to different degrees (Piperno and Pearsall 1998a).

In order to understand the emergence of these early complex societies, it is crucial to comprehend the role that wild and domesticated plant resources played in their economies. However, in many regions of lowland Central and South America with a perennially or seasonally humid climate, archaeo-botanical research focusing on the recovery and interpretation of macro-botanical remains (seeds, nuts, etc.) had long been hampered by the poor preservation of these types of plant remains (e.g., Piperno 1995; Pearsall 1995; Piperno and Pearsall 1998a; Pearsall 2000). Underground plant organs (roots, rhizomes, tubers, and corms) are particularly notorious for their failure to enter the record of carbonized remains. In the Americas, such types of plant organs have only been recovered from exceptional environments favoring preservation. These include the anaerobic peat that covers the Monte Verde II component (Ugent et al. 1987; Dillehay 1989b, 1997) and arid conditions favoring desiccation that characterize the desert coast of Peru, where remains of *Canna edulis* (Ugent et al. 1984) and *Manihot esculenta* (Ugent et al. 1985), among other tubers (see Pearsall 1992 for more detailed information) were recovered. Even in many of these cases, specimens were so fragmented that starch grain analysis had to be carried out in order to precisely identify the remains.

In the Neotropics, micro-fossil studies carried out by Piperno and Pearsall (see Piperno and Pearsall 1998a) have revealed the presence of diverse assemblages of plants from seed, root, and tree crops, and made it clear how many utilized and cultivated plant species of all types simply were not surviving for very long in the macro-fossil records. The same appears to be true in southeastern Uruguay. Despite the systematic application of fine-mesh sieving in all previous excavations in the region (Bracco et al. 2000a), and the implementation of an intensive flotation



program for the first time as part of this dissertation, no macro-botanical remains other than charred palm kernels (*Butia capitata*, *Syagrus romanzoffiana*) and one squash seed (José López, personal communication 2002) were recovered from archaeological sites (López 2001). These results indicated that different approaches were needed in order to rigorously study the prehistoric plant economy.

### **Previous Micro-Fossil Botanical Studies in the Study Area**

In 1999, the author carried out an internship at the Smithsonian Tropical Research Institute (hereafter called STRI) in Panama to learn phytolith and starch grain analyses. During this internship, preliminary phytolith and starch grain analyses were carried out in three sites of the region: Isla Larga, Los Indios, and Estancia Mal Abrigo (Iriarte et al. 2001) (see Figure 2.3; Table 6.1). Isla Larga, or site CG14E01, is a multi-component mound complex located on the western extreme of the Sierra de San Miguel surrounded by the wetlands of San Miguel. The excavation of the central part of the largest mound (40 m in diameter and 3.8 m high) exposed one of the longest continuous occupations of the region dating from ca. 3,600 bp to the historic period (Cabrera et al. 2000).

Los Indios is a multi-component, mound complex located over a tongue-shaped spur located on Arroyo de los Indios. The site consists of four mounds; two of them (Mound I and II) are connected through a ramp facing a third one (Mound III), creating a central open space that opens to the west. The fourth (Mound IV) is a burial mound located on top of a knoll overlooking the other mounds (López 2001:247, Figure 7) where thirteen burials have been recovered so far. The oldest Preceramic Archaic occupation at Los Indios dates to ca. 5,000 bp, and is represented by the buried A horizon that occurs below the mounds. According to López and Gianotti (2003), the development of mounded architecture and the appearance of the central plaza area took place around 3,000-2,500 bp.

Estancia Mal Abrigo (Iriarte et al. 2001) (Figure 2.5) is a large, multi-component mound complex extending over more than 50 ha and comprising more than 70 mounds located ca. 3 km southwest of Los Ajos. We currently lack radiocarbon dates from this site. The samples analyzed by the author and his colleagues correspond to the Ceramic Mound Component of one of the mounds that were excavated in a preliminary project (Iriarte et al. 2001).

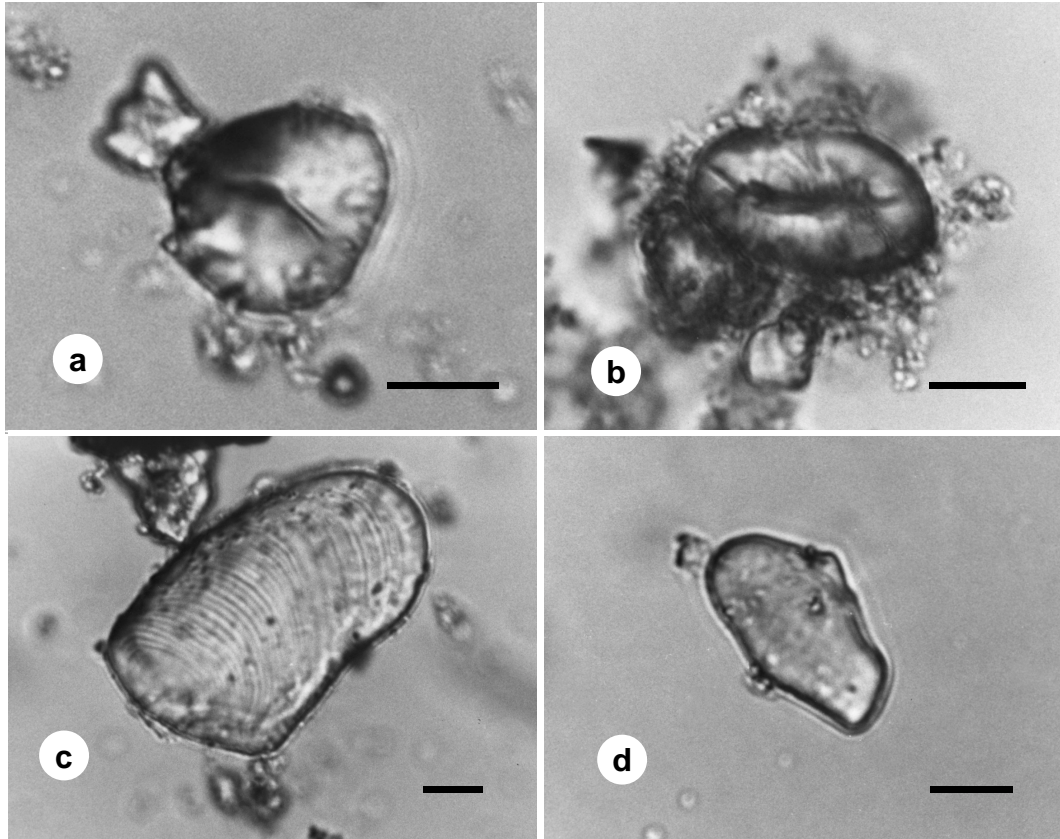


Figure 6.1. Starch grains from other archaeological sites in the region: a: *Zea mays* starch grain from Isla Larga site (max. depth. 2.85 m depth); b: starch grain of Legume possible *Phaseolus* spp. from Los Indios site-Exc. II (1.20-1.30 m depth); c: starch grain of *Canna* sp. from Isla Larga site (max. depth. 2.85 m depth); d: *Calathea* sp. starch grain from Isla Larga site (0.80-0.85 m depth). Scale bar=10um.

Table 6.1 . Results of Starch Grain Analysis from Estancia Mal Abrigo (EMA), Los Indios, and Isla Larga (from Iriarte et al. 2001).

Site	Excavation	Level	C14 dates	Type of starch grain	N	Mean ( $\mu$ )	Species
<b>EMA</b>	II	(0.5-0.6 m)		Graminae (isolated)	12	21x18	<i>Zea mays</i>
		(0.2-0.3 m)		Graminae	1	16x16	<i>Zea mays</i>
<b>Los Indios</b>							
	I	(1.85-1.90 m)	2,800±70	Graminae (isolated)	6	14x13	<i>Zea mays</i>
	II	(1.20-1.30 cm)	1,170±60	Graminae (isolated)	42	18x16	<i>Zea mays</i>
Graminae (aggregated)					20x17	<i>Zea mays</i>	
Leguminosae (isolated)				6	20-15	<i>Phaseolus spp.</i>	
Graminae (isolated)				18	16x13	<i>Zea mays</i>	
Graminae (aggregated)					18x18	<i>Zea mays</i>	
<b>Isla Larga</b>	III	(0.8-0.85 m)	1,190±80	Graminae (isolated)	9	18x15	<i>Zea mays</i>
				Marantacea	1	28x16	<i>Calathea spp.</i>
	(1.90-1.95 m)	3,050±90	Graminae (isolated)	14	19x16	<i>Zea mays</i>	
			Graminae (aggregated)		21x15	<i>Zea mays</i>	
			Leguminoseae (isolated)	3	27x29	<i>Phaseolus sp.</i>	
			Graminae (isolated)	18	16x15	<i>Zea mays</i>	
			Graminae (aggregated)		13x12	<i>Zea mays</i>	
	(max. 2.58 m)	3,660±120	Graminae (isolated)	18	16x15	<i>Zea mays</i>	
			Graminae (aggregated)		13x12	<i>Zea mays</i>	
			Cannacea	2	44x26	<i>Canna sp</i>	

A preliminary phytolith analysis of sediments from these three sites was carried out by the author under the supervision of Dr. Dolores Piperno. Dr. Dolores Piperno and Irene Holst carried out preliminary starch grain studies, in order to determine if further, more intensive work was warranted in this regard. Seeds, leaves, and roots from a variety of wild and domesticated species were well-represented in these records. Starch grains from the kernels of *Zea mays* (Figure 6.1a), beans of *Phaseolus* sp. (Figure 6.1b), and rhizomes of *Canna* spp. (“achira”) (Figure 6.1c) and *Calathea* spp. (small tubers belonging to the Marantaceae) were identified (Figure 6.1d). Maize starch grains occurred at Isla Larga in contexts dating to ca. 3,660 bp (ca. 3,936 cal. bp). Maize starches also occurred at Los Indios, in a context from Excavation I associated with a date of ca. 2,800 bp (ca. 2,910 cal. bp). *Phaseolus* starch grains appeared for the first time around 3050 bp (ca. 3,296 cal. bp) at Isla Larga. At Los Indios, *Phaseolus* starches occur at ca. 1,170 bp (ca. 1,063 cal. bp) from Excavation II. At the present time, *Phaseolus* starch grains can only be identified to the genus level. A positive identification of domesticated *Phaseolus* awaits an analysis of wild *Phaseolus* species native to the region (these include *P. adenanthus*, *P. lobatus*, *P. prostratus*, *P. erythroloma*, and *P. schottii* [Cabrera 1967]). *Canna* appeared only in the earliest contexts from Isla Larga, dating to around 3,660 bp, and *Calathea* was recovered solely from Isla Larga in contexts associated with a date of ca. 1,190 bp (ca. 1,117 cal. bp). The phytolith record from these three sites contained palm, *Cucurbita* fruit rind, and possible maize leaf phytoliths.

The results of this preliminary study thus suggested that populations of hunter-gatherers coping with an unstable Mid-Holocene environment first adopted maize, squashes, and *Canna* sp., and later incorporated beans into a mixed subsistence economy. In light of these results, a more ambitious research design tailored to investigate the identification, chronology, and contextual associations of the cultigens at Los Ajos in greater detail was developed. The research design included: (a) a flotation program, (b) the construction of a large, modern reference collection for phytoliths, so that the plants identified in the preliminary studies could be more robustly assigned to individual plant taxa, and (c) a phytolith and starch grain analysis of residue removed from the surface of plant grinding stones recovered from selected contexts at Los Ajos. A combined pollen and phytolith analysis of a sediment core was also undertaken (presented in

Chapter 3), in order to obtain insights into the interactions between culture and the environment during the Mid-Holocene period.

## **The Field and Laboratory Methodology**

### **Flotation Program**

Flotation was carried out in the field using a SMAP-style flotation system (Pearsall 2000) consisting of a plastic barrel of 500 l., which received water from a rice-irrigation canal pumped with a 3HP electric pump powered by a gasoline generator. Samples were left to dry before being processed. The loamy to silty loamy texture of the archaeological sediments facilitated the flotation process. The sediments were easily disaggregated. Operators were only needed to gently stir water in order to encourage soil that was sinking or stuck to the edges of the screen to move to the center towards the water flow. The screen used to capture the heavy fraction was made of window screen of 0.5 mm. The light fraction was captured at the end of the sluiceway using nylon stockings. Once the flotation process was finished, samples were hanged on wire-fences to dry. Light fraction charred materials were checked under the binocular microscope at 30X magnification to separate potential macro-botanical remains other than wood charcoal.

Knowing beforehand that preservation was poor at the site from an earlier report by Bracco (1993), the volume of soil processed for flotation was increased in order to augment the overall recovery of macro-botanical remains. A soil sample volume of twenty liters was taken from all the artificial levels excavated from Mound Gamma, the central part of TBN trench, and five off-mound test units. In addition, forty liter samples where taken from all major excavation features from Mound Gamma, including the entire contents of a sector level in the case of burials, stone structures, and hearths. Three crew members processed a total of 52 samples totaling 1140 liters in a period of two weeks. As mentioned before, despite the implementation of this intensive flotation program, no seed or root remains and scant amounts of charred wood were recovered from the light fractions of the samples. Figure 6.2 shows the flotation machine, the flotation of a sample in progress, and the scarce amount of charred wood recovered from 40 liters of archaeological sediment.

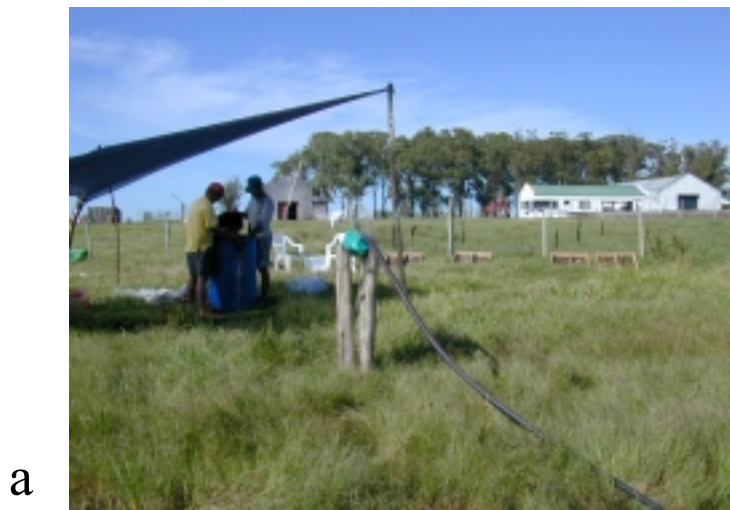


Figure 6.2. a: general view of SMAP-style flotation machine; b: flotation of a sample in progress; and c: example of scarce amount of charcoal recovered after floating 40 liters of sediments from Mound Gamma, 250-255 cm depth, sector 4/B.

### **Phytolith Baseline Reference Studies**

Because phytolith and starch grain analyses are recent additions to paleobotanical studies in southeastern South America, particular emphasis was placed on establishing modern reference collections for the region. Securely classifying phytoliths and other types of paleobotanical remains rests on having large, modern reference collections. Considerable attention was also given to assessing the quantities and preservation of phytoliths from different species once they are deposited into soils and sediments through the decay of plants. This was achieved through the analysis of modern soils from the most representative vegetational formations of the area. These studies also provided modern analogue data with which to compare paleoenvironmental phytolith records from core sediments. Phytolith data from modern vegetational contexts may also serve as a control for archaeological phytolith analysis; for example, in helping to distinguish phytolith patterns reflective of human selection and then deposition of plants from background environmental noise.

The modern reference collection consists of 60 grass species, 21 non-grass monocotyledonous species, 21 species of herbaceous dicotyledons, 7 woody dicotyledonous species, and 1 species of fern (Iriarte and Alonso 2002, Table 1). Seven modern surface soil samples were analyzed from wetlands, wet prairies, upland prairies, gallery forest, and palm forest. Of the 50 non-grass plant species analyzed, 25 contribute diagnostic phytoliths at different taxonomic levels corresponding to all the major ecological zones of southeastern Uruguay. Patterns of phytolith production and morphology were concordant with those observed in related taxa studied from other regions of the world (e.g., Bozarth, 1992; Kealhofer and Piperno, 1998; Kondo et al., 1994; Lawlor 1995; Piperno, 1988; Piperno and Pearsall 1998b; Runge, 1999). The phytolith analysis of modern soils revealed significant patterns that differentiate a number of specific habitats, showing that distinct vegetational formations can be discriminated by the phytolith signatures they produce. The results of this study are presented in detail in Iriarte and Alonso (2002).

Because an important aspect of the study was to study the timing of maize arrival to the region, the feasibility of identifying maize leaf decay through a technique developed by Piperno and Pearsall (Pearsall 2000; Piperno 1984, 1988, 1998) based on the size and three-dimensional morphology of cross-shaped phytoliths was tested. Subtropical Panicoid grasses that produce abundant cross-shaped phytoliths dominate the study area (Leon 1992), hence intensive studies of the regional Panicoid and certain other grasses were needed to ensure that no wild taxa have phytoliths that are potentially confusable with maize. A focused analysis of over 40 species of these grasses was carried out to determine whether their cross-shaped phytoliths could be confidently separated from those of maize on the basis of size and morphology. Cross-shaped phytoliths were also studied in seven modern soil samples that belong to the most representative vegetational formations of the area. These analyses demonstrated that an application of multivariate (linear discriminant function) analysis together with qualitative and other assessments of cross-shaped phytolith assemblages, as originally described by Piperno and Pearsall, can be successfully used to distinguish the presence of maize in the grasslands of southeastern Uruguay. The results of this study are presented in detail in Iriarte (2003).

## **Phytolith and Starch Grain Field and Laboratory Procedures**

### ***Field Sampling and Laboratory Extractions***

Phytolith samples were taken from profiled walls and features from Mound Gamma and the central part of the TBN trench. A total of 26 samples were processed, identified, and counted at the STRI archaeobotanical laboratory. Samples are listed in Table 6.3 along with detailed information on the excavation provenience. Figure 4.17 show their stratigraphic position. During the excavation, all potential plant processing tools (e.g., those with ground and/or polished surfaces) were immediately wrapped in aluminum foil and set apart for phytolith and starch grain residue analysis.

Phytolith extractions from modern plants, modern soils, and archaeological sediments, together with the analysis of residues on archaeological stone tools, followed standard procedures used at the STRI archaeobotanical laboratory. These procedures are described in detail in Piperno (1988: 119-129) and Piperno and her colleagues (2000). In order to maximize the recovery of important phytoliths of different size classes, such as those that derive from the



rinds of *Cucurbita* fruits and leaves and cobs of maize, archaeological sediments were separated by wet-sieving into silt (2-50  $\mu\text{m}$ ) and sand (50-2000  $\mu\text{m}$ ) fractions. The entire extract recovered from the sand fraction was scanned for *Cucurbita* phytoliths. The extraction of starch grains from sediments followed the technique described in Appendix 5.

### ***Phytolith Identification***

Refinements in the recognition of micro-morphological features, together with the application of multivariate statistical analyses to phytolith and starch grain assemblages, are allowing paleoethnobotanists to distinguish certain phytolith and starch morphotypes to specific taxonomic levels, and to differentiate wild from domesticated species. Examples include maize (Bozarth 1993; Pearsall 1978; Pearsall and Piperno, 1990; Pearsall et al. 2003; Piperno 1984, 1988, 1998; Piperno and Pearsall 1993, 1998; Thompson and Mulholland 1994), squashes and gourds (Bozarth, 1987; Piperno et al. 2000a; 2003), rice (Pearsall et al. 1995; Zhao et al. 1998), wheat and barley (Ball et al. 1999; Miller Rosen, 1992; Tubb et al. 1993), banana (Mindzie et al. 2001; Wilson, 1985), manioc, and yams (Piperno et al., 2000). Central to these advances has been the construction of extensive regional plant reference collections, which have enabled analysts to more securely characterize and classify paleoethnobotanical remains.

In this study, phytolith identifications were made by comparison to the modern reference collection built for the region mentioned above. In addition, the author used the extensive phytolith comparative collection curated at STRI, as well as published phytolith atlases and keys (e.g., Bozarth, 1992; Kealhofer and Piperno, 1998; Kondo et al., 1994; Lawlor 1995; Piperno, 1988; Piperno and Pearsall 1998b; Runge, 1999).

Identification of Poaceae phytoliths was based on a morphological classification first proposed by Twiss et al. (1969), and later modified or refined by various researchers by taking into account criteria based on three-dimensional morphology and other micro-morphological features. These researchers extensively studied North American grasses (Brown 1984; Fredlund and Tiezen 1994; Mulholland 1989; Twiss 1992); neotropical grasses (De Campos and Labouriau 1969; Pearsall 2000; Piperno 1988; Piperno and Pearsall 1998b; Sendulsky and Labouriau 1966; Sondahl and Labouriau, 1970; Teixeira da Silva and Labouriau 1970); and the Rio de la Plata Grasslands (Bertoli de Pomar 1971; Zucol 1996, 1998, 1999, 2000). An outline

Table 6.2. List of Archaeological Sediments Analyzed for Phytoliths from the Los Ajos Site

Sample no.	Excavation Unit	Provenience Level (cm)	Sector	Ages (bp)
Mound Gamma				
1	Gamma	115-120	3/A	
2	Gamma	140-145	3/D	
3	Gamma	140-145	1/A	
4	Gamma	155-160	5/B	
5	Gamma	165-170	4/B	
6	Gamma	165-170	1/B	
7	Gamma	170-175	5/B	
8	Gamma	175-180	6/B	
9	Gamma	180-185	3/B	
10	Gamma	190-195	4/B	
11	Gamma	190-195	1/A	
12	Gamma	195-200	2/B	
13	Gamma	200-205	4/B	
		210-215		3,460±100
14	Gamma	215-220	3/D	
15	Gamma	230-235	4/C	
16	Gamma	235-240	5/B	
17	Gamma	245-250	6/C	
18	Gamma	255-260	4/D	
19	Gamma	265-270	5/B	
20	Gamma	270-275	5/B	4,190±40
TBN Central Sector				
21	TBN	160-165	7	1,050±40
22	TBN	170-175	A2	
23	TBN	180-185	A2	
24	TBN	190-195	7	1,660±40
25	TBN	200-205	7	
26	TBN	205-210	7	
Plant-Grinding Tools				
1	Gamma	175-180	4/C	
2	TBN	180-185	10	
3	Gamma	205-210	6/D	
6	Gamma	150-155	3/E	

of the different grass subfamilies recognized by taxonomists, their ecological preferences, and how individual phytoliths they produce are assigned to different sub-families and genera follows below.

The Panicoid subfamily consists of mostly C4 grasses adapted to warm and wet environments. This subfamily mainly produces bilobates and crosses; however, exceptions to this pattern occur. Some examples are *Aristida* spp., *Stipa* spp., and several Oryzoid and Bambusoid grasses. Fortunately, these grasses contribute bilobate phytoliths that are distinguishable in three-dimensional form and other micro-morphological features, allowing us to differentiate them from “true” Panicoid bilobates (*sensu* Fredlund and Tiezen 1994). For example, *Aristida* spp. produces distinctive bilobates with long, thin shafts and flared, convex edges (Mulholland, 1989: 501; Piperno and Pearsall 1998b: 23, 35). *Stipa* spp. bilobates, which are very abundant in some subdivisions of the Rio de la Plata Grassland (Leon 1992), are characterized by their distinct asymmetrical trapezoidal cross-section in comparison to the more symmetrical cross-section of Panicoid bilobates (Fredlund and Tiezen 1994: 325; Mulholland 1989).

Oryzoid and Bambusoid bilobates and crosses will be described in detail below. The Chloridoid subfamily comprises C4 grasses adapted to warm and dry environments. They produce abundant quantities of saddle-shaped phytoliths. Bambusoid grasses, all of which use the C3 photosynthetic pathway, also produce saddle-shaped phytoliths but they are readily distinguishable from the Chloridoid forms because they are much longer and thinner (Kondo et al. 1994; Piperno 1988; Piperno and Pearsall 1998b). As noted in several previous studies, rondel phytoliths (those with at least one circular face) occur in all Poaceae subfamilies in significant amounts, and therefore cannot be used as an indicator of the Pooid subfamily of grasses. In this analysis, following Mulholland (1989), rondels were classified as circular to oval in planar view and as trapezoidal in cross-section. We followed the specialized trapezoid category defined by Brown (1984: 349-50) for the classification of Pooid phytoliths, which are produced in high amounts by this subfamily. The Wavy Trapezoid category used in this analysis corresponds to Brown’s (1984: 363) VA1 and VA2 shapes, the Rectangular/Square category corresponds to VB1 and VB2a1, and the Round/Oblong forms correspond to VB2 shapes.

The shade-tolerant Bambusoid grasses present in the study region are very diagnostic of forested environments. As has been previously described, Bambusoid grasses produce several

distinct phytolith morphotypes. These include high amounts of characteristic bamboo saddles (i.e., Kondo et al. 1994: 46; Piperno 1988:57;), spiked bodies, *Chusquea* bodies unique to that genus, *Pharus* bodies unique to that genus, collapsed saddles, and bodies with elliptoid/biloboid tendencies, as well as distinctive percentages of squat versus tall saddles (Piperno and Pearsall 1998b). All of these peculiar forms allow us to easily detect the presence of Bambusoid grasses in fossil phytolith assemblages.

Oryzoid grass species are very good indicators of wetland and wet prairie formations because their distribution is limited to seasonally inundated, wetland environments (Burkart 1969; Rosengurt et al. 1970; Alonso 1997). The distinctive characteristics of Oryzoid dumbbells and crosses have been described (Chaffey 1983; Kunoh and Akai 1977; Metcalfe 1960; Palmer and Tucker 1981; Pearsall et al. 1995) and applied in paleoenvironmental reconstruction (Kealhofer and Piperno 1996). Oryzoid bilobates have “scooped” (*sensu* Pearsall et al. 1995) ends and are curved and lobed in side view. Also, Oryzoid grasses have a variant of the “scooped ends” bilobate, in which one face is usually bilobate-shaped, and the other is characterized by a rather rhomboidal shape with pointed triangular ends. In addition, Oryzoid crosses are characterized by the presence of pointed, triangular projections extending from the lobes of the nontype-tier face of the cross; lobes are characteristically angular but often rounded; indentations usually are arch-like between two pointed lobes; and usually there is no clear demarcation in the middle of the cross-shape phytolith (Iriarte 2003). These idiosyncratic Oryzoid phytoliths not only have great potential as paleoenvironmental indicators, they are also useful in differentiating wild Oryzoid crosses from maize. The Oryzoid short-cell phytolith assemblages from all species analyzed in this study are dominated by “scooped” bilobates. Present in fewer amounts are Oryzoid crosses, while spiked-bodies, saddles, and rondels are represented in very small proportions.

The phytolith morphotypes used in this analysis for the identification of non-grass monocotyledons and dicotyledons are described in detail in Iriarte and Alonso (2002). Figure 6.3 illustrates representative specimens from each morphotype.

### ***Phytolith Identification of Maize***

The maize leaf identification method and the feasibility of its application in the region have been briefly summarized above and are treated thoroughly in Iriarte (2003, in press).

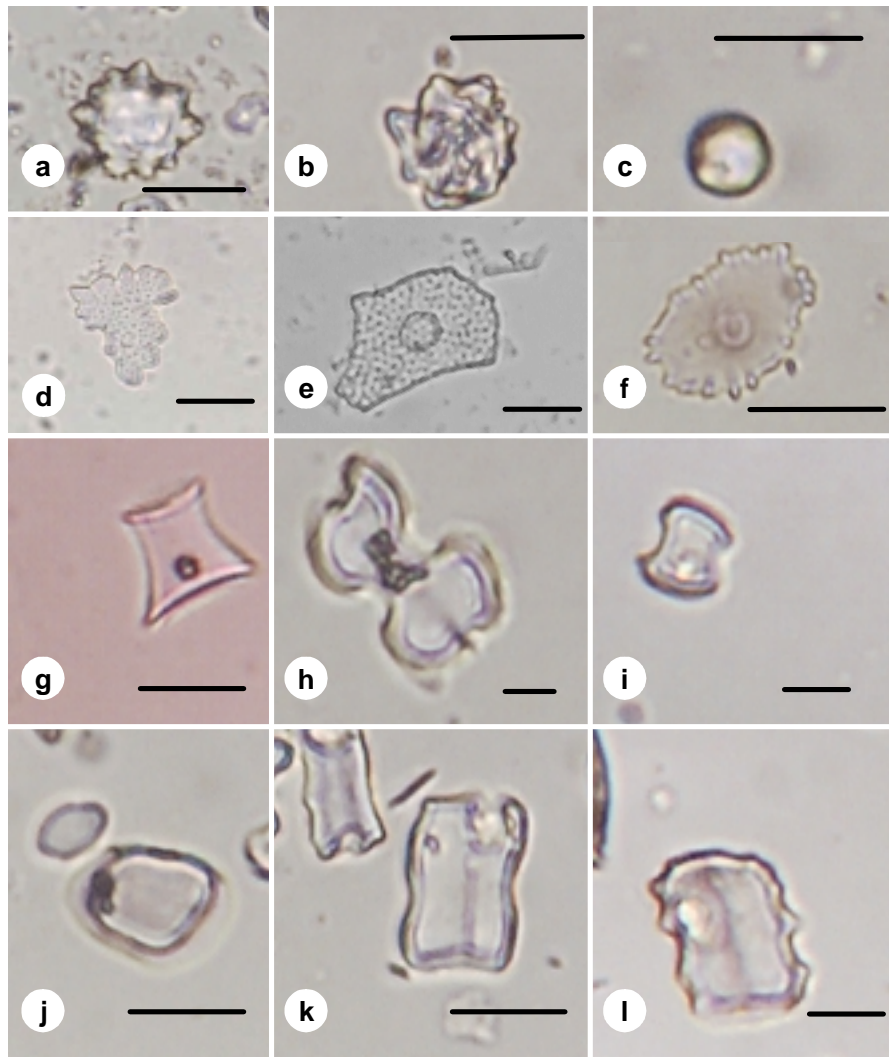


Figure 6.3. Phytolith types: a: palm spinulose sphere phytolith; b: woody dicot other spherical phytolith type; c: woody dicot spherical smooth type; d: Celtis echinate plate; e: Cyperus achene body; f: Carex achene body; g: rondel; h: bilobate; i: saddle; j: round/oblong; k: rectangular/square; l: wavy-trapezoid. Scale bar=10um.

Cross-shaped phytoliths were identified and measured using Pearsall's (1978) criteria to separate crosses from bilobates. Cross-shape phytolith three-dimensional morphology was determined using Piperno's (1984:368-371; see also Pearsall and Piperno 1990:325-330) three-dimensional cross-shape variant definitions. Cross-shaped phytoliths were rotated, measured with an eyepiece micrometer, and counted at 400X. As with any identification technique, learning to rotate and identify the different three-dimensional variants took practice and good supervision, but these forms became readily identifiable. At least 25 cross-shaped phytoliths were counted in each sample.

Maize cob phytoliths have also been recently studied, and phytolith criteria have been published that allow the discrimination of phytoliths from maize cobs in North America and the Neotropics. Maize cob phytolith assemblages from all areas of the Americas are dominated by rondels, a phytolith variety with at least one circular face (Mulholland 1993: 140-41; Piperno and Pearsall 1993: Table 2 and 7). The diagnostic types of rondels found in maize cobs were defined by Bozarth (1993) and Mulholland (1993) for North American maize races. The latter author defined them as "rondels with a plateau top and a multiple indented base". This type was also identified in Piperno and Pearsall's (1993) study of the phytoliths produced in the cobs of Latin American maize races and in the fruitcakes (homologous to the cob of maize) of maize's probable wild ancestor, teosinte. They were called by Piperno and Pearsall "decorated circular to oval phytoliths" and, as in North America, were considered to be diagnostic of the genus *Zea* in the Neotropics. Recently, Pearsall and her colleagues (2003) studied additional varieties of Latin American maize races, and now call the distinctive maize rondels "wavy-top" and "ruffled-top" rondels. Other diagnostic maize and teosinte phytolith types first identified by Piperno and Pearsall (1993) are further compared to those in non-*Zea* wild grasses and refined by Pearsall and her colleagues (2003).

In this study, this detailed definition of rondel types is employed to identify maize. They have restricted the definition of wavy-top rondels to rondels that meet the following criteria: (a) the base must be a rondel, that is, circular to oval in shape, (b) the base must be flat; (c) the base must be longer than the height of the rondel; (d) the top must be a single, complete wave that is equal to or less than the length of the rondel, and does not present acute or sharply angled edges; and (e) the lateral ends of the rondels should be concave. Ruffle-top rondels defined by Pearsall and her colleagues (2003) present the same characteristics of the wavy top rondels, but the top is

ruffled, that is, with undulating edges. It should be noted that these diagnostic types constitute a minor part of the rondel assemblages produced by maize cobs, and are absent in some maize races (Mulholland 1993; Pearsall et al. 2003; Piperno and Pearsall 1993).

The application of these more restricted criteria successfully rules out potential rondel confusers produced by Bambusoid and Pooideae grasses from the region. Some Bambusoid grasses from southeastern Uruguay, like those of Ecuador and Panama (Piperno and Pearsall 1998b), have a base that is longer than tall, and they may present wavy- and ruffle-topped edge decorations, but they failed to meet the other aspects of the definition. As was noted by Pearsall and her colleagues (2003) and Piperno and Pearsall (1998b), Bambusoid grasses either have multiple-spiked bases, or they have bilobate/saddle/rectangular, concave bases, features that clearly separate them from maize rondels. In addition, wavy- and ruffled-top rondels are clearly differentiated from Pooideae phytoliths in that the latter have rectangular or long elliptical bases, do not have ruffled tops, are trapezoidal in cross-section, have a top shorter than the bottom, and have straight-ended sides (see also Bozarth 1993: 283). These are very important distinctions for the study site since the background vegetation of the rock outcrops that dotted the hilltop where Los Ajos site is located is dominated by Pooideae grasses (Table 6.2).

In summary, after a revision of the grass reference collection for the region, and comparison with grasses from the Neotropics (Pearsall et al. 2003; Piperno and Pearsall 1993; 1998b), and the Great Plains (Bozarth 1993, Mulholland 1993; Thompson and Mulholland 1994) it can be concluded that wavy- and ruffle-top rondels are good, secure indicators of maize presence in phytolith assemblages from southeastern Uruguay.

### ***Phytolith Characteristics in Wild Cucurbitaceae from the Region and Their Differentiation from Domesticated Cucurbita spp.***

The other major crop plants of Uruguay that can be informed by phytolith analysis are squashes and gourds of the genus *Cucurbita*. The fruit rinds of *Cucurbita* spp. produce a diagnostic morphotype specific to the genus level. The phytoliths are spheres and have “deeply scalloped surfaces of contiguous concavities” (Bozarth 1987: 608; Piperno 1988; Piperno et al. 2000). Recent studies (Piperno et al. 2002) show that the production of these scalloped phytoliths is genetically controlled by the same gene that controls the lignification of the rinds, thus phytolith production is not affected by environmental variability through time. Moreover, an

Table 6.3. Plant Inventory of Hilltop Rock Outcrops at the Los Ajos Site

**Taxon**

**Apiaceae**

*Eryngium ebracteatum* Lam.  
*Hydrocotyle*  
*Hydrocotyle bonariensis* Comm. ex Lam.  
*Lilaeopsis*

**Asteraceae**

*Facelis retusa* (Lam.) Sch. Bip.

**Brassicaceae**

*Rorippa bonariensis* (Poirot) Macloskie

**Campanulaceae**

*Pratia hederacea* (Cham.) G. Don

**Caryophyllaceae**

*Cerastium humifusum* Cambess. ex A. St.-Hil.  
*Paronychia brasiliiana* DC.

**Convolvulaceae**

*Evolvulus sericeus* Sw.

**Cyperaceae**

*Eleocharis bonariensis* Nees

**Fabaceae**

*Ornithopus micranthus* (Benth.) Arechav.  
*Vicia graminea* Sm.

**Hypoxidaceae**

*Hypoxis decumbens* Linn.  
*Sisyrinchium iridifolium* Kunth ssp. valdivianum (Phil.) Ravenna  
*Trifurcia lahue* ssp. amoena

**Loasaceae**

*Blumenbachia insignis* Schr.

**Malvaceae**

*Modiola caroliniana* (L.) G. Don

**Oxalidaceae**

*Oxalis paludosa* A. St.-Hil.

**Poaceae**

*Agrostis tandilensis* (OK.) Parodi  
*Briza minor* L.  
*Cynodon dactylon* L..  
*Melica argyrea* Hack.  
*Poa annua* L.  
*Setaria geniculata* (Lam.) Pal. Beauvois

**Polygalaceae**

*Polygala australis* Benn.  
*Polygonum punctatum* Elliott

**Portulacaceae**

*Portulaca cryptopetala* Speg.

**Ranunculaceae**

*Ranunculus apiifolius* Pers.  
*Ranunculus bonariensis* Poirot

**Ranunculaceae**

*Ranunculus apiifolius* Pers.  
*Ranunculus bonariensis* Poirot

**Rubiaceae**

*Hedyotis salzmännii* (DC.) Steudel  
*Relbunium richardianum*

**Scrophulariaceae**

*Gratiola peruviana* L.



extensive study of wild and domesticated neotropical *Cucurbita* species carried out by Piperno (et al. 2000) and Piperno and Stothert (2003) demonstrated that scalloped phytoliths from wild species of *Cucurbita* are often much smaller than those in domesticated varieties. Thus, as with macro-botanical remains of *Cucurbita* (e.g., the seeds and peduncles), size can be used to discriminate wild from domesticated *Cucurbita* phytoliths in archaeological sediments. The analyses of Piperno and her colleagues (2002) also suggested that some infra- and interspecific morphological differences exist among *Cucurbita* phytoliths. For example, the wild species *Cucurbita maxima* subsp. *andreana*, the wild ancestor of *C. maxima* (Sanjur et al. 2000) which is native to southern South America including Argentina and parts of Uruguay, has phytoliths that can be distinguished from other species, including its domesticated product *C. maxima*.

Various, extensive modern studies of regional flora from the Americas and elsewhere indicate that scalloped phytoliths from *Cucurbita* are unique to that genus. For example, no phytoliths similar to them are reported by Bozarth (1987, 1992), Piperno (1988), Kealhofer and Piperno (1998), Kondo et al. (1994); Lawlor (1995), Runge and Runge (1997), and Piperno and her colleagues (2000). A close inspection of phytoliths occurring in wild Cucurbitaceae native to the area was carried out in this study. Of the six other genera of wild cucurbits reported for the Rio de la Plata grasslands, including *Apodanthera*, *Cucurbitella*, *Abobra*, *Cucurbita*, *Cayaponia*, and *Cylanthera* (Cabrera 1967), four of them have already been studied by Piperno (Piperno et al. 2000) and are curated at STRI. They were checked by the author in order to learn and be more acquainted with the morphology of these wild species. The phytoliths that they contribute could be readily distinguished by both size and morphological characteristics from domesticated *Cucurbita*. The phytoliths produced in non-*Cucurbita* wild cucurbit species are characterized by “small, flat, and unscalloped four-to seven-sided pieces of silica or unremarkable forms”(Piperno et al. 2000:195). The same results were reported earlier by Bozarth (1987) in his study of two wild non-*Cucurbita* species from the Great Plains, *Sicyos angulatus* and *Echinocystis lobata*.

During the author’s review of the *Cucurbita* and other Cucurbitaceae phytoliths curated at STRI, special emphasis was given to the study of *Cucurbita maxima* subsp. *andreana*, which at present grows in Uruguay and Argentina (but not in southeastern Uruguay). Recent genetic studies (Sanjur et al. 2000) have identified this wild species as the wild progenitor of *C. maxima*. *C. andreana* produced abundant numbers of scalloped phytoliths, but unlike other species of

*Cucurbita*, these phytoliths are not spheres, but rather irregular, four to seven-sided planar bodies with grainy surfaces (see Figure 6.4). They are readily distinguishable from the spherical forms produced in domesticated species. In sum, this brief review shows that it is possible to identify domesticated *Cucurbita* and differentiate them from wild species of the Cucurbitaceae growing in the study region using size and morphological characteristics.

## Results

### Analysis of Archaeological Sediments

Analyzed samples from Mound Gamma and the TBN central sector are listed in Table 6.3 along with detailed information on excavation provenience. The backplot depicted in Figure 4.23 displays the stratigraphic position of the samples. The number of phytoliths counted in the modern soil samples varied from 207 to 358 per slide in order to include at least 200 short-cells for each sample. In all the archaeological sediment samples at least 200 short-cell phytoliths were identified and counted under the light microscope at 400x magnification. The count and percentage distribution of the different types of phytoliths in the archaeological sediments from Mound Gamma and the central part of TBN trench are presented in Table 6.4 and 6.5 and illustrated in the phytolith diagrams presented in Figures 6.5 and 6.6. The diagrams were made using Tilia software (Grim 1988). The Y-axis of the diagrams lists the samples' number (listed in Table 6.3) or excavation provenience; the bars in the X-axis indicate percentages, and circles indicate presence of each phytolith morphotypes.

In the tool residues at least 100 phytoliths were counted. In order for phytoliths to be typed accurately they were rotated on the slide to view their three-dimensional morphology. This is easily accomplished by gently tapping or pushing the cover-slide with the point of a pen since the samples were scanned before the Permout mounting medium hardened. Given the dominance of Poaceae morphotypes in all the samples and in order to emphasize the variability of short-cells, Panicoid, Chloridoid, and Pooideae percentages were calculated on the sum of the short-cell types alone. Percentages of non-grass phytoliths were calculated on the basis of the total sum of phytoliths.

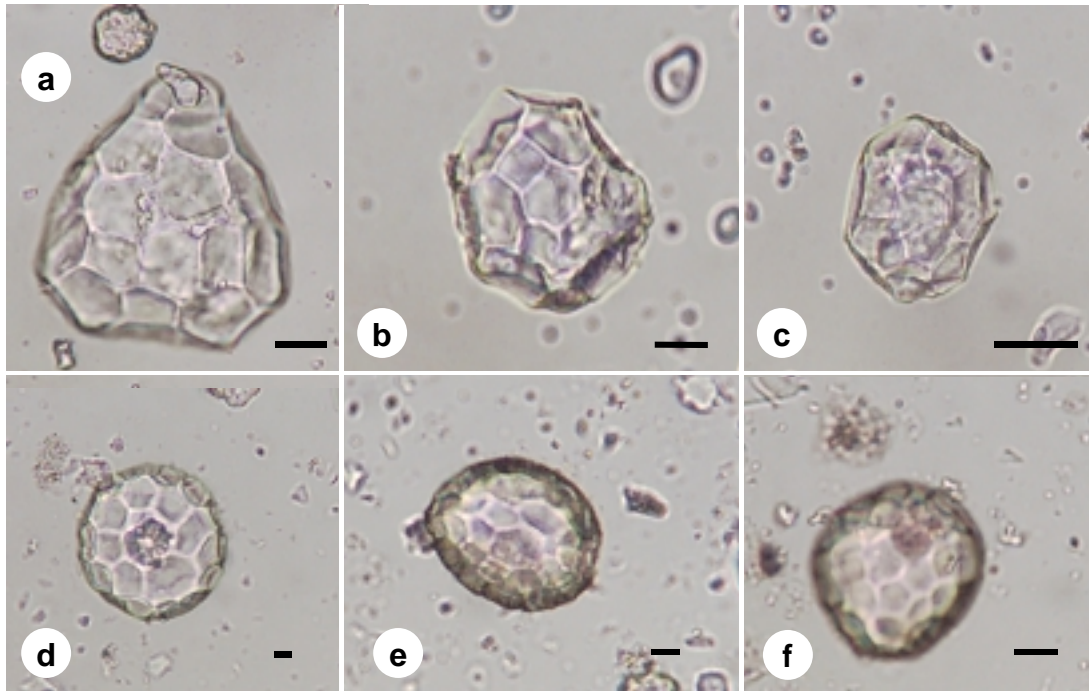


Figure 6.4. a, b, c: phytoliths from *Cucurbita maxima* subsp. *andreana*; d, e, f: *Cucurbita* phytoliths from archaeological contexts: Gamma 180-185 cm depth, sector 3/B; Gamma 175-180 cm depth, sector 6/B; and TBN 180-185 sector A2, respectively. Scale bar=10um.

Table 6.4. Detailed Count and Percentages from Mound Gamma

Morphotypes	Level (cm)	270-275	265-270	255-260	245-250	235-240	230-235	215-220	200-205	195-200	190-195	190-195											
	Sample No.	20	19	18	17	16	15	14	13	12	11	10											
Bilobates		11	4.4%	14	6.3%	19	7.7%	22	9.5%	13	5.8%	22	9.7%	31	14.2%	17	8.0%	21	10.2%	15	7.4%	25	11.4%
Crosses		2	0.8%	4	1.8%	7	2.8%	2	0.9%	4	1.8%	2	0.9%	4	1.8%	1	0.5%	2	1.0%	1	0.5%	2	0.9%
Total Panicoid		13	5.2%	19	8.5%	26	10.6%	24	10.3%	17	7.6%	24	10.6%	35	16.0%	18	8.5%	23	11.2%	16	7.9%	27	12.3%
Chloroid		22	8.7%	11	4.9%	19	7.7%	4	1.7%	14	6.3%	16	7.1%	9	4.1%	15	7.1%	21	10.2%	12	5.9%	22	10.0%
Round/Oblong		70	27.8%	52	23.3%	65	26.4%	55	23.7%	71	31.8%	45	19.9%	24	11.0%	40	18.9%	50	24.3%	57	28.2%	47	21.5%
Rectangular/Square		65	25.8%	56	25.1%	42	17.1%	48	20.7%	48	21.5%	38	16.8%	37	16.9%	25	11.8%	37	18.0%	49	24.3%	52	23.7%
Wavy trapezoids		27	10.7%	18	8.1%	15	6.1%	17	7.3%	23	10.3%	21	9.3%	26	11.9%	43	20.3%	32	15.5%	19	9.4%	15	6.8%
Total Pooid		162	64.3%	126	56.5%	122	49.6%	120	51.7%	142	63.7%	104	46.0%	87	39.7%	108	50.9%	119	57.8%	125	61.9%	114	52.1%
Rondels		55	21.8%	67	30.0%	78	31.7%	81	34.9%	48	21.5%	81	35.8%	85	38.8%	66	31.1%	41	19.9%	49	24.3%	54	24.7%
Wavy- and ruffle-top rondels		0	0.0%	0	0.0%	3	1.2%	3	1.3%	2	0.9%	1	0.4%	3	1.4%	5	2.4%	2	1.0%	0	0.0%	2	0.9%
Short-cell count		252		223		248		232		223		226		219		212		206		202		219	
Cucurbita scalloped phytoliths		0	0.0%	0	0.0%	2	0.8%	1	0.4%	1	0.4%	3	1.2%	2	0.9%	1	0.5%	2	0.9%	4	1.6%	0	0.0%
Sedge achene bodies		0	0.0%	3	1.3%	4	1.5%	2	0.8%	2	0.8%	5	2.0%	1	0.4%	1	0.5%	2	0.9%	0	0.0%	0	0.0%
Palm spinulose spheres		0	0.0%	2	0.9%	3	1.2%	2	0.8%	5	2.1%	7	2.8%	2	0.9%	2	0.9%	3	1.4%	6	2.4%	0	0.0%
Woody dicot phytoliths		1	0.4%	3	1.3%	5	1.9%	7	2.9%	8	3.3%	5	2.0%	4	1.8%	4	1.8%	3	1.4%	37	14.9%	15	6.4%
		253		231		262		244		239		246		228		220		216		249		234	

Table 6.4. Continued

Morphotypes	Level (cm)	180-185		175-180		170-175		165-170		165-170		155-160		140-145		140-145		Mound surface	
	Sample No.	9	8	7	6	5	4	3	2	1	2	1	2	1	2	1	1		
Bilobates		14	6.8%	27	13.3%	27	13.4%	15	7.2%	40	19.5%	35	17.5%	33	15.9%	23	11.4%	65	22.1%
Crosses		0	0.0%	1	0.5%	2	1.0%	2	1.0%	3	1.5%	0	0.0%	4	1.9%	0	0.0%	13	4.4%
Total Panicoid		14	6.8%	28	13.8%	29	14.4%	17	8.2%	43	21.0%	35	17.5%	37	17.8%	23	11.4%	78	26.5%
Chloroid		19	9.2%	32	15.8%	38	18.9%	47	22.7%	45	22.0%	29	14.5%	26	12.5%	28	13.9%	133	45.2%
Round/Oblong		34	16.4%	35	17.2%	19	9.5%	55	26.6%	41	20.0%	29	14.5%	42	20.2%	35	17.4%	35	11.9%
Rectangular/Square		24	11.6%	31	15.3%	37	18.4%	14	6.8%	13	6.3%	19	9.5%	22	10.6%	32	15.9%	5	1.7%
Wavy trapezoids		15	7.2%	12	5.9%	4	2.0%	26	12.6%	25	12.2%	32	16.0%	25	12.0%	22	10.9%	3	1.0%
Total Pooid		73	35.3%	78	38.4%	60	29.9%	95	45.9%	79	38.5%	80	40.0%	89	42.8%	89	44.3%	43	14.6%
Rondels		94	45.4%	64	31.5%	74	36.8%	48	23.2%	37	18.0%	50	25.0%	55	26.4%	60	29.9%	40	13.6%
Wavy- and ruffle-top rondels		7	3.4%	1	0.5%	0	0.0%	0	0.0%	1	0.5%	6	3.0%	1	0.5%	1	0.5%	0	0.0%
Short-cell count		207		203		201		207		205		200		208		201		294	
Cucurbita scalloped phytoliths		3	1.3%	3	1.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sedge achene bodies		0	0.0%	2	0.9%	0	0.0%	0	0.0%	1	0.5%	3	1.4%	2	0.9%	0	0.0%	4	1.1%
Palm spinulose spheres		5	2.1%	5	2.2%	1	0.5%	5	2.3%	6	2.8%	4	1.9%	1	0.4%	1	0.5%	25	7.0%
Woody dicot phytoliths		19	8.1%	16	7.0%	7	3.3%	9	4.1%	2	0.9%	0	0.0%	23	9.8%	9	4.3%	35	9.8%
		234		229		209		221		214		207		234		211		358	

## Mound Gamma

### *Poaceae Morphotypes*

The phytolith assemblages of the archaeological sediments are dominated by Poaceae morphotypes. The short-cell phytolith assemblage in Mound Gamma is predominantly composed of Pooideae phytoliths (29.9-63.7%) (Table 6.4, Figure 6.5). When comparing the PMC with the CMC, there is a major presence of Pooideae phytoliths in the PMC, where they vary from 39.7 to 63.7%. In the CMC, though they are the dominant morphotype, they are less frequent, ranging from 29.9 to 45.9%. The Panicoid and Chloridoid morphotypes are less frequent in both the PMC and CMC. The Panicoid percentages range from 7.6 to 16% in the PMC and from 6.8 to 21% in the CMC. In comparison with the TBN trench sediments in Mound Gamma, the Panicoid morphotypes, and in particular crosses, are minimally represented. The significance of this difference will be discussed in detail in the next section. The Chloridoid morphotypes are present in minor quantities, varying between 1.7 and 10.2% in the PMC and 9.2 and 22.7% in the CMC. Overall, these general trends hold with minor fluctuations for both the Preceramic and Ceramic Mound Components. For reasons explained below, these figures do not take into account the Mound surface sample.

We interpret the dominance of Pooideae phytolith morphotypes as a result of the phytolith signature of the background vegetation of the flattened spur patched with rock outcrops. These poorly drained areas that, with the exception of the summer months, remain waterlogged for the most part of the year are dominated by Pooideae grasses well adapted to moist and cool conditions. Some of these grasses include *Agrostis tandilensis*, *Briza minor*, *Melica argyrea* and *Poa annua*. Panicoid grasses like *Setaria geniculata* and the introduced *Cynodon dactylon* are also present in these formations, along with other moist-loving species like *Hydrocotyle* spp, *Elocharis* spp, and *Ranunculus* spp. (see Table 6.2). In addition, the extensive borrow areas created by the extraction of soil used as fill material for mound building creates shallow ponds during the autumn, winter, and most of the spring months. This situation further increases the presence of Pooideae grasses in the flattened spur where Los Ajos site is placed and helps explain the dominance of Pooideae morphotypes in the mound sediments. Thus, the Pooideae dominated short-cell phytolith assemblages of Mound Gamma are interpreted as the result of the background vegetation together with the possible cultural modification of the

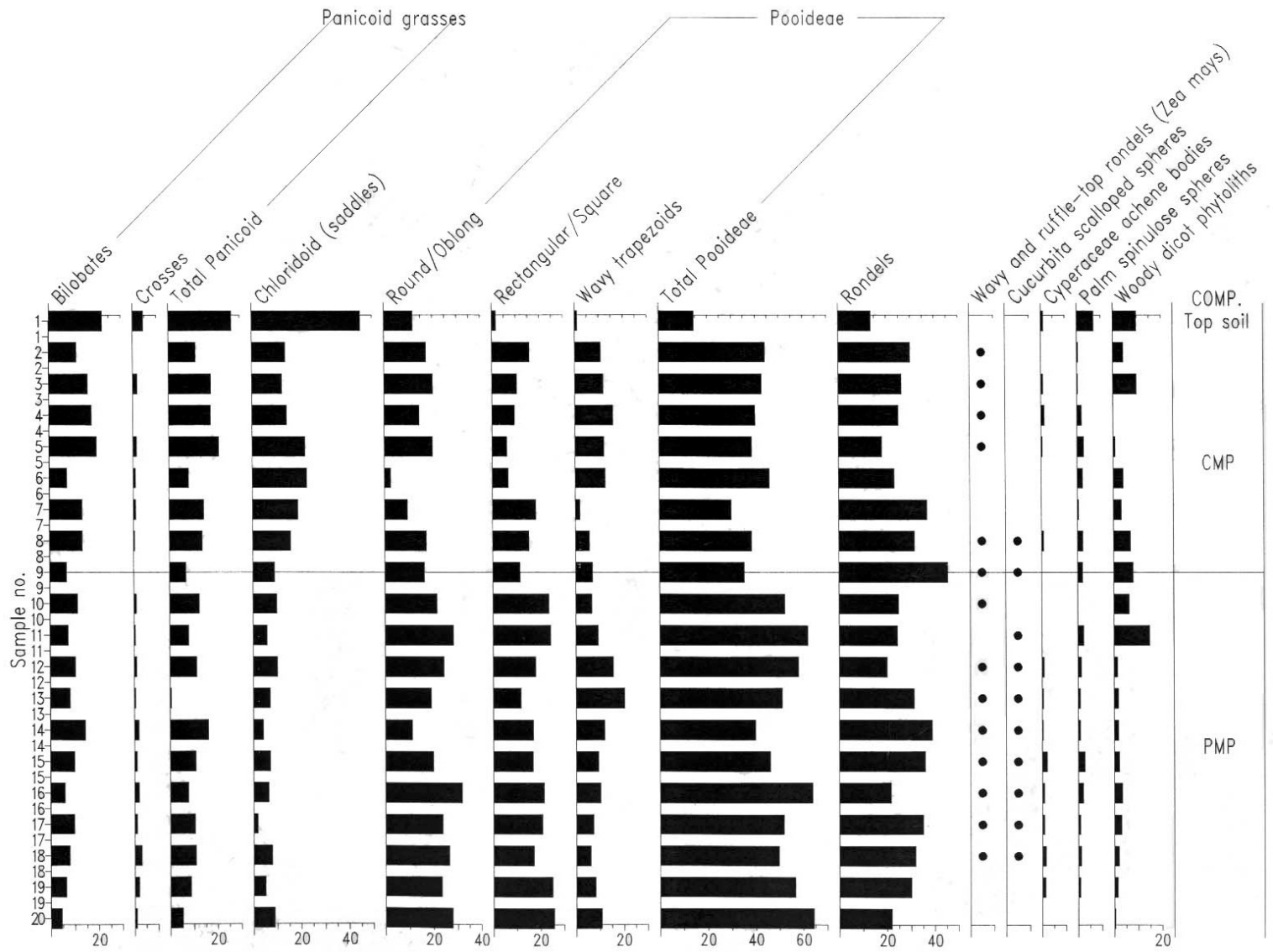


Figure 6.5. Phytolith diagram of Mound Gamma

landscape during mound building. During the beginning of the mound accretion in the PMC, the low dome-shaped occupational mound probably remained moist for a large part of the year. Although located in a high part of the landscape not subjected to seasonal flooding, the superficial, poorly-drained soils of the central part of the Los Ajos site remain intermittently waterlogged during a large part of the year, especially, during the late autumn-winter-early fall period. Although a marked rainy season does not exist, evaporation during winter is very slow, saturating with water the slightly developed A-R horizon soils of this sector of the site. This situation created ideal conditions for Pooideae grasses to thrive. As the Mound Gamma grew during the Ceramic Mound Component. Pooideae phytoliths continued to dominate the short-cell assemblage. This is partially explained by the background vegetation and the deposition of filling materials removed from the A-R knoll soils, which are dominated by Pooideae grasses. The origin of the dominant Pooideae grasses in the archaeological mound sediments is interpreted as a result of the incorporation of sediments from borrows areas where Pooideae grasses are dominant. The major abundance of Panicoid and Chloridoid phytoliths in the CMC is probably due to the drier conditions that began to prevail at the top of the mound as the mound became taller, allowing for these grasses to grow.

The Mound Gamma surface sample should be considered separately since it is at present covered by the non-native *Cynodon dactylon* (Bermuda grass), which was introduced in historic times. This saddle-shaped phytolith producing grass occurs in abundance outside the low-lying zones. The dominance of Chloridoid morphotypes in the Mound Gamma surface is, then, probably the result of the presence of *Cynodon dactylon*. Given the fact that most of the modern vegetational formations in the region are sediments is interpreted as a result of the incorporation of sediments from borrow areas where Pooideae grasses are dominant. The major abundance of Panicoid and Chloridoid phytoliths in the CMC is probably due to the drier conditions that began to prevail at the top of the mound as the mound became taller, allowing for these grasses to grow. The Mound Gamma surface sample should be considered separately since it is at present covered by the non-native *Cynodon dactylon* (Bermuda grass), which was introduced in historic times. This saddle-shaped phytolith producing grass occurs in abundance outside the low-lying zones. The dominance of Chloridoid morphotypes in the Mound Gamma surface is, then, probably the result of the presence of *Cynodon dactylon*. Given the fact that most of the modern vegetational formations in the region are dominated by Panicoid grasses (Iriarte and Alonso



2002), and that *Cynodon dactylon* was introduced recently, the dominance of saddle-shape morphotypes provides a horizontal marker for historic vegetation in the region, and a marker to test subsurface mixing of deposits. *Bromus rubens*, a historically introduced grass in the Mohave Desert of southwestern U.S., represents another example of how a recently introduced grass has the potential to be used as a historical marker to assess subsurface mixing of deposits in other areas (Lawlor 1995).

The low presence of saddle-shape morphotypes in the CMC contexts (9.2 to 22.7%,  $x=16.1\%$ ) in comparison to Mound Gamma surface (45.2%) indicates that subsurface mixing and the vertical displacement of phytoliths is negligible. It can then be interpreted that the analysis of the different archaeological contexts from the site largely reflects in-situ deposition of phytoliths (Jones and Beavers 1964; Norgren 1973; Piperno 1985; Rovner 1986). I will return to this point after all the results are presented in the final section of the chapter.

### ***Domesticated and Other Important Economic Plants***

In addition to the presence of Poaceae morphotypes, woody dicots, and sedge achene phytoliths, three plants of economic importance are represented in the phytolith record of the Preceramic Mound component of Mound Gamma; maize, *Cucurbita*, and palms. Maize is represented by its diagnostic wavy and ruffle-top rondel phytoliths representative of cob decay. *Cucurbita* scalloped phytoliths from fruit rinds are present, and their sizes indicate a domesticated species (below). Palms are represented by their diagnostic phytoliths characterized by spinulose spheres.

As mentioned earlier, ruffle and wavy top maize rondel types constitute a minor part of the prolific rondel assemblages produced by maize cobs, and may be absent in some maize races (Mulholland 1993; Piperno and Pearsall 1993; Pearsall et al. 2003). In light of this fact, all archaeological samples were subjected to an intensive search for these types with positive results. Wavy and ruffle-top rondels are present in low quantities (3-7) starting in the level from 255-260 cm corresponding to the lower sector of the PMC Layer 4, and they continue to be present throughout the sequence. This evidence indicates that the Early Formative peoples started to grow crops immediately after early village formation took place.

As presented below in the section on “Phytolith and starch grain analysis from plant-processing tools” and describe in detail in Appendix 5 (Plant-processing tools’ starch grain

residue analysis), in Mound Gamma, maize starch grains were recovered from a mano excavated in the PMC contexts (Tools 3, level 205-210 cm depth, sector 6/D) and two milling stone bases (one complete and the other fragmented) recovered from CMP contexts (Tool 1: level 175-80 cm depth, sector 4/C; and Tool 6: level 150-155 cm depth, sector 3/E, respectively) (Figure 6.13) (see below). This evidence further indicates that Mound Gamma was an area in which maize was prepared and consumed. Thus, it is reasonable to expect the presence of maize cob phytoliths in the sediments that constituted the floors in which these activities were carried out. Figure 6.6 illustrates maize cob wavy and ruffle-top rondels recovered from Mound Gamma tool residues and archaeological sediments.

*Cucurbita* scalloped spheres were examined by scanning at least two sand fraction slides from each sample. *Cucurbita* phytolith data are presented in detail in Table 6.7. *Cucurbita* phytoliths occurred for the first time in level 255 cm, 15 cm above the earliest dated context of the Preceramic Mound Component at around 4,190 bp.

As Table 6.7 shows, the *Cucurbita* phytolith record from the archaeological sediments is characterized by the presence of few and large scalloped spherical phytoliths. Both patterns agree with the presence of domestic species of *Cucurbita* at the site, since many domesticated varieties do not produce large amounts of scalloped phytoliths (Piperno et al. 2002; Piperno and Stothert 2003). In order to assess the domesticated status of the archaeological *Cucurbita* phytoliths found in the Mound Gamma and the TBN crescent-shaped rise, they were compared with the nine wild *Cucurbita* species reported in Piperno and Stothert (2003:1056, Figures 1A and B). Particular attention was given to the comparison of the archaeological *Cucurbita* phytolith assemblage with the only wild species of *Cucurbita* that have been reported for other regions of Uruguay, *C. maxima* ssp. *andreana* (Cabrera 1968).

Table 6.5. Cucurbita Phytolith Dimensions from Gamma Mound and Central TBN Trench Sediments

Sample No.	Provenience			Length	Mean		Mean Thickness
	Unit	Depth	Sector		Length	Thickness	
8	Gamma	175-180	6/B	85	83.3	60	51.6
				75		50	
				90		45	
9	Gamma	180-185	3/B	80	81.7	65	58.3
				75		50	
				90		60	
11	Gamma	190-195	1/A	85	77.5	50	54.7
				75		50	
				75		64	
				75		55	
12	Gamma	195-200	2/B	75	71.5	60	55
				68		50	
13	Gamma	200-205	4/B	85		90	
14	Gamma	215-220	3/D	85	80	55	60
				75		65	
15	Gamma	230-235	4/C	70	74.3	50	56.3
				85		64	
				68		55	
16	Gamma	235-240	5/B	85		60	
17	Gamma	245-250	6/C	80		55	
18	Gamma	255-260	4/D	85	80	60	55
				75		50	
21	TBN	160-165	7	90		50	
23	TBN	180-185	A2	100	81.7	75	65
				75		60	
				70		60	
25	TBN	200-205	7	80		60	

In this regard, the mean length and thickness of all the archaeological phytoliths from the two excavation units combined are 79.9  $\mu\text{m}$  (range, 68-100) and 58.1  $\mu\text{m}$  (range 45-90  $\mu\text{m}$ ), respectively. The mean length of the archaeological samples exceeds the mean of all the nine wild *Cucurbita* studied by Piperno and Stothert (2003), but *C. maxima* ssp. *andreana* to which is very similar. The lower length size limit of the *Cucurbita* archaeological samples exceeds all nine wild *Cucurbita*. The upper size limit exceed all wild *Cucurbita* species but *C. lundelliana* (100  $\mu\text{m}$ ), *C. maxima* ssp. *andreana* (120  $\mu\text{m}$ ), and *C. ecuadorensis* (128  $\mu\text{m}$ ).

The range and mean thickness of the archaeological assemblage of *Cucurbita* phytoliths significantly surpass the range and mean thickness of *C. maxima* ssp. *andreana* and the rest of the wild *Cucurbita*, except *C. argyrosperma* ssp. *sororia* and *C. lundelliana*, both of which are non-native to the region. Overall, when comparing the dimensions the *Cucurbita* archaeological samples with *C. maxima* ssp. *andreana*, it can be observed that the former exhibits a greater mean thickness and higher lower and upper ranges of thickness. In addition, and more importantly, *C. maxima* ssp. *andreana*, can be ruled out from the archaeological sample on the basis of morphology since the archaeological phytoliths were not the planar and grainy irregular bodies that *C. maxima* ssp. *andreana* produces. Compare for example, the large domestic spherical scalloped phytoliths identified in archaeological sediments from the Mound Gamma the TBN trench with the angular, blocky, and grainy phytoliths of *C. maxima* ssp. *andreana* (compare Figure 6.4 a, b and c with d, e, and f). Overall, the patterns of size and morphology of the *Cucurbita* phytoliths recovered at Mound Gamma and the TBN crescent-shaped rise are in agreement with the presence of domestic *Cucurbita* spp. at the site.

Like maize ruffle and wavy-top rondels, domesticated *Cucurbita* phytoliths did not appear in the very first level of the Preceramic Mound Component at Mound Gamma. This indicates that domesticated squashes were adopted latter when the process of early village formation was already triggered shortly after 4,190 bp.

In addition to maize and squash, palm spinulose spheres (Figure 6.3a) were recovered from both the PMC and CMC contexts. Besides phytolith data from Los Ajos and other sites in the region (del Puerto and Campos 1999; Campos et al. 2001; Iriarte et al. 2001), there is macro-botanical and artifactual data indicating that palm kernels may have been an important aspect of the local diet. Charred palm kernels (“coquitos”) of *Butia capitata* and *Syagrus romanzoffiana* have been recovered from almost all the mound sites in the region (López and

Bracco 1992; Bracco et al. 2000a; López 2001). In addition, nut-cracking stones (locally called “rompe-cocos”) have been found in surface contexts at Los Ajos (Gustavo Uriarte, personal collection) and from several sites in the region both PMC and CMC contexts. These artifacts have small, pecked holes in the center of one or more of their surfaces where a palm fruit kernel or nut could be placed and cracked with a light blow with other stone. There is ample ethnographic (e.g., Oliveira 1995) and experimental replicative data (Ranere 1980) indicating that these artifacts are well suited to open palm kernels. It must be remembered that the palm forest constituted an extremely rich seasonal resource for the prehistoric populations living in the area constituting an abundant and rich source of glucose and lipids (López and Bracco 1992) (see Chapter 3).

Since the phytolith and starch grain data carried out in this study mark the earliest occurrence of maize (*Zea mays*), squash (*Cucurbita* spp.), and possibly domesticated beans (*Phaseolus* spp.) and tubers (*Canna* spp. and *Calathea* spp) in southeastern South America, it is worth reviewing again the contexts and provenience from which these sample were obtained. As described in detail in Chapter 4 the Preceramic Mound component in Gamma Mound consists of a compact, very dark brown loam/silty loam organic sediment containing high concentrations of burned clay, ash lenses, and charcoal. It is constituted by relatively undifferentiated cultural deposits that lack stratigraphy or other significant internal structure, but it contains different concentrations of charcoal or burned earth associated with hearths and hearth rubble.

Two radiocarbon samples were run from the PMC. One was obtained from a piece of charcoal recovered from the lowest part of this component at 265 cm in depth. It yielded a date of 4,190±40 bp (ca. 4,820 cal. bp) (Beta-158280). The other radiocarbon sample corresponds to the upper part of the PMC at 210 cm in depth. It yielded a date of 3,460±100 bp (ca. 3,700 cal. bp) (Beta-158279). In addition, Bracco (1993) obtained five stratigraphically consistent dates between ca. 3,550 and 3,950 bp from the PMC of Mound Alfa. Overall, the stratigraphy and eight consistent radiocarbon dates from the lower and upper parts of this layer, corresponding to the Preceramic Mound Component from mounds Gamma, Delta, and Alfa, place this component at Los Ajos between ca. 4,190 and 2,960 bp. The internal consistency of these dates further confirms the integrity of the stratified context of Layer 4 (See Table 4.4 and Figure 4.6 and 4.17).

This layer is interpreted as the accretion of multiple overlapping residential occupations. The gradual deposition of domestic debris related to the continuous human occupation resulted over time in the formation of a dome-shaped occupational midden that was used as a platform for residential purposes. The very slow accretional rate of the mound and the lack of filling episodes support the idea that this layer corresponds to a residential area that slowly grew through the accumulation of debris and hearth rubble. The Preceramic Mound component occupational midden containing the analyzed phytolith samples present no evidence of animal tunnels or burrowing, as evidenced by the absence of differential soil texture or color.

### **TBN Trench Transect**

A very different and interesting pattern appears when comparing the archaeological sediments from Mound Gamma to the central part of the TBN trench. As summarized above, Mound Gamma archaeological sediments are characterized by: (a) a predominance of Pooideae phytoliths (29.9 to 63.7%); (b) low frequency of panicoid phytoliths (6.8 to 21%), and in particular, very low frequency of crosses, in particular, Variant 1 large crosses; and (c) the presence of wavy-top and ruffled-top rondels diagnostic of maize cob. Collectively, these characteristics indicate that maize leaf did not contribute significantly to the phytolith content of the archaeological samples. However, the presence of maize cob phytoliths in both the archaeological sediments and tool residues indicates that Mound Gamma was an area where preparation and consumption of maize was carried out.

In contrast, the central TBN phytolith assemblages from the CMC contexts (levels 165-200 cm depth) are characterized by: (a) a higher frequency of panicoid morphotypes (26.3 to 37.4%) including bilobates and crosses; (b) lower frequency of Pooideae morphotypes (Table 6.5, Figure 6.7); and (c) more importantly, a maize leaf signature indicated by the application of Piperno and Pearsall (Piperno 1984, 1988; Pearsall 2000) multivariate Fisher's linear discriminant function (Table 6.6). Figure 6.8a-c illustrates Large Variant 1 cross-shape phytolith; Figure 6.8 d-f displays examples of Variant 5/6 and Variant 3.

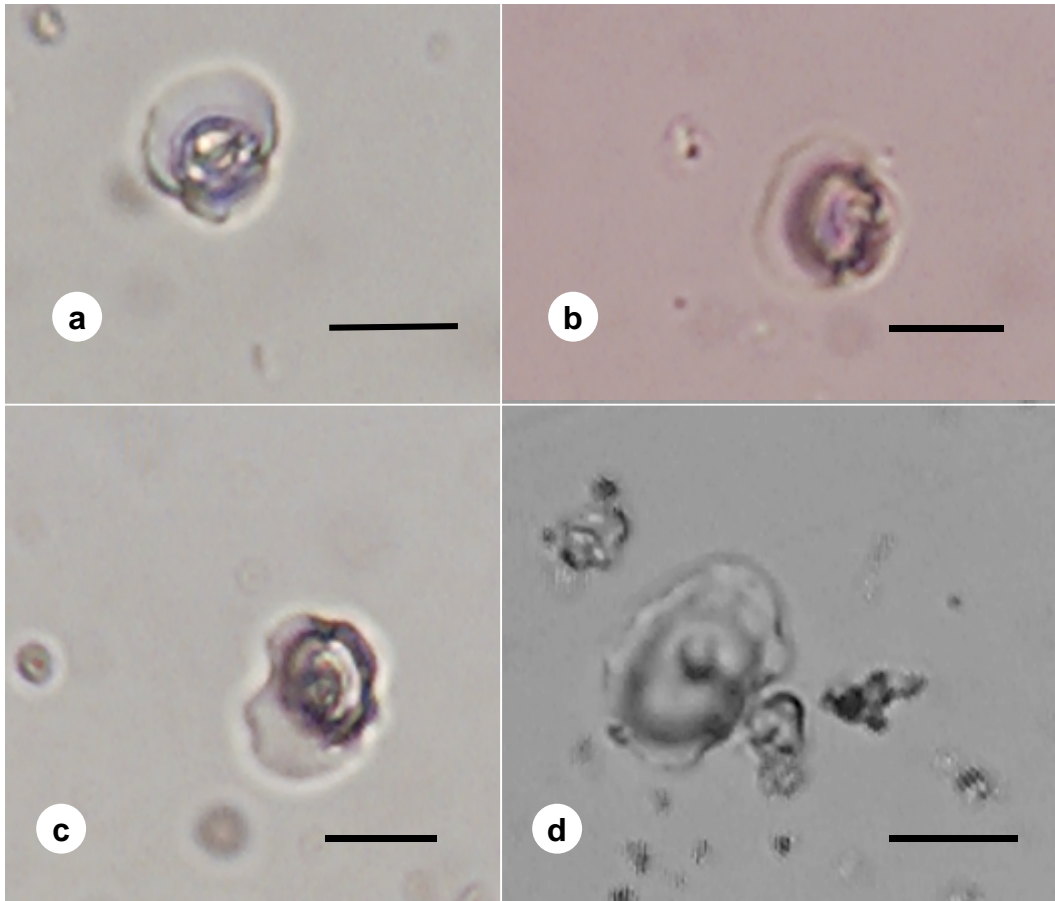


Figure 6.6. a. b. c: maize cob wavy top rondels: a: Mound Gamma, 200- 205 cm depth, sector 4/B; b: Mound Gamma, 190-195 cm depth, sector 4/B; c: Mound Gamma 155-160 cm depth, sector 5/B; d ruffle-top rondel: Tool 6 (Mound Gamma, 155-160 cm depth, sector 3/E). Scale bar=10um.

The phytolith assemblage from the only APP level analyzed is characterized by a minimum contribution of Panicoid and Chloridoid morphotypes and a major representation of Pooideae morphotypes. In addition, neither maize nor *Cucurbita* phytoliths were recovered from this Pre-Mound Preceramic Archaic component.

As mentioned before, the production of diagnostic phytoliths from multiple parts of the maize plant in combination with the common decay-in-place depositional nature of phytoliths, provides researchers with the potential to identify different activity areas in archaeological contexts, such as gardens and household consumption areas. The different patterns recovered from Mound Gamma and the TBN trench phytoliths assemblages indicates that the TBN was an area where maize was possibly planted and/or husked. The rich, fertile, organic soil of the TBN domestic refuse provided an ideal context serving as compost soil to grow corn and squash. The combination of the silty loam texture with the high content of midden nutrients (see detailed description in Appendix 7) make these disturbed areas around settlements an especially attractive setting to plant and experiment with these new cultigens. In particular, during the early PMC, before the inner precinct acquired its strong public ritual character and possibly later, these midden areas may have served as house gardens, constituting experimental plots, in which these newly adopted plants were grown and evaluated for their use. Although the subtropical wetlands of southeastern Uruguay are a different environment from the Amazonian neotropical forest, we can have a glimpse of how these house gardens from early Preceramic Mound Component worked by looking at the modern Amazonian house gardens described by Lathrap (1977), where he envisioned the domestication of many lowland crops. Similar practices have been observed in the Upper Xingu (Heckenberger 1996) where middens are frequently used for planting a variety of plants, but mainly maize, due to the high fertility of midden soils.



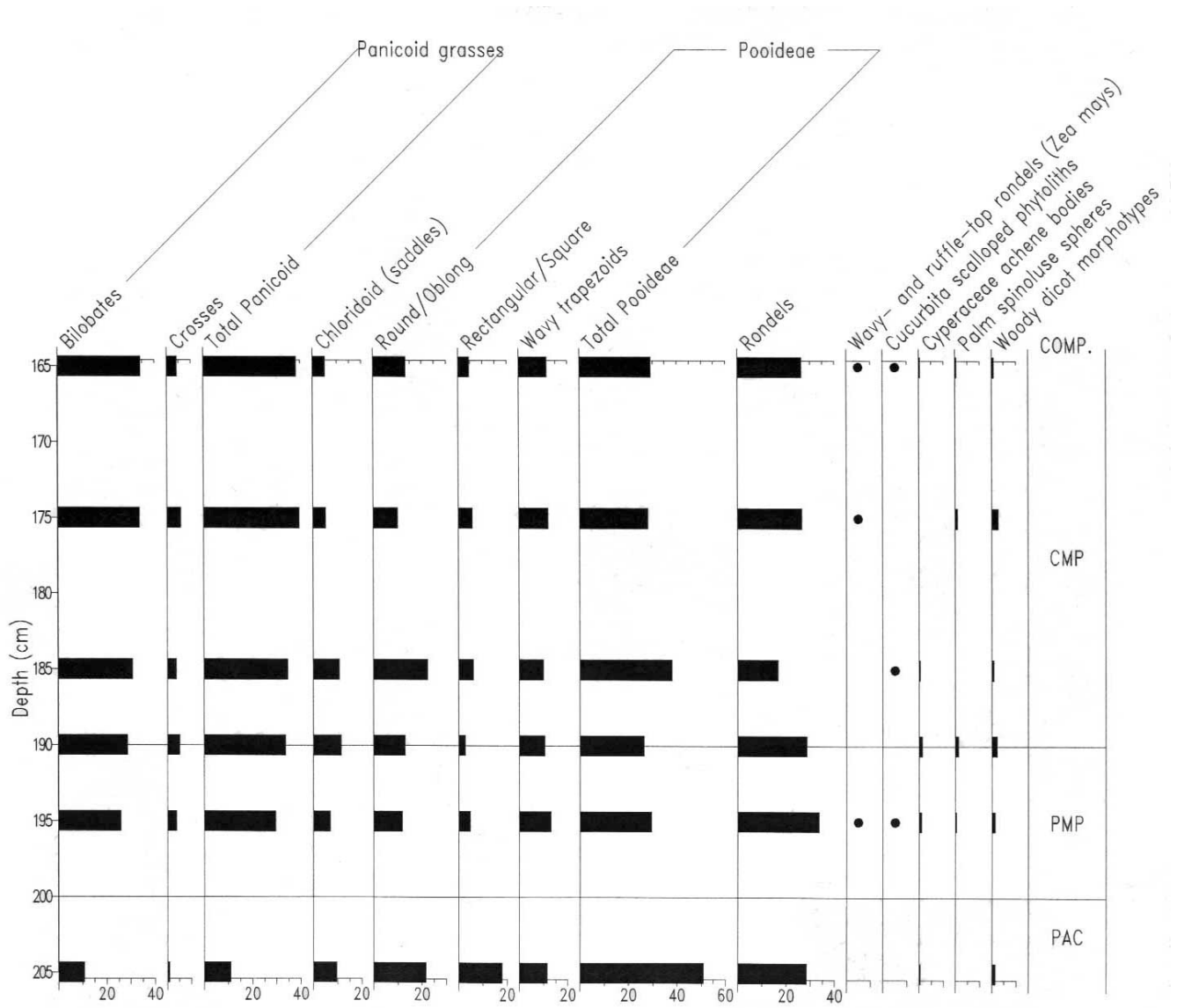


Figure 6.7. TBN phytolith diagram

Table 6.6. Detailed Count and Percentages of Central TBN Archaeological Sediments

Morphotypes	Level (cm)	205-210		190-195		185-190		180-185		170-175		160-165	
	Sample No.	26	25	24	23	22	21						
Bilobates		23	10.6%	55	25.7%	62	28.6%	65	30.8%	70	33.8%	74	34.3%
Crosses		2	0.9%	8	3.7%	11	5.1%	8	3.8%	12	5.8%	9	4.2%
Total Panicoid		24	11.0%	63	29.4%	73	33.6%	73	34.6%	82	39.6%	83	38.4%
Chloroid		21	9.6%	15	7.0%	25	11.5%	23	10.9%	11	5.3%	11	5.1%
Round/Oblong		47	21.6%	25	11.7%	28	12.9%	47	22.3%	21	10.1%	29	13.4%
Rectangular/Square		39	17.9%	10	4.7%	6	2.8%	13	6.2%	12	5.8%	10	4.6%
Wavy trapezoids		25	11.5%	28	13.1%	23	10.6%	21	10.0%	25	12.1%	25	11.6%
Total Pooid		111	50.9%	63	29.4%	57	26.3%	80	37.9%	58	28.0%	63	29.2%
Rondels		62	28.4%	72	33.6%	62	28.6%	35	16.6%	55	26.6%	57	26.4%
Wavy- and ruffle-top rondels		0	0.0%	1	0.5%	0	0.0%	0	0.0%	1	0.5%	2	0.9%
Short-cell count		218		214		217		211		207		216	
Cucurbita scalloped phytoliths		0	0.0%	1	0.5%	0	0.0%	3	1.4%	0	0.0%	1	0.5%
Sedge achene bodies		1	0.5%	2	0.9%	3	1.3%	1	0.5%	0	0.0%	1	0.5%
Palm spinulose spheres		0	0.0%	1	0.5%	3	1.3%	0	0.0%	2	0.9%	1	0.5%
Woody dicot phytoliths		3	1.4%	3	1.4%	5	2.2%	2	0.9%	6	2.8%	2	0.9%
<b>Total phytolith count</b>		<b>222</b>		<b>221</b>		<b>228</b>		<b>217</b>		<b>215</b>		<b>221</b>	

Table 6.7. TBN Trench Cross-Shape Phytoliths Discriminant Function Data

Level (Sample)	X Var 1	X Var 5/6	% Var 1	N	df Pipersall (2000) <sup>2</sup>		
					Maize	Wild	
160-165 (20)	13.5	11	61	44	13.35	34.51	33.44
170-175 (21)	13.3	10.9	70	33	13.37	35.55	34.08
180-185 (22)	13.4	10.6	65	35	13.31	34.70	33.56
190-195 (23)	13.5	10.7	52	25	13.13	32.42	31.97

1.  $df = 0.8082 (X \text{ size Var } 1) + 0.1025 (X \text{ size Var } 6) - 0.0215 (\% \text{ Var } 1)$ .

2. Maize prediction =  $3.96459(\text{Mean Var } 1) + 0.63790 (\text{Mean Var } 5/6) + 21.06987(\% \text{ Var } 1) - 38.88593$

Wild grass prediction =  $3.39275(\text{Mean Var } 1) + 0.35512 (\text{Mean Var } 5/6) + 15.09343 (\% \text{ Var } 1) - 25.47899$

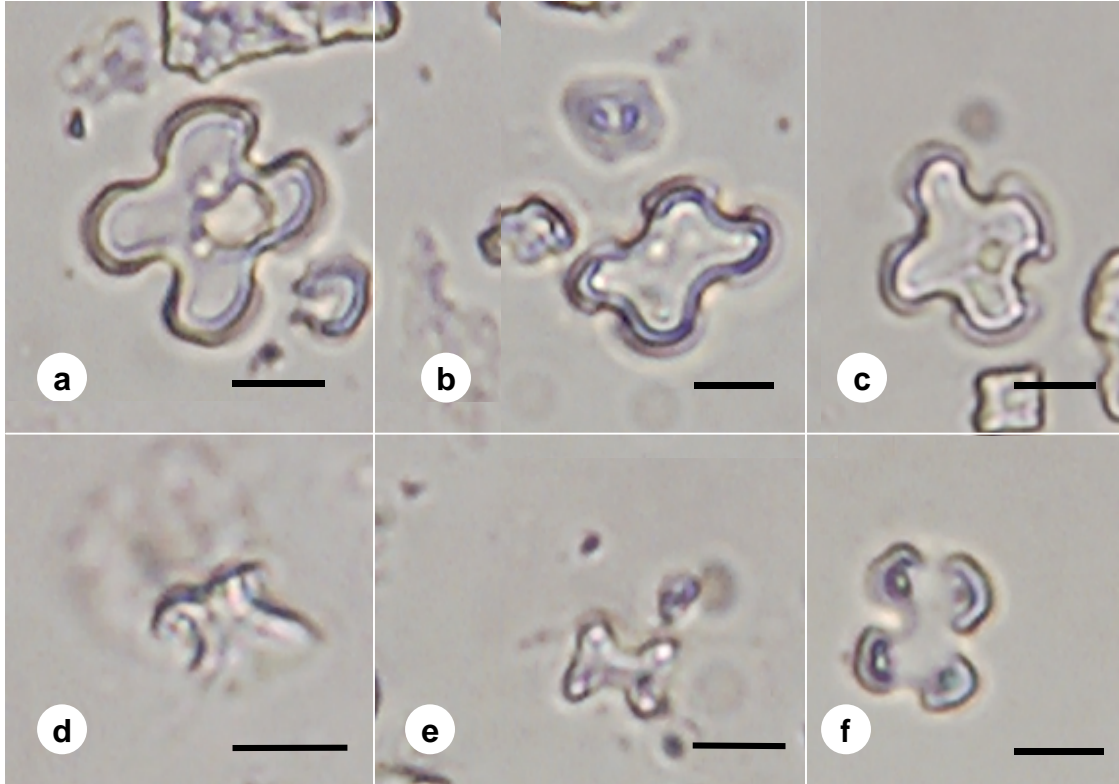


Figure 6.8. Maize leaf cross-shaped phytoliths. a, b, and c: Large Variant 1 cross-shaped phytoliths; c and d: Variant 5&6 cross-shaped phytoliths; f: Variant 3 cross-shaped phytolith. Scale bar=10 µm.

In sum, the archaeological sediments from Los Ajos represent a combination of background phytoliths making up the site's vegetation, and phytoliths from wild and domestic plants brought to the site and planted in particular sectors of it. The data from the archaeological sediments indicate that maize is present in the earlier contexts of the PMC in Mound Gamma (255-260 cm depth) dating shortly after 4,190 bp. In addition, the maize leaf signature in the TBN sediments suggest that maize was planted and/or husked in this midden refuse area.

In addition to maize, the consumption of domestic *Cucurbita* is indicated by the presence of scalloped spherical phytoliths from the earliest PMC contexts in Mound Gamma. *Cucurbita* is present throughout the CMC contexts of both Mound Gamma and the TBN trench. Spinulose spheres, which are present throughout the entire archaeological Mound Gamma sequence indicate the exploitation of palm nuts. Further studies are needed to determine to what extent palms were cultivated or encouraged, and if they naturally occurred in the area.

### **Phytolith and Starch Grains Analyses from Plant Processing Tools**

This section describes the plant grinding processing tools recovered at Los Ajos site and presents the results of the phytolith and starch grain residue analyses from these tools. 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 STRI in Panama. Appendix 5 presents the detailed methodology and results of plant grinding tools' starch grains residue analysis.

#### **Plant-Processing Tools**

Six potential plant processing tools were set apart during excavation for starch grain and phytolith residue analyses. After the separation of the attached sediment by gentle sonication, only four of them showed clear polished surfaces. However, as a control test, all samples were subjected to residue extraction (Appendix 5). For the extraction of residue the methodology described in Piperno et al. (2000a) was employed (Appendix 5). Here follows a morphological description of the plant grinding tools and their recovery context. Their stratigraphic positions in

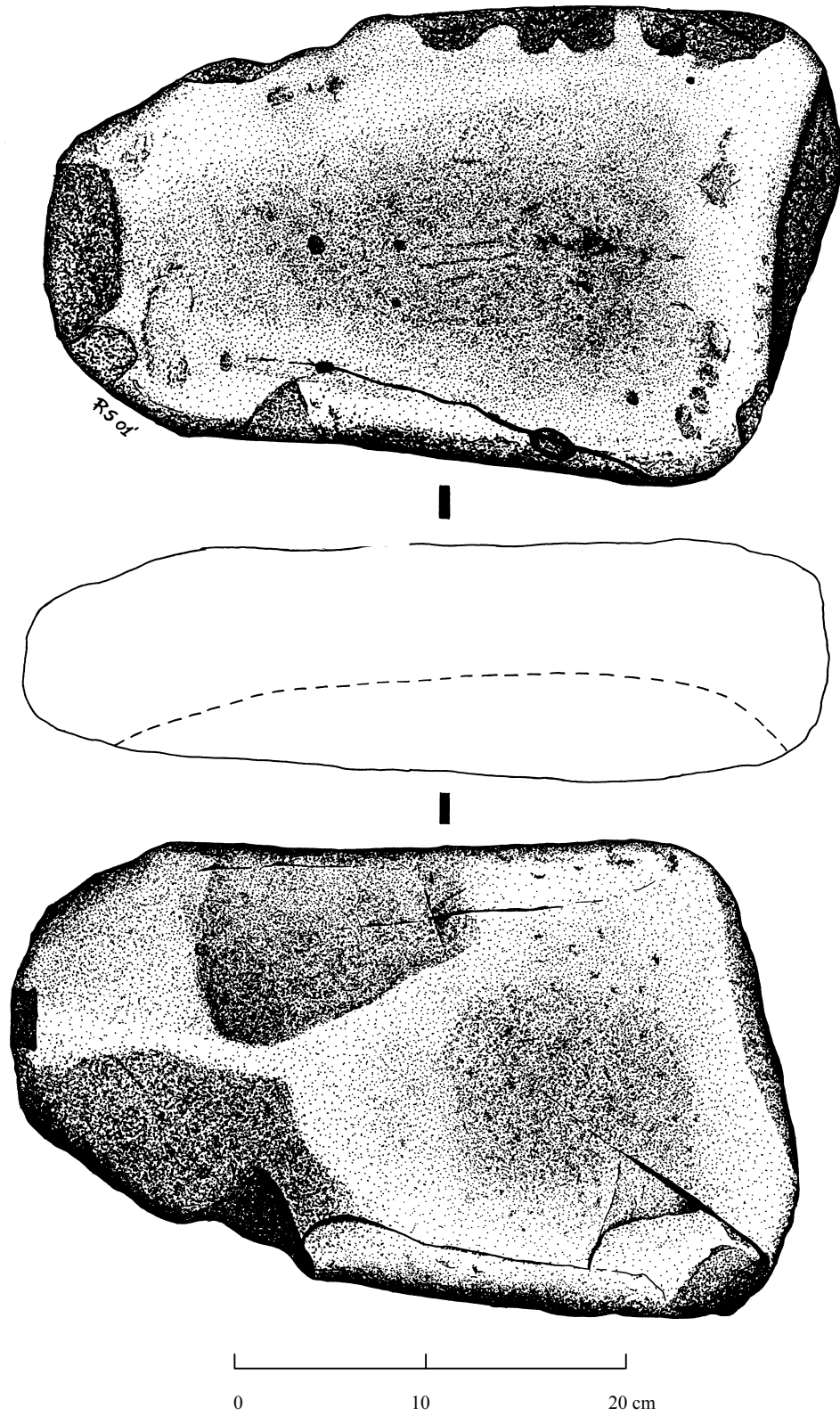


Figure 6.9. Tool 6. Milling stone base from Mound Gamma 150-155 cm, 3/E.

Mound Gamma and the TBN trench are illustrated in the backplot diagram in Figure 4.23 and in Figure 4.16 respectively.

A milling stone base and a fragment of a milling stone base were excavated from Mound Gamma. Milling stones consist of large boulders with one or two flat surfaces, and they usually have a slight concavity. One milling stone base was recovered from Mound Gamma 150-155 cm depth, sector 3/E (Tool 6, Figure 6.9). This specimen is rectangular in shape, rectangular in cross-section, its dimensions are 20 x 12 x 6.2 cm (length x width x thickness), and it has shallow depressions on both faces. On one of the faces, the depression is circular, 8 cm in diameter, and 1 cm deep. On the other face, the depression is oval, tapering towards one end, 13 cm long, and 0.8 cm deep. The depressions are ground smooth and demonstrate slight pecking. The remainder of the face is ground smooth. The face with the larger depression was turned down and placed on top of a “hearth”. This tool was located well away from burials and other disturbances. Tiny flecks of charcoal were observed in the binocular lupe. They were collected and sent for an AMS radiocarbon date. The tiny amount of charcoal was not sufficient to obtain a date, however.

The milling stone base fragment of grainy rhyolite was excavated from level 175-180 cm depth, sector 4/C (Tool 1, Figure 6.10). This specimen is fairly rectangular in shape. The fragment dimensions are 9.1x7.2x4.1 (length x width x thickness). Only one face has a ground smooth depression, which is approximately 0.3 cm deep.

These two milling stone bases pertain to the Ceramic Mound Component of Mound Gamma. It must be noted that Bracco (1993) also recovered a milling stone base of 30 x 25 x 7 cm. This specimen has only one face with a shallow, polished depression. The active face of this milling stone base was turned down on a hearth in the lower levels of the PMC, from which three radiocarbon essays were run dating between ca. 3,750 and 3,950 bp. Additionally from the lower PMC levels of Excavation I in the Estancia Mal Abrigo site, another milling stone base was recovered. Like the other two milling stone bases recovered from site Los Ajos, the face bearing the larger, more pronounced depression was turned down on the ground. The fact that the active face of these plant-grinding tools is turned down suggests that these tools were probably cached

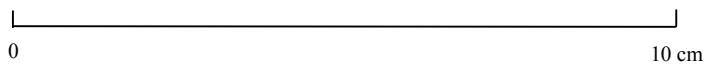


Figure 6.10. Tool 1. Milling stone base fragment from Mound Gamma 175-180 cm, 4/C.



at the site upon abandonment. This represents an exceptionally good context, which eliminates any possibility of contamination of the plant-grinding tools from above.

In addition to the milling stone bases, two manos were recovered during excavation. Manos are made of cobbles pecked and flaked into a cylindrical form. They present one to four smooth and regular working facets, which are the result of the back and forth grinding action against milling stone bases. Manos were presumably used in a circular grinding motion and/or in pounding along with milling stone bases.

One mano was recovered from the PMC level of Mound Gamma at 210-215 cm depth, sector 4/C (Tool 3, Figure 6.11). A radiocarbon date of 3,460 ± 100 bp was obtained from the middle-upper part of the Preceramic Mound component five cm below this tool. Tool 3 is made of grainy rhyolite, its dimensions are 8.1 x 7.1 x 2.8 cm., is subspherical in shape, elliptical in cross section, and like the other specimen presents two opposite working facets that are flattened. Its dimensions are 6 x 5 cm and 5 x 5.5 cm.

The other mano was recovered from the TBN trench at level 180-185 cm depth, sector 10 (Tool 2, Figure 6.12). It is also made of rhyolite, its dimensions are 9 x 8.5 x 4.5 cm., is subspherical in shape, rectangular in cross section, and presents two opposite circular working facets that are flattened of 6 x 5 cm. and 6 x 6 cm. This tool pertains to the CMC of the TBN trench transect.

In addition to the plant grinding tools recovered during excavation, Dr. Gustavo Uriarte surface collected more than a dozen of mortars, milling stone bases, flat grinding slabs, mortars, and nutting stones from Laguna de los Ajos, whose bottom is exposed during exceptional droughts.

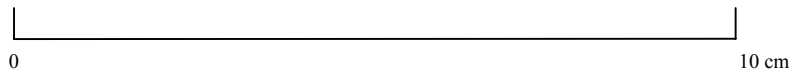
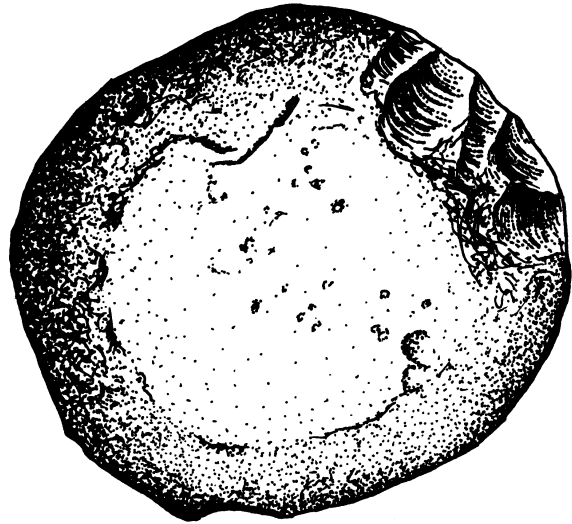
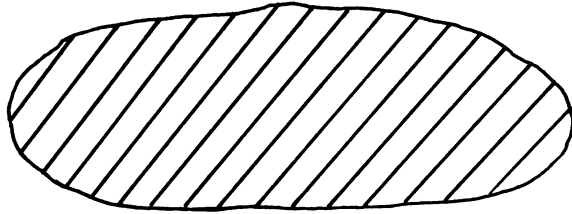
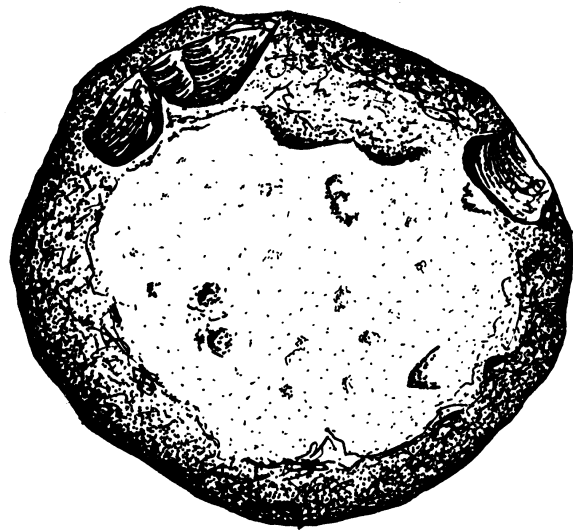


Figure 6.11. Tool 3. Mano from Mound Gamma 210-215 cm, 4/C.

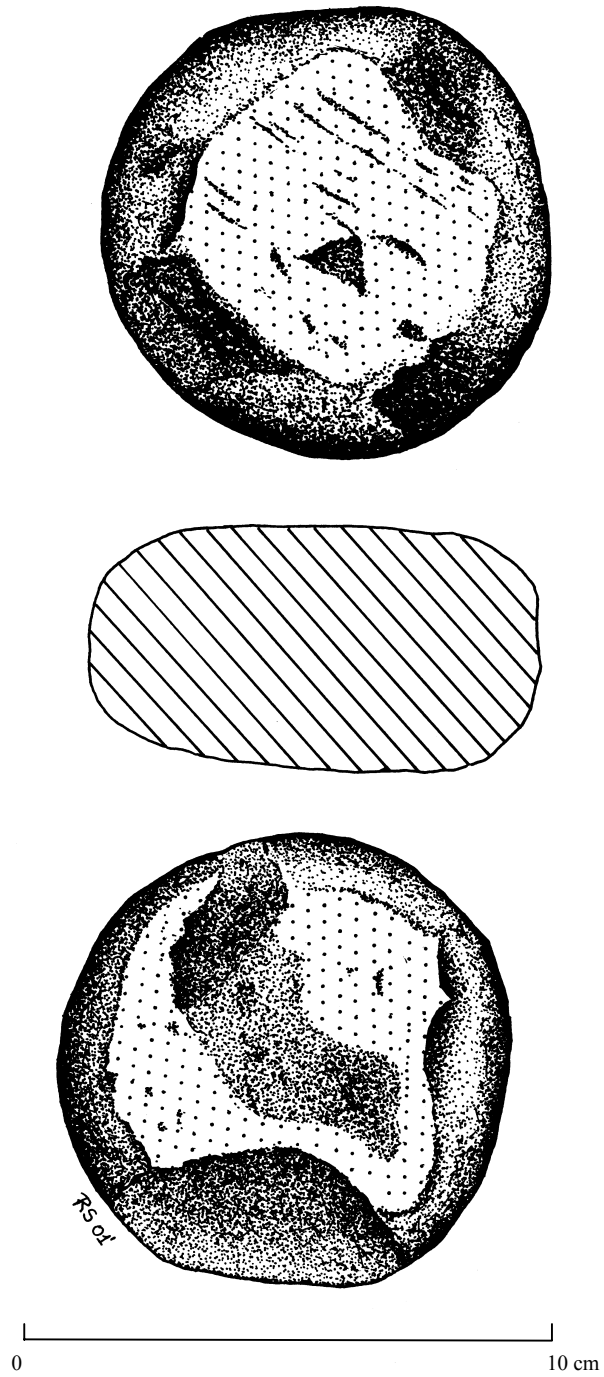


Figure 6.12. Tool 2 . Mano from TBN 180-185-10.

## **Starch Grain and Phytolith Residue Analyses**

The detailed methodology and results of the starch grain analysis is presented in Appendix 5. Here, I present a summary of the results. In the first place, it is interesting to note that two unwashed tools considered potential manos in the field, but which once washed by gentle sonication in the lab did not conform to grinding stones and did not display any polished surfaces. However, they were processed as a control test against the tools that do present polished and ground surfaces. These artifacts did not have starch grains or phytoliths from domestic plants (Appendix 5).

### **Starch Residue Analysis**

All the artifacts described above, with the exception of Tool 2 have starch grains of maize. This determination was made on the basis of size range and morphology of multiple starch grains. Tool 2 had a phytolith that is consistent with those found in *Zea glumes*. Figure 6.13 displays some representative maize starch grains identified in the residue extracted from Tools 3 and 6. Figure 6.1 illustrates some representative starch grains recovered from three other sites in the region mentioned above (Iriarte et al. 2001). One starch grain of Fabaceae and one from Cannaceae were also identified in Tool 6. The small number of the sample of grain prevents us from making a more conclusive statement about the presence of these families in Los Ajos plant assemblage.

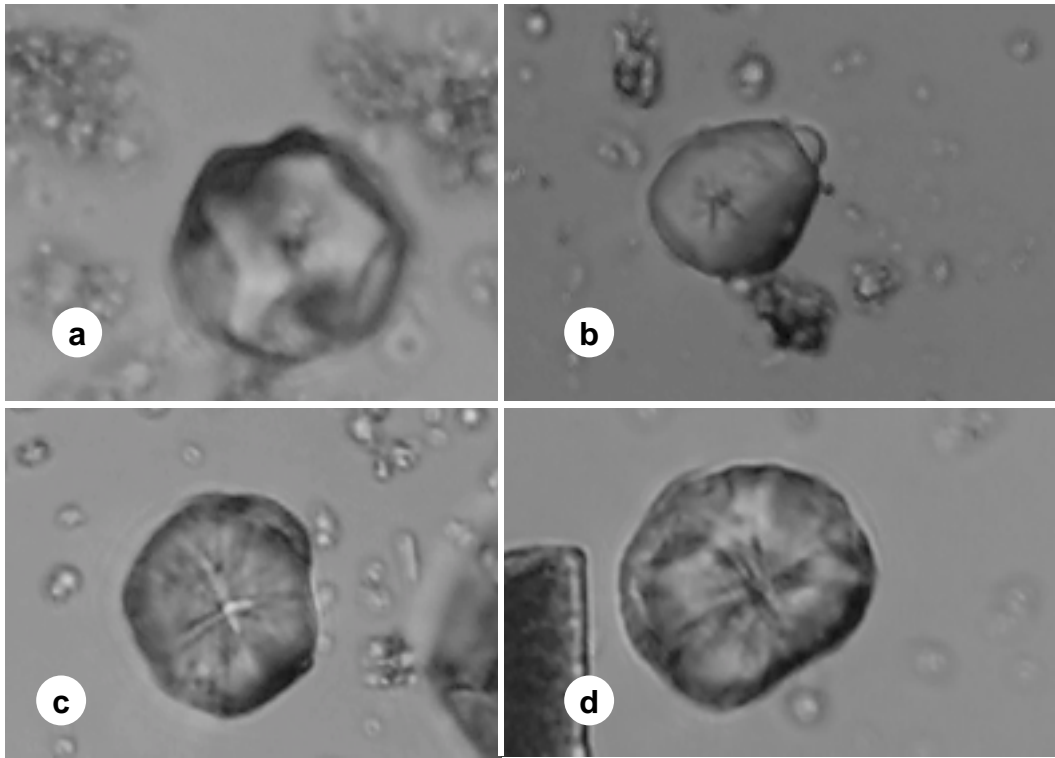


Figure 6.13. Maize starch grains from plant-processing tool residues: a: Tool 3; b, c, and d: Tool 6.

### **Phytolith Residue Analysis**

The results of the phytolith analysis of tool residues are presented in detail in Table 6.8. The presence of both maize starch grains described above and wavy and ruffle-top rondels indicate that tools 1, 2, 3 and 6 were involved in the preparation and consumption of maize at the site. When comparing the phytolith assemblage recovered from tool residue to the phytolith assemblage of the archaeological sediment and non-tools, the following patterns emerge. The tool residue phytolith assemblage from these tools (1, 2, 3, and 6) is distinctive and presents: (a) a large number of wavy and ruffle-top maize rondels (see Table 6.8), (b) a large number of rondels (38.5 to 55%), and (c) a lower number of Pooideae (10.7-14.7%) and Chloridoid phytoliths (1.4 to 3.7%). This phytolith assemblage is well in accordance with what we should expect from a maize cob assemblage, which are dominated by rondels and in minor proportions by bilobates and crosses (Mulholland 1993; Piperno and Pearsall 1993; Pearsall et al. 2003). The small amount of Pooideae, Chloridoid, spinoluse spheres, and woody dicot morphotypes recovered in these samples should be considered intrusive.

In sum, the combination of phytolith and starch grain residue analyses from the plant grinding tools indicates that Tools 1, 2, 3 and 6 were used to prepare maize at the site. This evidence complements and reinforces the analysis from the archaeological sediments at the site.

Table 6.8. Detailed Phytolith Frequencies and Percentages from Tools

Tools	1		2		3		4		5		6	
Morphotypes												
Bilobates	15	13.9%	22	18.6%	16	15.1%	9	8.7%	15	14.3%	12	11.3%
Crosses	1	0.9%	0	0.0%	1	0.9%	0	0.0%	0	0.0%	3	2.8%
Total Panicoid	16	14.8%	22	18.6%	17	16.0%	13	12.5%	15	14.3%	15	14.2%
Chloroid (saddles)	2	1.9%	2	1.7%	3	2.8%	12	11.5%	5	5.0%	4	3.8%
Round/Oblong	3	2.8%	9	7.6%	9	8.5%	12	11.5%	10	9.5%	15	14.2%
Rectangular/Square	5	4.6%	6	5.1%	6	5.7%	21	20.2%	6	5.7%	12	11.3%
Wavy trapezoids	7	6.5%	6	5.1%	7	6.6%	17	16.3%	15	14.3%	6	5.7%
Total Pooid	15	13.9%	21	17.8%	22	20.8%	50	48.1%	31	29.5%	33	31.1%
Rondels	67	62.0%	69	58.5%	57	53.8%	28	26.9%	51	48.6%	47	44.3%
Wavy-and ruffle-top rondels	6	5.6%	4	3.4%	7	6.6%	0	0.0%	0	0.0%	6	5.7%
Palm spinulose spheres	1	0.9%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	1	0.9%
Woody dicots phytoliths (spherical smooth and other spherical)	1	0.9%	0	0.0%	0	0.0%	0	0.0%	3	2.9%	0	0.0%
Total	108		118		106		104		105		106	

## Summary of Phytolith and Starch Grain Data

The results of phytolith and starch grain analyses highlight the importance of undertaking micro-fossil archaeo-botanical studies in this region, particularly characterized by the poor preservation of macro-botanical remains. This study stresses the role of micro-fossil botanical remains as a complementary and alternative data set to the study of macro-botanical remains. A multi-proxy micro-fossil plant analysis that combines both phytolith and starch grains is particularly appropriate for the plant families that do not produce diagnostic phytoliths, for example, different species of tubers and root crops, but which in turn, produce distinctive starch grains (e.g., Iriarte et al. 2001; Perry 2000; Piperno and Holst 1998; Piperno et al. 2000). This type of multi-proxy studies constitutes a crucial approach to help researchers obtain finer-grained interpretations and more reliable reconstructions of the diet of prehistoric groups.

Overall, the phytolith and starch grain analyses carried out to date indicate that the early Formative societies of southeastern Uruguay practiced a mixed economy, including a variety of seeds, roots, vegetables, and palm plants. More significantly, cultigens do not occur alone, but appeared as part of a crop assemblage. The Los Ajos' site phytolith and starch grain data put into question previous models that characterize the early Formative societies as complex hunter-gatherers and contribute significantly to the ongoing debate about the timing and nature of plant adoption in southern South America. Like in other regions of South America, it is becoming increasingly apparent that the use of domesticated plants was a more important aspect of subsistence, long before previously recognized temporal and cultural placements suggest (Piperno and Pearsall 1998a). The analysis undertaken in this study marks the earliest occurrence of at least two cultivated plants in southeastern South America, namely, maize, squash, and beans. What follows is a brief summary of the main results of this study.

Maize cob phytoliths and starch grains were recovered from plant grinding tools' residue and selected archaeological sediments, corresponding to an undisturbed occupational midden. The earliest context for the appearance of maize is located in the lowermost sector of the Preceramic Mound component in Gamma Mound at 255-260 cm deep; 15 cm above the earliest date for this component dated ca. 4,190 bp. A maize leaf signature also was recorded for the first level of the midden refuse in the TBN crescent-shaped rise, where the basal levels date to around



1,660 bp. At other sites in the region, for example, Isla Larga, maize starch was recovered from unmixed contexts dating to 3,600 bp. (Cabrera et al. 2000; Iriarte et al. 2001).

Few and large spherical scalloped phytoliths diagnostic of domestic (*Cucurbita* spp.) were recovered from the lower part of the Preceramic Mound Component at Mound Gamma, at 255 cm deep; 15 cm above the earliest dated context of the PMC approximately 4,190 bp. Beans (*Phaseolus* spp.) were not recovered from the Los Ajos site. However, previous preliminary studies documented the presence of beans at the Isla Larga site, in contexts dating to ca. 3,050 bp, and at the Los Indios site around 1,170 bp (Iriarte et al. 2001) (see Figure 1.2 and 6.1b). As cautioned in the phytolith and starch sections of this chapter, the positive identification of *Phaseolus* is awaiting the analysis and comparison with the wild *Phaseolus* species that exist in the region.

As has already been reviewed in chapter 3, the important role that wild tubers and root crop agriculture play in tropical and seasonally humid environments has been stressed by several investigators (Bronson 1966; Lathrap 1970; Sauer 1952). Thanks to new recovery techniques, notably, starch grains analysis, hypotheses about the role tubers and root crop agriculture may have played in the economy of these groups can now be tested (e.g., Perry 2000, 2002; Piperno and Holst 1998; Piperno et al. 2000). The tuber plants Achira (*Canna* spp.) and arrowroot (*Calathea* spp.) were not recovered at the Los Ajos site, but were documented previously at the Isla Larga site from contexts dated between ca. 3,050 and 1,190 bp. More analysis, in particular, comparisons of starch grains' size and morphology between wild and domestic species is required to determine if the *Canna* and *Calathea* starch grains present in the sediments represent domesticated or wild plants. It must be noted that the leaf of the *Cannaceae* produces diagnostic spherical phytoliths, which have not been identified in the archaeological samples yet. This indicates that only the starchy rhizomes, possibly collected in nearby wetland habitats, were brought to the site for consumption.

This new information further corroborates the importance tubers played in the economy of early Formative groups. As discussed before, root crops not only constitute an important source of carbohydrates, proteins, and minerals, but are easy to procure, particularly, at wetlands, which provide an abundant and year-round supply of below-ground tubers and rhizomes. *Canna* spp. and *Calathea* spp. are excellent starch producers that require minimal processing. They

could be simply roasted in hearths or consumed without being processed (Schmeda-Hirschmann 1994).

Last but not least, the exploitation of palms, whether cultivated, encouraged or wild is evidenced by the presence of abundant palm spinulose' spheres in the basal Preceramic Mound Components at Los Ajos, Isla Larga, and Estancia Mal Abrigo (Iriarte et al. 2001). The implications of these data sets are manifold and will be considered in the concluding section of this chapter.

## **Faunal Analysis at the Los Ajos Site**

### **Introduction and Methodology**

This section offers a basic faunal analysis of the bone assemblage recovered from Mound Gamma at Los Ajos. Of all the excavated mound and off-mound units at the site, faunal remains only were recovered from Mound Gamma's block excavation. This excavation unit yielded a small, fragmentary, yet diverse and informative collection of vertebrate fauna (N=815). No bones were recovered from Layers 2 and 3 corresponding to the Preceramic Archaic component of Mound Gamma. Bone preservation was relatively good in the Preceramic Mound Component of Mound Gamma, which comprises the vast majority of the total faunal assemblage representing 76.3% (N=622). The remaining 23.7 % (N=193) was recovered from the Ceramic Mound Phase. There are two natural factors that appear to account for the better preservation of bones in the PMC: (a) the fine-grained silty loamy sediments of the PMC are less abrasive than the coarse gravelly layers present in the CMC and (b) the fine-grained ashy sediments of the PMC create a more alkaline environment, which promotes superior bone preservation (Gordon and Buikstra 1981; Woods 1982).

The faunal collection was analyzed in its entirety. The materials described in this section were identified by Lic. Andres Rinderknech from the School of Sciences, State University of Uruguay (Facultad de Ciencias, Universidad de la República) and the Museum of Natural History (Museo de Historia Natural) Montevideo, Uruguay. Bone fragments were identified by comparing against specimens curated at both the Museum of Natural History and the National Museum of Anthropology as well as Andrés Rinderknech's personal reference collection.

When bone material was fragmentary and the surviving morphological characteristics of bone fragments were unclear, some specimens were identified to species or genus level, others could only be identified to family level and others only could be placed in a general unidentified category.

Bones were recovered *in situ*, in the 5 mm dry screen and in the 0.5 mm heavy fraction screen of the flotation machine. A total of 815 bone specimens were recovered from all the excavation contexts. The quantitative technique known as the Number of Identified Specimens (NISP) was used to summarize the data for this analysis. Table compilations and contextual analysis were completed by the author.

### **Results of the Analysis: Contributions of Major Taxonomic Groups by NISP**

As has been discussed in detail in Chapter 4, wetlands are now recognized as one of the most environmentally diverse habitats of the earth, supporting a great diversity of flora and fauna (Williams 1989; Janetski and Madsen 1990; Nicholas 1998). In this regard, the southern sector of the Laguna Merin basin displays a variety of plant communities, including wetlands, wet prairies, upland prairies, halophytic, riparian and palm forests' vegetation formations; capable of supporting diverse populations of animal and plant species both in the past and in the present. The animal profile obtained from Los Ajos' faunal remains reveals the existence of a wide range of species.

The total assemblage of identified taxa recovered at Mound Gamma along with information collected on the habitat, behavior and weight of the different species is offered in Table 6.9. The total vertebrae faunal inventory recovered at Mound Gamma is summarized in Table 6.10 and illustrated in the diagram presented in Figure f4. Given that the general patterns of the faunal assemblage hold in broad terms for both Mound Gamma components, the faunal assemblage information is presented as a whole. Considering the entire faunal assemblage of Mound Gamma in terms of NISP, the taxonomic group that is best represented is mammals (88.5%) (Figure 6.15a). Figure 6.15b presents the percentages of identified plus unidentified mammal bones in terms of animal size. Large mammals correspond to different species, namely, deer (*Ozoteros bezoarticus*, *Mazama guazubira*), fox (Carnivora), and capybara (*Hydrochaeris*

Table 6.9. Identified Taxa from all Vontexts of Mound Gamma

Scientific Name	Common name	Habitat	Behavior	Weight (Kg)
<b>Mammals</b>				
Rodents				
<i>Cavia</i> sp.	"Aperea"	wet-praire-grassland ecotone	Gr.	0.75
<i>Cricetidae</i>	"Raton de campo"/ Mouse	grassland		
<i>Holochilus brasiliensis</i>	"Rata-nutria"/ Rat-otter	wetlands	Gr.	0.32
<i>Myocastor coypus</i>	"Nutria"/ Otter	Streams, lagoons, wetlands	Shd	4.5-9
<i>Hydrochaeris hydrochaeris</i>	"Carpincho"/ Capybara	Strems, lagoons, wetlands	Gr.	25-50
Deer				
<i>Ozotoceros bezoarticus</i>	"Venado de campo"/ Pampas Deer	grassland -wetprairies	Gr.	30-40
<i>Mazama guazubira</i>	"Ciervo Guazubira"/ Guazubira Deer	grassland - forest	Sl.	17-23
Edentados				
<i>Euphractus sexinctus</i>	"Peludo" / Species of armadillo	grassland	Sl.	1.2-1.8
<i>Dasyus</i> sp.	"Mulita"/ Species of armadillo	grassland	Sl.	5
Other mammals				
<i>Didelphis albiventris</i>	"Comadreja comun"/ Common opossum	forest	Sl.	2.75
<i>Lutreolina crassicaudata</i>	"Comadreja colorada"/ Red opossum	forest	Sl.	0.2-0.8
<i>Carnivora</i>	"Zorro" / Fox		Sl.	2.5-11
<b>Reptils</b>				
<i>Tupinambis merianae</i>	"Lagarto overo" / Lizard			
<i>Chelonia</i>	Turtle	streams, lagoons		
<i>Crotalidae</i>	Poisonous snake			
<i>Colubroidea</i>	Non-poisonous snake			
<b>Fish</b>				
<i>Osteichthyes</i>	Fresh-water fish	streams, lagoons		
<b>Birds</b>				
<i>Podiceps major</i>	"Somorgujo-Maca"			
<i>Rhea americana</i>	"Nandu"	grassland		
<i>Zenaida auriculata</i>	"Torcaza comun"/ Pigeon	forest		

Gr.=gregarious; SL.: solitary

Note: The data compiled in this table was obtained from Talice (1969), López and Bracco (1992), Redford and Eisenberg (1992) and PROBIDES (2000)

Table 6.10 Detailed Frequency of Mound Gamma Bone Assemblage

Level (cm)	Rodents							Deer			Other Mammals					Unidentified mammals					
	"Aperca" ( <i>Cavia</i> sp.)	"Rata nutria" ( <i>Holochilus brasiliensis</i> )	"Raton" (Cricetidae)	"Carpincho" ( <i>Hidrochoerus hydrochaeris</i> )	"Nutria" ( <i>Myocastor coypus</i> )	Unidentified rodent	Possible rodent	<b>Subtotal Rodents</b>	Unidentified deer	"Venado de campo" ( <i>Ozotoceros bezoariticus</i> )	"Ciervo Guazubira" ( <i>Mazama gouazoubira</i> )	<b>Subtotal Deer</b>	"Comadreja overa" ( <i>Didelphis albiventris</i> )	"Comadreja colorada" ( <i>Lutreolina crassicaudata</i> )	"Mulita" ( <i>Dasyypus</i> sp.)	"Peludo" ( <i>Euphractus sexinctus</i> )	"Zorro" (Carnivora)	Unidentified mammals	Possible unidentified mammal	Mammal and possible mammals	<b>Total Mammals</b>
110							0				0									0	0
110-120						1	1				0									0	1
125-130					2		2				0									0	2
135-140							0	1		1	1							3	2	5	6
140-145				1		1	2				0							1		1	3
145-150						1	1	1	1	1	1							1		1	3
150-155							0				0								1	1	1
155-160							0				0									0	0
160-165							0				0							2		2	2
165-170					1	1	2				0			1				1	1	2	5
170-175			1			1	2	2	2	2	2							19	7	26	30
175-180					2	2	4	2	2	2	2				2			14	7	21	29
180-185	1				1	1	3	4	4	4	4									0	7
185-190	1				2	1	4	2	2	2	2			2				13	5	18	26
190-195					3	2	5	2	2	2	2			1				23	8	31	39
195-200	1				1	1	4	5	5	5	5				1			32	13	45	55
200-205			2	1	6	1	10	5	5	5	5			1				26	11	37	53
205-210	1	1	1		6		9	5	1	6	6	1						21		21	37
210-215	2				6	1	9	1	1	2	2							41	12	53	64
215-220	2				11		13	1	1	2	2							13	1	14	29
220-225	2	1	2			1	4	10	7	7	7							45	13	58	75
225-230	4				15	2	21	9	2	11	11			1	1	1		42	15	57	92
230-235	1	1			3	1	6	6	1	7	7							48	16	64	77
235-240				1	5		4	10	3	3	3							47	10	57	70
240-245					2		2	1	1	1	1									0	3
245-250					3		3				0									0	3
250-255			1			1	2				0									0	2
260-265							0				0							7		7	7
	15	2	8	3	69	11	17	125	57	4	2	63	1	2	4	4	1	399	122	521	721

**Table 6.10. Continued**

Level (cm)	Reptils			Birds			Fish	Unidentified Vertebrates						
	"Culebra" (Culobroidea)	"Yara, cruceira, or cascabel" (Crotalidae)	"Lagarto overo" ( <i>Tupinambis merrianae</i> )	Turtle (Chelonia)	Unidentified reptil	<b>Total Reptilist</b>	"Nandu" ( <i>Rhea Americana</i> )	"Maca" ( <i>Podiceps major</i> )	"Torcaza" ( <i>Zenaida auriculata</i> )	<b>Total Birds</b>	<b>Fish</b>	Unidentified vertebrates	Possible vertebrate	Total per level
110		1				1								1
110-120						0								1
125-130						0					1			3
135-140						0							1	7
140-145						0								3
145-150		1				1								4
150-155						0								1
155-160				1		1								1
160-165						0								3
165-170						0								5
170-175		3	1			4	2		2			4		40
175-180						0	2	1	3		1	7		40
180-185						0	1		1		1			9
185-190						0						3		29
190-195	1			1		2					1	2	2	46
195-200						0						5	1	61
200-205				1		1					1	4		59
205-210				2	1	3					1			41
210-215		1				1					2	4		71
215-220				2		2						1	1	33
220-225						0					2	4		81
225-230				2		2					2	1		97
230-235				1		1						6		84
235-240	1	1				2					2	2	1	77
240-245		1				1								4
245-250						0		1	1					4
250-255						0								2
260-265	0					0					1			8
	1	2	7	10	2	22	5	1	1	7	15	43	6	815

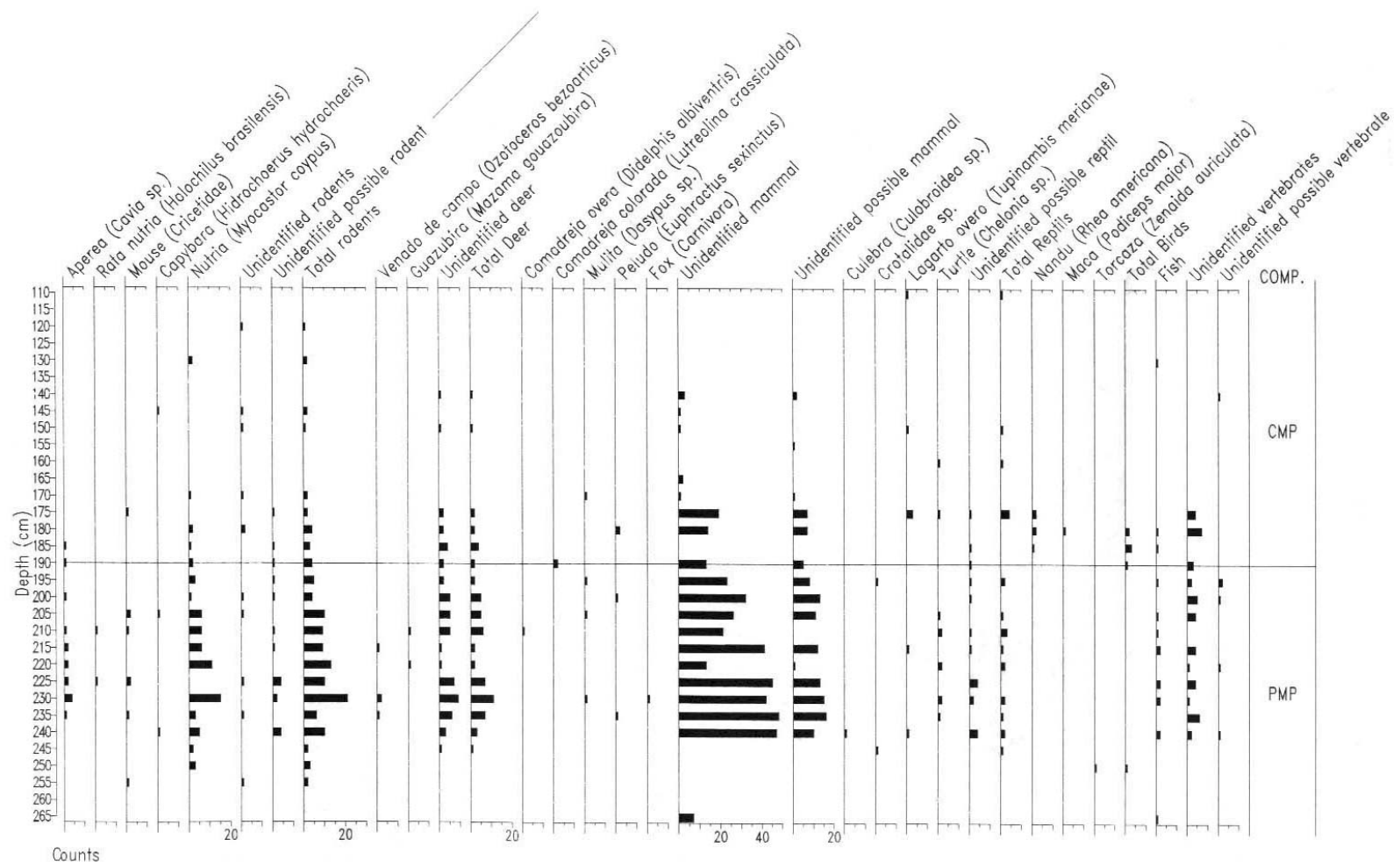


Figure 6.14. Frequency diagram of Mound Gamma Bone Assemblage

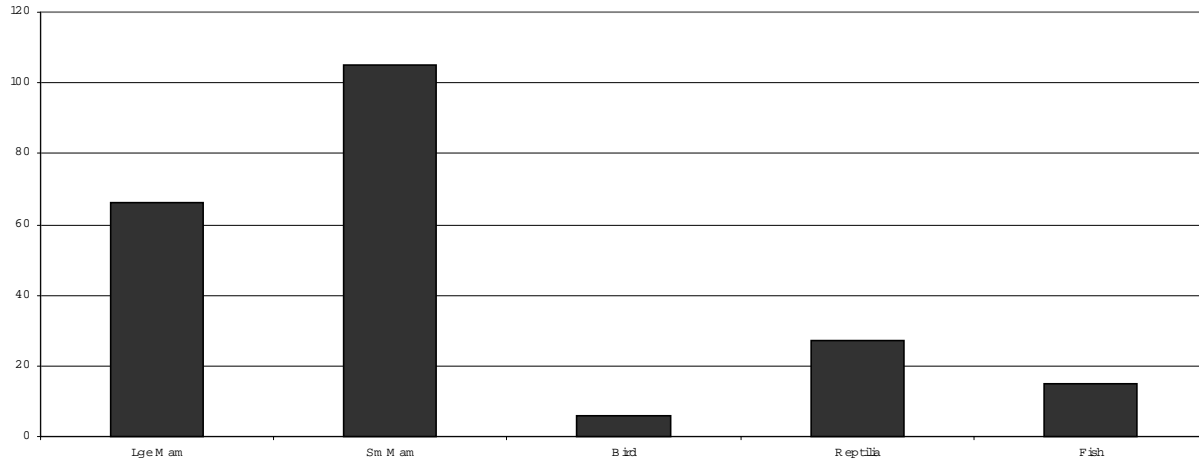


Figure 6.15a. Contribution by NISP of major taxonomic groups from the total bone assemblage of Mound Gamma.

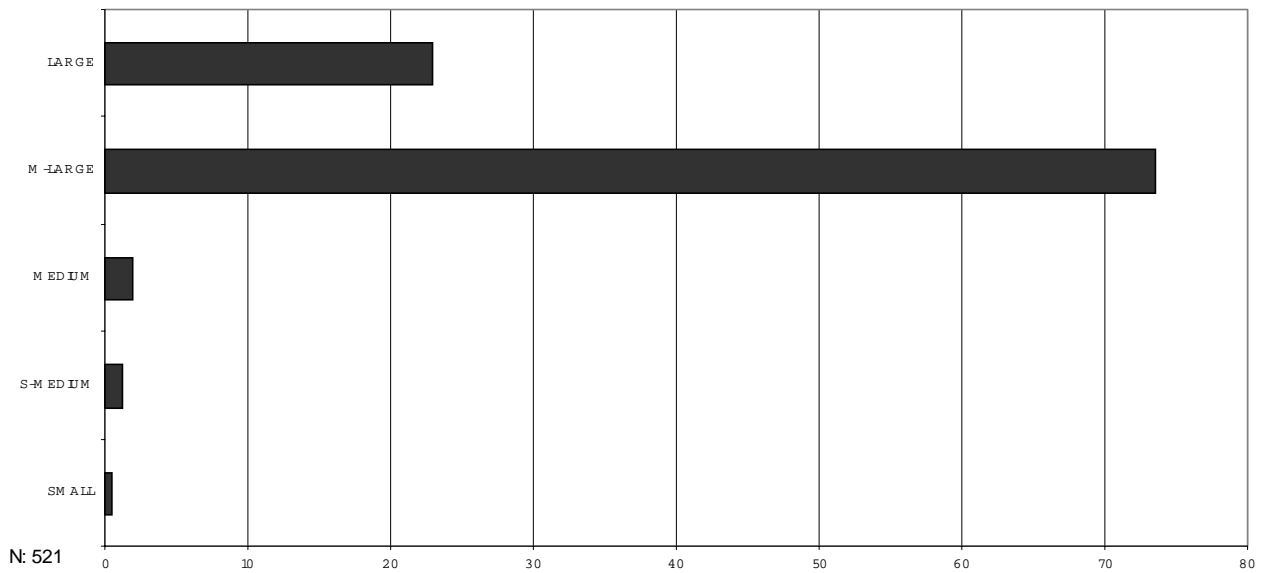


Figure 6.15b. Percentage of unidentified mammal size representation from the total bone assemblage of Mound Gamma.



*hydrochaeris*). Medium-sized mammals mostly comprise nutria (*Mycastor coypus*) and opossums (*Didelphis albiventris* and *Lutreolina crassiculata*). Small mammals consist of mice (Cricetidae), “apereá” (*Cavia* sp.) and rat-otters (*Holochilus brasiliensis*). The intermediate categories of small-medium and medium-large mammals comprise the bones that could not be securely placed among these animal size categories but which fall between them.

Within the broad category of unidentified mammal bones, which represent 72% (N=521) of the total mammal bones identified at the site, the major bone contribution comes from medium and large mammals while small mammals are represented in minor quantities (Figure 6.15b). The majority of mammal bones identified to different taxonomic levels (N=115, 16% of the total mammal assemblage), which correspond to low-utility but morphologically diagnostic parts (teeth, mandible, and metapods) are represented by medium (e.g., nutria) and small mammals (e.g., apereá, mice, and rat-otter) (Figure 6.15b). In terms of the NISP, the mammals that are most represented are reptiles and fish whereas the least represented group is the birds (see Table 6.10 and Figures 6.14-6.15a). Below follows a detailed description of each taxonomic group and the species identified in the collection.

*Rodents*. Five different rodents were identified to different taxonomic levels in the faunal collection (Table 6.9-10). Three of them are small mice and rats, including, apereás (*Cavia* sp.) (N=15), mice (Cricetidae) (N=8), and rat-otters (*Holochilus brasiliensis*) (N=2). One of the otters, nutria, (*Myocastor coypus*) (N=69) is medium size whereas the Capybara (*Hydrochaeris hydrochaeris*) (N=3) is large in size. In addition to these identified specimens, 11 bone fragments in the sample correspond to unidentified rodents and 17 bone fragments are of possible rodent origin. Like the rest of the bone assemblage, rodent bones are better represented in the lower levels of the PMC (Table 6.10, Figure 6.14). In terms of element representation, the rodent assemblage is dominated by teeth (65%), mandibles (10%), and metapods (6%) (Figure 6.16a). As with the majority of the species identified in the bone collection, most of the species-level identifications come from low-utility, but morphologically diagnostic parts, such as teeth, mandibles, and metapods.

It must be kept in mind, however, that the small amount of tiny mouse’ bones may be the result of sampling, recovery, and preservation biases. The small bones of apereás, mice, and rat-otters only were recovered from the heavy fraction mesh of the flotation machine. Given that only 1 of the 35-excavated sectors of Mound Gamma was floated, we only recovered 1/35 of the

potential small bone assemblage. This recovery bias led to an under representation of small mammals in the sample. As will be shown below, the same applies for reptiles, fishes, and birds.

As described in more detail in Chapter 3, *Myocastor coypus*, *Holochilus brasiliensis*, and *Hydrochaeris hydrochaeris* are semiaquatic rodents, typically found near water. Compared to other rodents that inhabit either the forests or grasslands, semiaquatic rodents attain significant population densities in wetlands and wet prairie habitats (Redford and Eisenberg 1992). Wetlands constitute the natural habitat of these animals, providing nesting, food, and shelter from predators. *Myocastor coypus* is confined to areas with permanent water, such as swamps, marshes, streams, and drainage ditches, but always with succulent vegetation in or near water. Populations of *Myocastor coypus* were extremely abundant in the area and were commercially exploited for their fur, reaching up to 265,000 individuals captured per year in Rocha Province, Uruguay (FAO, 1980).

*Holochilus brasiliensis* is distributed throughout southern and eastern South America in low, marshy areas and is capable of reaching large populations. As with the nutria and the rat-otter, capybaras (*Hydrochaeris hydrochaeris*) are confined to areas with permanent standing or slow running water. Their densities can reach up to 12.5 individuals per hectare while in Uruguay herds often range between seven and fifteen individuals (Redford and Eisenberg 1992). Despite their great abundance in wetlands and riverine habitats in the region, this is a species that is underrepresented in the faunal record of the region (Pintos and Gianotti 1995; Pintos 2000).

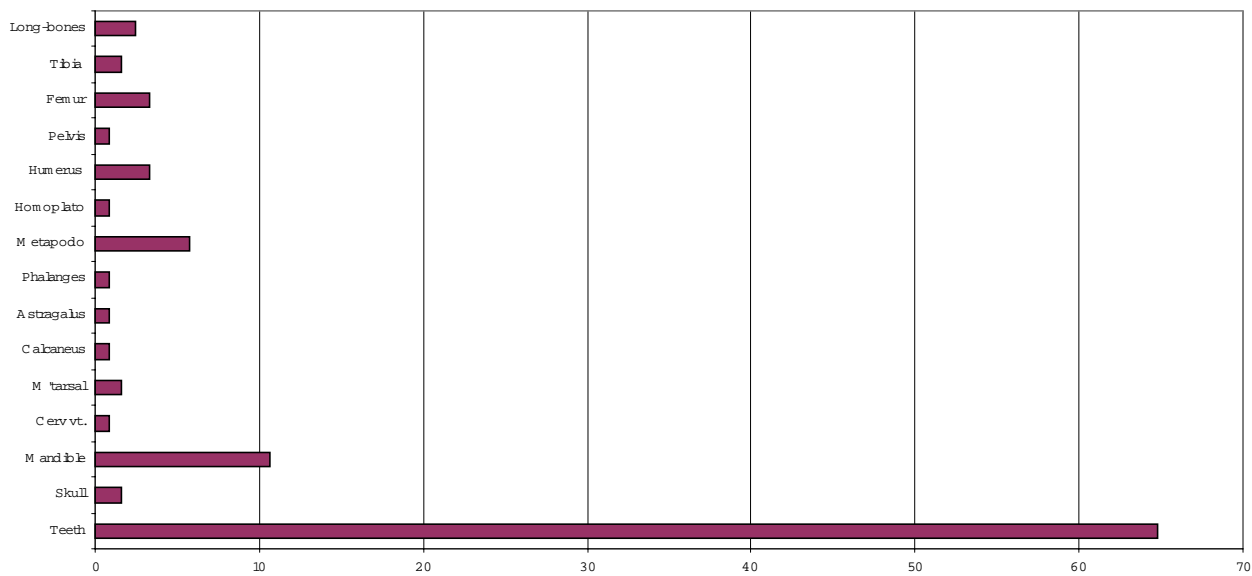


Figure 6.16a. Percentual representation of rodent elements from the total bone assemblage of Mound Gamma.

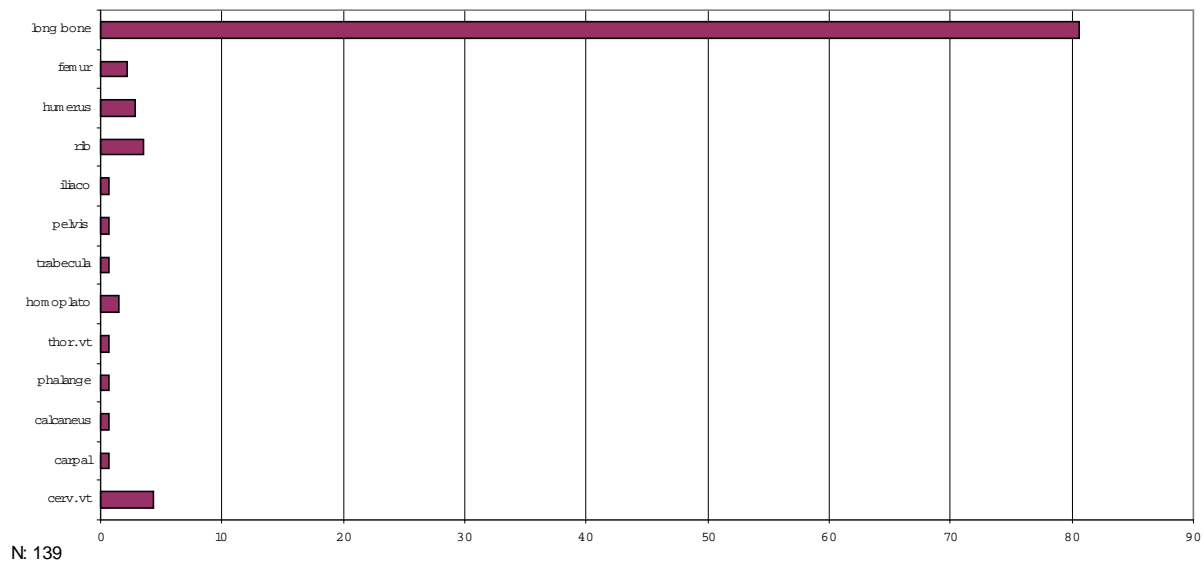


Figure 6.16b. Percentual representation of unidentified mammal elements from the total bone assemblage of Mound Gamma.

Finally, apereá and mice (Cricetidae) are mainly grassland herbivores that are mostly abundant in wet-prairie ecotones. Although the poor preservation and fragmentary nature of the small faunal assemblage recovered at Los Ajos prevent us from arriving at a more certain interpretation, this small rodent assemblage is probably representing: (a) a generalized practice of small game procurement nearby the site, (b) “garden hunting” (*sensu* Linares 1976) in nearby areas where crops were planted, (c) the presence of mice as commensals in the site (e.g., Bar-Yosef 1985) given that Los Ajos was occupied on a more permanent basis, or (d) all of the aforementioned options.

*Deer.* Two species of deer were identified in the sample (Table 6.9), “Venado de Campo” or Pampas Deer (*Ozoteros bezoarticus*) (N=4) and Guazubirá Deer (*Mazama guazubira*) (N=2). In addition, 57 other bone fragments were classified as deer (Cervidae), which comprise a large portion of the unidentified large mammals bone assemblage. In terms of element representation, the identified deer bones correspond to low utility parts such as teeth (27%), metapods (25%), and phalanges (11%) (see Figure 6.17).

“Venado de campo” or Pampas Deer was common in the open vegetation formations of central and southern South America. Orestes Araujo (1925) suggests that the name of Sierra de los Ajos, translated as “Garlic Hills”, came from the large aggregations of deer in the area. Adult males produce a very strong, pungent, garlic-smell odor from the interdigital gland on the hindfeet, thus, the name given to these hills. Pampas Deer lives in groups that rarely exceed five individuals, but which congregate at feeding grounds. The extensive wet prairies in the Wetlands of India Muerta, locally known as “Varges”, provide abundant forage, crucial to maintain higher population densities of herbivores compared to other areas (Arrarte Amonte 1969), and thus, may have constituted a favorite feeding ground for deer populations. Guazubirá Deer also ranges in open grassland areas and forests. The ecotone constituted by marshes, riparian forests, wet-prairies, and grasslands may have been a privileged habitat for this species of deer, which may have reached dense populations.

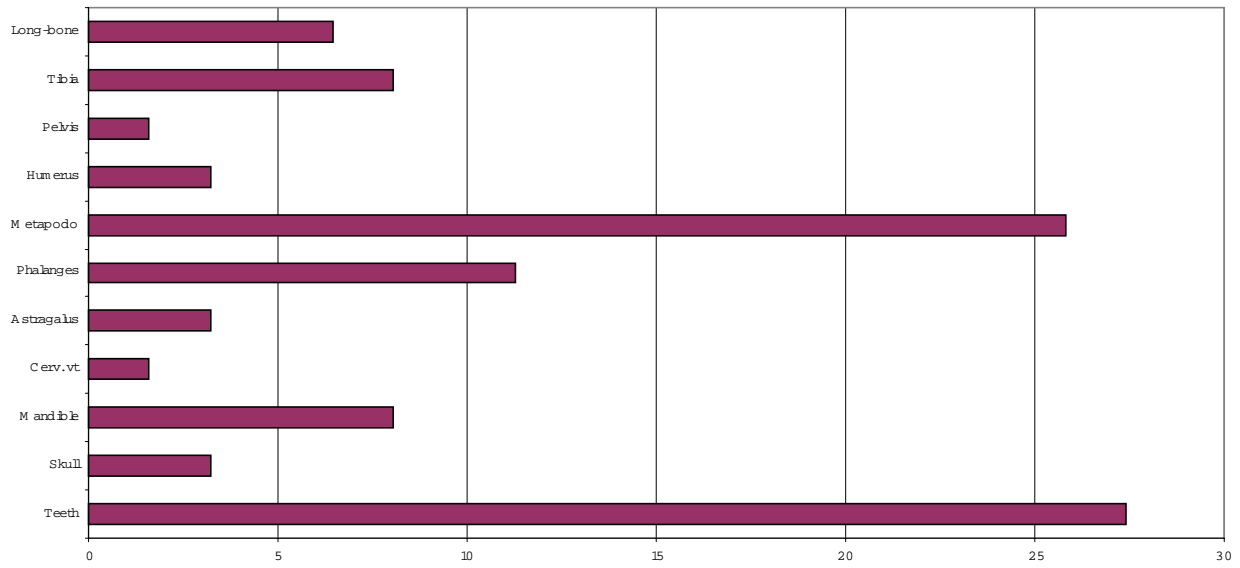


Figure 6.17. Percentual representation of deer elements from the total bone assemblage of Mound Gamma.

*Unidentified mammals.* A large portion of the faunal collection corresponding to 521 bones and bone fragments were classified as unidentified mammals. In terms of animal size, the unidentified mammal bones assemblage is dominated by medium-large (73%) and large mammals (23%). This pattern reinforces the fact that most of the bone assemblage corresponds to medium and large animals, such as large rodents (“Nutria” and “Carpincho”) and deer (“Venado de Campo” and “Ciervo Guazubira”). It must be noted that other medium and large mammals identified at other sites in the region could be represented in the unidentified medium and large mammal assemblage (Pintos and Gianotti 1995; Pintos 2000). Included in this assemblage are the most important and now extinct Marsh Deer (*Blastocerus dichotomus*), a gregarious deer that lived in wetland areas and weighed between 100 and 150 kg; the extinct peccari (*Tayassu tajacu*), apted to palm forests and grasslands with an average weight of 20 kg; giant otter (*Pteronura brasiliensis*), and “lobito de rio” (*Lutra paranaensis*), both living along rivers and streams with weights between 10 and 32 kg.

With regards to element representation, unlike the species-level identified collection which is dominated by low utility elements like teeth, mandible, and metapods, the unidentified mammal assemblage is dominated by high-utility parts; in particular, long-bone fragments (81%) (Figure 6.16b). In addition, these more abundant fragments of mammal long-bones present the most important frequency of charred and chipped fragments, many of which also exhibit cut marks.

*Taxa other than Deer and Rodents with low representation.* Deer and semiaquatic rodents represent the largest part of the bone assemblage; however, other taxa represented in very minor quantities including reptiles, fishes, birds, and some mammals like opossum and fox also were identified in the collection. Reptiles are represented by one lizard species “Lagarto overo” (*Tupinambas merianae*) (N=12), turtle (*Chelonia*) (N=10), and poisonous (*Crotalidae*) (N=2) and non-poisonous (*Colubroidea*) (N=1) snakes. “Lagarto overo” bones are represented by cervical vertebrae (N=7), humerus (N=3), and mandibles (N=2). Turtles are represented by plaques and snakes by vertebrae.

Fresh-water fish (*Osteichthyes*) (N=16) is represented by vertebrae (N=8), skull bones (N=5), and spines (N=3) although none of them could be identified to a lower taxonomic level. Birds are represented by three species, the ostrich like “Ñandú” (*Rhea americana*) (N=5), pigeon

(*Zenaida auriculata*) (N=2), and “Maca” (*Podiceps major*) (N=1). “Ñandú” is only represented by egg fragments, the pigeon is represented by a humerus and a coracoid’s bone, and “Maca” is represented by a coracoid’s bone.

As stated above, small rodents, reptiles, birds, and fish bones were only recovered from the floated samples representing 1/35 of the excavated volume at Mound Gamma. Thus, they were subjected to a high recovery bias and consequently, are underrepresented.

In addition, given the fact that lizards, both “mulita” and “peludo”, and snakes are burrowers that live in the mounds and that their bones did not present clear anthropic-related modifications, it is difficult to assess whether their presence in Mound Gamma is due to human or natural factors. This is particularly true for the uppermost part of the CMC component which exhibits extensive perturbation caused by these borrowers.

### **Summary of Faunal Analysis**

A basic faunal analysis was conducted on the small and fragmentary faunal assemblage recovered at Mound Gamma and some interesting patterns can be outlined. This analysis provided important information on: (a) an approximation to the contribution of different animal species to the diet of the early Formative societies at the Los Ajos site, (b) the paleoenvironment, and (c) the nature of the occupation at the Los Ajos site and, more specifically, at Mound Gamma.

*Contributions of different animal species to the diet.* Collectively, most of the bone assemblage is dominated by medium-large size mammals, where the best-represented is deer. In addition, the unidentified mammal bones are mostly represented by medium and large mammals. In terms of bone elements, the majority of bones identified to lower taxonomic levels correspond to low-utility but morphologically diagnostic parts such as teeth, mandibles, and metapods. In contrast, unidentified medium-large and large mammals, which represent the most significant part of the mammalian bone assemblage, correspond to high-utility fragmented long bones, most of which are charred, chipped, and exhibit cut marks. Small mammals, fishes, birds, and reptiles are minimally represented in the faunal assemblage. However, their contribution to the diet of the Los Ajos’ people is difficult to assess due to preservation, sampling, and recovery bias that led to an underestimation of their role and, in turn, to an overrepresentation of medium-large and large mammal bones.

With the current data at hand, we can infer that medium and large mammals, such as deer and nutria, played an important role in the diet of Los Ajos' communities. The role of small mammals, (e.g., "apereás", mice, and rat-otters), reptiles, birds, and fishes are more difficult to assess due to the preservation and recovery biases' problems stated above. However, several lines of evidence show that these small, lower ranked resources may have played a major role in the economy of Early Formative groups. First, these small animals are diverse and extremely abundant in wetland areas. Second, archaeological data suggest that these groups aggregated and occupied wetland areas more intensively. This process was concomitant with a period of dryness, which caused the desiccation of upland grasslands, thus, diminishing the carrying capacity of upland prairies to support large herbivores. Finally, as discussed in detail in Chapter 5, the lithic technology shows a tendency toward a more generalized and expedient technology, which is generally associated with a more diverse economy. Overall, these lines of evidence suggest that these populations intensively exploited a broad spectrum of wild animal and plant resources as well as domestic plants rather than one or two resources. This point will be considered in detail in the final section of this chapter.

*Indication of paleoenvironment.* The faunal collection is in agreement with several other lines of evidence that suggest that Los Ajos' communities focused on the localized exploitation of wetland and wetland-related areas. The analysis of bones from Los Ajos reveals that the early Formative peoples who resided at this site, exploited a variety of closely juxtaposed ecotonal zones, including marshes, riparian forests, wet-prairies, palm forests, and upland prairies. In this respect, the faunal assemblage further corroborates that the Los Ajos site was probably a pivotal residential site which provided an easy access to exploit multiple and different habitats. The important presence of semiaquatic rodents in the sample, also suggests that the area surrounding the site was a wetland environment.

*Nature of the Los Ajos site.* Unfortunately, there is no other assemblage from the site to compare with the assemblage of Mound Gamma because bone fragments were only preserved at Mound Gamma block excavation unit. The presence of distinctive spiral fractures, bone splinters typical of broken skeletal elements, in addition to, charred bones displaying cut marks, indicate that the processing and consumption of medium and large mammals was carried out at Mound Gamma.



Along with other lines of evidence, it further corroborates the residential, multi-purpose nature of the PMC component and shows how hunting-gathering-fishing occurred alongside with other subsistence activities, such as gardening. I will return to this point in the final section of this chapter.

*Los Ajos' faunal data in regional context.* The faunal data from the Los Ajos site conforms well to previous faunal studies in the region (Chagas 1995; Pintos and Gianotti 1995; Pintos 2000; Cabrera et al. 2000), which evidenced that these groups obtained a large portion of their diet from animal resources. In the region, the most comprehensive faunal study has been carried out by Pintos (2000) who compared the faunal assemblages from four sites in the region (Punta de la Coronilla, Laguna de Castillos, Potrerillo de Santa Teresa, and CH2D01 B) (Figure 1.2) corresponding to the Ceramic Mound Component of the southern sector of the Laguna Merin basin dating between ca. 2,930 and 1,090 bp (ca. 3,120 and 971 cal.bp). From this comparative analysis, Pintos (2000) concludes that the faunal assemblages from these sites are rich in species, but not very diverse. The faunal assemblages are dominated by deer (including *Blastocerus dichotomus*, *Ozotocerus bezoarticus*, and *Mazama guazubira*) in the inland sites and by sea-lion (mainly *Arctocephalus australis*) in the Atlantic coast archaeological sites. Taking into account that Pinto's study was carried out using the *in situ* bones recovered through hand trowelling and in 5 mm screens, the dominance of the deer complex could well be the result of a recovery bias caused by the use of a screen mesh size that tends to over-represent larger bones of medium and large size mammals. In this regard, as discussed above, intensive studies of wet sieving faunal collections need to be carried out in order to properly assess the contributions of small mammals, birds, and fishes to the diet of the early Formative societies of southeastern Uruguay.

### **Early Formative Subsistence: A Mixed Economy**

In order to reconstruct the economy of the early Formative societies at Los Ajos, this multidisciplinary project involved: (a) comparative baseline phytolith studies, which included the construction of a modern phytolith reference collection from selected native plants and modern soils (Iriarte and Alonso 2002) and the intensive analysis of 41 Panicoid, Oryzoid, and Bambusoid grasses in order to assess the feasibility of identifying maize leaf decay through the technique developed by Piperno and Pearsall (Piperno 1984, 1988, 1998; Pearsall 2000) based on

the size and three-dimensional morphology of cross-shaped phytoliths (Iriarte 2003), (b) the combined phytolith and starch grain analyses from plant grinding tool residues and selected archaeological sediments, (c) the faunal analysis of Los Ajos bone assemblage, and (d) the reconstruction of the paleoclimatic record for the mid-Holocene through combined pollen and phytolith analyses of a sediment core extracted from the wetlands of India Muerta in Rocha Province, Uruguay (presented in Chapter 3).

The combined subsistence data obtained from this study indicate that the early Formative societies at Los Ajos engaged in a variety of subsistence activities, including hunting, fishing, and collecting wild resources, in addition to the adoption of maize, squash, and possibly, domesticated beans (*Phaseolus* spp.) and tubers (*Canna* spp. and *Calathea* spp.). These data forces us to reconsider the concept of complex hunters-gatherers groups first proposed by López and Bracco (1992, 1994) and the early dispersal of cultigens into southeastern South America.

Presently, we have neither botanical nor faunal data to help us determine the economy of the Preceramic Archaic groups that inhabited Los Ajos. Phytolith and starch grain analyses from plant grinding tools residue and selected archaeological sediments recovered at Los Ajos document a mixed economy, including the adoption of maize (*Zea mays*) and domesticated squash (*Cucurbita* spp.) shortly after 4,190 bp, which marks the beginning of the Preceramic Mound Period. Faunal analysis indicates that these early Formative societies also consumed a variety of species of mammals, reptiles, birds, and fishes. The combined microfossil plant analyses and the faunal record indicate that during the Preceramic Mound Component, these societies adopted a mixed economy, combining hunting, fishing, and gathering with small-scale horticulture of maize, squash, and possibly, domesticated beans and tubers. Additional starch grain and phytolith data from Isla Larga and Los Indios sites document the presence of *Phaseolus* spp. ca. 3,050 bp, *Canna* spp. ca. 3,660 bp, and *Calathea* spp. ca. 1,190 bp, indicating the practice of small-scale horticulture. Hunting, gathering, and fishing complemented this agricultural practices; further corroborating the adoption of a mixed economy (Iriarte et al. 2001).

During the Ceramic Mound Period, the starch grain and phytolith residue analyses from two milling stone bases and a mano, recovered from the CMP contexts (Mound Gamma and TBN crescent-shaped rise), indicate that these plant-grinding tools were used to process maize. The phytolith analysis of selected archaeological sediments in Mound Gamma marked the

presence of maize cob and domesticated squash rind phytoliths. In the CMP contexts of the TBN crescent-shaped rise, domesticated squash phytoliths and a maize leaf signature were documented. Collectively, this data forces us to reconsider the conceptualization of the “Constructores de Cerritos” as complex hunter-gatherers.

### **Revisiting the “Constructores de Cerritos” as Complex Hunter-Gatherers**

The initial characterization of the “Constructores de Cerritos” economy, envisioned these societies as complex hunters-gatherers living in a rich and abundant environment that fostered cultural complexity. López and Bracco (1994:38) stated that:

“Taking into account that the archaeological investigations developed up to this moment did not produce the necessary botanical evidence to consider the proposal of a productive economy, we understand that it is correct to suggest an alternative model based on high-efficiency adaptive strategies. Such a model does not exclude cultigens; on the contrary, it foresees its eventual incorporation, but bounded to a limited contribution to the economic strategies of these groups centered on the abundance of natural resources in this region, where the practice of cultivation will demand a greater effort (sensu Cohen 1984:40).”

This characterization of the “Constructores de Cerritos” as complex hunter-gatherers was the result of absence of macro-botanical remains of domesticated plants and the variety of faunal remains encountered at the sites (López and Bracco 1992; 1994). This characterization was later reinforced by trace element and isotope analyses carried out on human bones. Bracco and his colleagues (2000c) carried out Zn-Sr analysis on the bones of 15 skeletons from the site CH2D01 Mound A and Mound B, pertaining to the Ceramic Mound Period (ca. 2,500 to 400 bp). From this analysis, he (op.cit.) concluded that there was little variation in the diet of the CMC population throughout this period and that the CMC groups have a relatively rich diet in Sr, which is probably related to the intensive exploitation of aquatic resources, particularly, freshwater fishes and nutia. The C13 isotope analysis of bone collagen from skeletal remains indicated that during the CMC, 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, 2000c). While bone chemistry studies have increased our understanding of the economy of the early Formative societies of southeastern Uruguay, they are not without their limitations. First and most important, bone isotope and trace element analyses have been only conducted on human

bones corresponding to the Ceramic Mound Period in the region, which cannot be extrapolated to the earlier Preceramic Mound Period. Second, bone isotope data is most useful for assessing the status of maize as a staple crop consumed on a regular basis. The phytolith and starch grain analyses show that the early Formative societies of southeastern Uruguay adopted maize but also a broader crop assemblage, which includes roots, legumes, vegetables, and palms. It is significant to note that all these plants (*Cucurbita* spp., *Phaseolus* spp., *Canna* spp., and *Calathea* spp) except maize, will contribute a C3 signature to the bone isotope signature. Therefore, the presence of diverse horticultural practices within a broader mixed economy characteristic of many early Formative societies is difficult to detect by C13 bone isotope analysis. This seems to be the reason for the lack of correspondence between bone isotope analysis and micro- and macro-fossil botanical remains in other early Formative cultures like the Barra Phase in the Soconusco region in Chiapas, Mexico (Blake et al. 1991) or in Valdivia I-III in Real Alto southwestern Ecuador (Pearsall 2002) (see Piperno and Pearsall 1998a for a comprehensive review of early Formative subsistence practices).

Third, the studies of C13 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 a) the bone apatite carbonate fraction provides a more accurate record of the carbon isotope composition of the diet, b) it is less susceptible to diagenic alteration, and more importantly, c) apatite carbonate is more sensitive for detecting and measuring maize consumption (Norr 1995; Pearsall 2000).

Overall, the combined micro-fossil botanical analysis, faunal analysis, and bone isotope studies along with data on settlement patterns and the lithic assemblage evidence that the early Formative societies emerging in southeastern Uruguay shortly after 4,190 bp gradually adopted a mixed economy, combining a variety of subsistence activities including hunting, fishing, and gathering of wild resources with the growing of corn, squash, and possibly, domesticated beans and tubers. The adoption of a mixed economy is also paralleled with the appearance at the Los Ajos site of plant grinding tools consisting of milling stone bases and manos in conjunction with a gradual change on the chipped stone technology towards a more generalized and expedient technology. Like in other parts of the Americas (e.g., Ranere 1980; Richardson 1978; Rossen 1991), these changes appeared to be reflecting a shift to a more diverse economy which played a major emphasis on plant resources.

As should be apparent from the previous discussion, it is still too early to determine the relative importance of the various subsistence activities. The faunal data demonstrate, the economy remained mixed during the prehistoric period, although the importance of cultivated crops probably increased. It is reasonable to suggest that along with the more intense and permanent occupations of wetland areas documented at Los Ajos, local natural resources may have been exhausted, which in turn, may have pushed the early Formative societies to increase their reliance of domestic crops. Alternatively, the adoption of a mixed economy, and in particular, the ability to manage one's food supply in addition to the region's rich and abundant resources may have encouraged the possibility of forming and remaining in larger groups for longer periods. I will consider these aspects in detail in Chapter 9.

### **The Dispersal of Cultigens into Southeastern South America**

Los Ajos phytolith and starch grain data contribute significantly to the ongoing debate about the timing and nature of the adoption of domesticated crops in southeastern South America. It is becoming increasingly apparent that the use of domesticated plants was a more important aspect of subsistence long before previously recognized temporal and cultural placements suggest. The analysis undertaken in this and our previous study (Iriarte et al. 2001) marked the earliest occurrence of at least two domesticated crops: *Zea mays* and *Cucurbita* spp. In addition, these studies have documented for the first time the presence of *Phaseolus* spp. and *Canna* spp. and *Calathea* spp. tubers in the region. This novel data open new questions about the antiquity and routes of introduction of the prehistoric cultigens adopted by the early Formative societies that developed during the mid-Holocene in southeastern Uruguay.

It also forces us to reconsider the traditional view that agriculture was introduced around A.D. 1000 by the Tupi-Guarani (e.g., Brochado 1984; Schmitz et al. 1991). In historic times, these tropical forest horticulturalist practiced swidden agriculture, which is restricted to the seasonal tropical forest associated with the riparian forest through which they migrated during pre-Hispanic and Hispanic times (Brochado 1984; Schmitz et al. 1991; Acosta y Lara 1988; Cabrera 1995). In this study, the author argues that the early dispersal of agriculture in southeastern South America should not be restricted to the practice of swidden agriculture associated to the seasonally dry tropical forest. Along with other studies in the Americas (Blake 1999; Siemens 1999), this study indicates that the ancient use and manipulation of wetlands

along lake, river, and swamp margins was a much more important and frequent activity than previously thought. This is reflected by the remarkable correspondence between the larger archaeological sites and the most fertile agricultural lands in the region (Bracco 2000c). Although the practice of flood-recessional agriculture remains hypothetical, it should be mentioned that the wetlands of India Muerta represent an ideal scenario for the practice of flood recessional agriculture. As described in the Study Area Chapter, during the spring and summer months organic soils are exposed on the wetland margins, and constitute a privileged location for the practice of flood-recessional horticulture. The superficial peat horizons are highly fertile, hold moisture, and are easy to till. Moreover, the floodwater and the overbank flow of the Cebollatí River that inundates the area, replenishes these soils with nutrients periodically (Juan Montaña, personal communication 2000).

Unfortunately, basic data are still lacking in order to propose a route for the spread of these early cultigens into southeastern South America. In this respect, the potential routes of dispersion like southern Amazonia, the Gran Chaco, or the Atlantic tropical forest are awaiting more studies to define a more basic chronology and nature of the settlements. However, there are three aspects regarding the contexts and chronology of the domestication of crops in the Americas that favors and early adoption of these cultivars during the mid-Holocene in southeastern South America. First, there is mounting evidence indicating that the domesticated plants present in Uruguay, were domesticated elsewhere in the Americas during the early Holocene, several millennia before they were adopted by the local populations of southeastern Uruguay (see Piperno and Pearsall 1998 for a detailed synthesis). In the second place, all these studies show how early domesticates spread quickly between their centers of origin and other areas, for example, maize and manioc (e.g., Pohl et al. 2001; Piperno 2000a). Last but not least, there are no major geographical barriers for the spread of these cultigens into the region of southeastern South America; in fact the major river corridors that La Plata Basin constitute may have facilitated the exchange of crops among different populations at a very early date. Additional examples are needed before the Uruguayan contexts are fully accepted, but evidence is certainly accumulating.

## **Chapter 7**

### **Ceramic Analysis**

#### **Introduction**

This chapter presents a basic analysis of the ceramic assemblage recovered at the Los Ajos site. The first section of the chapter describes the methodology employed in the ceramic analysis followed by the results of the analysis. The presentation of the results begins with a general technological description of the ceramic assemblage, follows with an account of the vertical distribution of ceramics in the different sectors of the site, and concludes with a description of the reconstruction of vessel forms. Once the results of the analysis are provided, a summary and comparison of Los Ajos ceramic assemblage at a regional level is offered. In the next chapter, I will examine in more detail the ceramic density distribution across the site (both in vertical and horizontal contexts) and its broader implications for the interpretation of settlement structure and the occupational history of Los Ajos.

#### **Methodology**

The ceramic assemblage of Los Ajos consists of 674 ceramic sherds recovered from the Ceramic Mound Component of Mound Gamma (115-190 cm depth), the TBN trench transect (145-195 cm depth in its central sector), and from the off-mound test units. Ceramic sherds were recovered *in situ*, in 5 mm dry screens, and in the 0.5 mm heavy fraction mesh of the flotation machine. The complete ceramic assemblage obtained from these different sectors of the site was analyzed by Oscar Marozzi (Facultad de Humanidades y Ciencias de la Educacion, Universidad de la Republica, Uruguay). The ceramics were analyzed using a similar data coding form employed in the southern sector of the Laguna Merin basin by Licenciado R. Bracco at CH2D01 (Bracco 1992b; Bracco et al. 1993) and by Licenciado L. Cabrera at Isla Larga site (Cabrera et al. 2000). John Warner did the calculation of vessel's diameter and the drawings presented in Figures 7.1-5. The author completed table compilations and the contextual analysis of the assemblage. The basic technological attributes examined in this study included: temper, firing

atmosphere<sup>17</sup>, paste texture, and surface treatment. The analysis also included rim and lip shape for rim sherds. Appendix 5: Ceramic Data Coding Form, describes in detail the different states of the attributes examined.

Before proceeding with the description of the assemblage, some qualifying statements are in place. In the first place, like all Vieira ceramics (Brochado 1984; Schmitz 1976; see Chapter 2), the ceramics from Los Ajos are coiled manufactured, homogeneous, and lack any type of decoration. This prevents us from identifying time-sensitive decorative styles that may allow us to obtain a finer chronological resolution for the Ceramic Mound Period. In addition, excavations recovered few rim sherds large enough for allowing us to reconstruct vessel form. Therefore, the results of the attempted vessel form analysis should be considered tentative.

## **Results**

### **General Description of the Assemblage**

Table 7.1 summarizes the technological attributes for temper, firing atmosphere, paste texture, surface treatment, and sherd thickness from all the excavation units at Los Ajos. A close reading of Table 7.1 indicates the following. In terms of technological attributes, it is clearly apparent that the majority of ceramics have been manufactured with fine-sand temper (86%). The rest were made using of medium-sand temper (9.7 %) and coarse-sand temper (3.9%).

Taking into account all temper categories together, paste texture is dominantly homogeneous (96%). However, when temper is cross tabulated with paste texture (Table 7.2), there is a significant association between these two attributes ( $\chi^2=52.5$ ,  $p. > 0.001$ ). The paste of fine-sand tempered sherds is almost exclusively homogenous (98%) whereas in medium-sand tempered and coarse-sand tempered sherds, the percentage of homogenous paste is lower (88.5% and 76%, respectively).

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<sup>17</sup> Firing atmosphere was inferred from the color of the paste. In this regard, a warning regarding misleading oversimplification is in place here. As ceramic specialists (e.g., Shepard 1965; Rice 1987) have cautioned, in order to make accurate interpretations of firing atmosphere on the basis of color of the paste, it is essential to understand the basics of firing and the range of variability of clays of the ceramics in question. Because, no thin-section petrographic analysis of clays has been carried out and the basics of firing of ceramics are little understood at Los Ajos, the inferences of firing atmospheres made from paste color in this analysis should remain tentative.



Table 7.1. Ceramic Technological Attributes for Mound Gamma, TBN Trench, and Test Units

	Temper				Firing				Paste texture				Surface Treatment				Thickness (mm)			
	Fine Sand	Medium Sand	Coarse Sand	Subtotal	Reducing	Reducing	Oxidizing	Oxidizing	Subtotal	Homogeneous	Heterogeneous	Lamellar	Subtotal	No surface treatment	Smoothed	Slipped	Subtotal	Mean	STD	Total
All	561 86.4%	63 9.7%	25 3.9%	649	120 18.5%	213 32.9%	183 28.3%	131 20.2%	647	622 96.3%	11 1.7%	13 2.0%	646	371 57.3%	272 42.0%	4 0.6%	647	7.25	1.66	649
Gamma	15 35.7%	21 50.0%	6 14.3%	42	11 27.5%	6 15.0%	11 27.5%	12 30.0%	40	24 60.0%	8 20.0%	8 20.0%	40	17 42.5%	23 57.5%		40	6.88	2.01	42
TBN	420 93.8%	23 5.1%	5 1.1%	448	91 20.3%	157 35.0%	124 27.7%	76 17.0%	448	445 99.3%	3 0.7%		448	291 65.0%	153 34.2%	4 0.9%	448	7.23	1.61	448
TBN Central	168 95.5%	7 4.0%	1 0.6%	176	23 13.1%	67 38.1%	57 32.4%	29 16.5%	176	176 100.0%			176	111 63.1%	63 35.8%	2 1.1%	176	7.19	1.63	176
Test Units	126 79.2%	19 11.9%	14 8.8%	159	18 11.3%	50 31.4%	48 30.2%	43 27.0%	159	153 96.8%		5 3.2%	158	63 39.6%	96 60.4%		159	7.4	1.69	159

Table 7.2. Temper Types Cross Tabulated with Paste Texture

Temper	Paste Texture			Total	
	Homogeneous	Heterogeneous	Lamellar		
Fine-sand	O	549	3	8	560
	E	539.2	9.5	11.8	
Medium-sand	O	54	4	3	61
	E	58.7	1	1.2	
Coarse-sand	O	19	4	2	25
	E	24.1	0.4	0.5	
Total		622	11	13	

O= Observed count

E= Expected count

More than half of the ceramic assemblage (57.3%) does not exhibit surface treatment, 42% is smoothed and only two sherds were slipped. It is also noteworthy that type of temper is significantly associated with surface treatment ( $\chi^2=18.025$ ,  $p > 0.001$ ) (Table 7.3). While most of the medium and coarse-sand tempered sherds lack surface treatment (79% and 59%, respectively), fine-sand tempered sherds are dominated (60%) by smoothed surfaces. From this, we can see how finer sand temper is associated with homogeneous paste texture and smoothing, while coarser sand temper is correlated with heterogenous paste and lack of surface treatment. In summary, it appears that fine-sand tempered vessels are more carefully made than coarsely tempered ones, although this could be an incidental effect of differences in the coarseness of the temper (Christopher Pool, personal communication 2003). Sherd thickness means for all the units ranges between 6.88 and 7.4 mm and its standard deviation varies between 1.61 and 2.01 mm. The ceramic assemblage displays a high variability of firing atmospheres including both reducing and oxidizing firing. This high variability is in accord with the simple, fairly uncontrolled technology that was probably used at Los Ajos to fire ceramics.

The ceramic assemblage exhibit differences when comparing the different areas of the site. A difference appears when comparing the ceramic assemblage of Mound Gamma with the TBN central sector and the off-mound grid test units. While Mound Gamma presents more variability in temper, displaying 36% of fine-sand temper, 50% of medium-sand temper and 14% of coarse-sand temper, both the TBN trench transect and the off-mound grid test units are dominated by fine-sand temper (95.5 and 80%, respectively). In addition, although paste texture is dominantly homogeneous in all excavation units, both the TBN and the off-mound test units homogeneous paste texture represents more than 95% of the sample, whereas, in Mound Gamma it only comprises 60% of the sample. Last, in relation to surface treatment, Mound Gamma presents a major percentage of smoothed sherds (57.3%) in relation to the central sector of the TBN (35.8%) and (34.2%). Overall, Mound Gamma ceramic assemblage exhibits more variability in temper, less homogeneous texture and major percentage of smoothed sherds.

Table 7.3. Temper Types Cross Tabulated with Surface Treatment

Temper	Surface treatment		Total	
	No surface treatment	Smoothed		
Fine-sand	O	219	338	557
	E	236.5	320.5	
Medium-sand	O	36	25	61
	E	25.9	35.1	
Coarse-sand	O	18	7	25
	E	10.6	14.4	
Totals		273	370	

O= Observed count

E= Expected count

## **Vertical Distribution of Ceramics**

### ***Mound Gamma***

The small sample of sherds (N=49) recovered from Mound Gamma prevents us from making stratigraphic comparisons to infer technological changes over time. Table 7.4 displays the technological attributes of Mound Gamma ceramics by level.

This small sample does not show any statistical significant differences through the stratigraphy in terms of paste, paste texture, firing atmosphere or surface treatment. The only noticeable temporal changes observed in Mound Gamma are the following: (a) the use of coarse-sand temper, although it is very limited in occurrence, increases in the upper levels, (b) the use oxidizing firing atmospheres becomes more common in the upper levels, (c) the upper levels display more variation in paste texture, whereas, in the lower levels only homogeneous paste is present, and (d) the upper levels exhibit the only two slipped sherds recovered at Los Ajos. Only seven rim sherds were recovered from Mound Gamma (Table 7.5) from which two are direct, two are expanded, and three are vertical. Lips are rounded (N=4), pointed (N=3), and beveled (N=2). The vessel shape attempted reconstruction from the most complete rim is illustrated in Figure 7.1a, which probably represent a bowl.

### ***TBN Trench Transect***

In the case of the TBN, only its central sector, which attained the maximum vertical expression (units 6, 7, A1 and A2) and was the least subjected to vertical displacement was analyzed in order to explore temporal differences. This sector comprised 176 (39.3 %) of the total 476 recovered from the TBN trench. Table 7.6 shows the technological attributes of the TBN trench central sector. In general, the technological attributes do not show remarkable chronological differences. Fine-sand temper prevails in all the levels (88.9 to 100%); firing atmosphere is highly variable like in all the levels of the site; paste texture is homogenous (100%) in all the levels; and in all, but the

Table 7.4. Mound Gamma Ceramic Technological Attributes

Levels (cm)	Temper			Firing				Paste texture			Surface Treatment	
	Fine Sand	Medium Sand	Coarse Sand	Reducing		Oxidizing		Homogeneous	Heterogeneous	Lamellar	No surface treatment	Smoothed Slipped
				Red. Incomplete	Red. Complete	Oxid. Incomplete	Oxid. Complete					
120	2	3				1	2	2		1	3	2
125	1	2				2	1	3			1	2
130	1	6	2	6		2	1	5	2	2	2	7
135	2	5		2		2	3	2	3	2		7
140	3		1	1	2		1	3	1		2	2
145			1				1			1	1	
155	1		1			1	1	1	1		1	1
160		3		1			2	3			2	1
170		1			1			1				1
175		1			1			1				1
180	1					1		1			1	
190	1				1			1			1	

Table 7.5. Mound Gamma Rim Profile and Lip Shape.

Levels (cm)	Rim profile			Lip shape		
	Direct	Expanded	Vertical	Rounded	Pointed	Beveled
120			1	1		
125				1		
130	1	1		1	1	
135	1		1		2	
140						
145						
155		1		1		1
160			1			

Table 7.6. TBN Central Sector Ceramic Technological Attributes

Levels (cm)	Temper				Firing				Paste texture				Surface Treatment				
	Fine Sand	Medium Sand	Coarse Sand	Subtotal	Reducing		Oxidizing		Subtotal	Homogeneous	Heterogeneous	Lamellar	Subtotal	No surface treatment	Smoothed	Slipped	Subtotal
					Red. Incomplete	Red. Complete	Oxid. Incomplete	Oxid. Complete									
160	11			11		7	1	3	11	11			11	4	7		11
	100.0%				0.0%	63.6%	9.1%	27.3%		100.0%				36.4%	63.6%		
165	56	4		60	5	25	21	9	60	60			60	39	21		60
	93.3%	6.7%			8.3%	41.7%	35.0%	15.0%		100.0%				65.0%	35.0%		
170	33	1		34	5	14	8	7	34	34			34	21	13		34
	97.1%	2.9%			14.7%	41.2%	23.5%	20.6%		100.0%				61.8%	38.2%		
175	37		1	38	6	12	11	9	38	38			38	22	14		36
	97.4%		2.6%		15.8%	31.6%	28.9%	23.7%		100.0%				61.1%	38.9%		
180	16	2		18	5	4	8	1	18	18			18	11	7		18
	88.9%				27.8%	22.2%	44.4%	5.6%		100.0%				61.1%	38.9%		
185	12			12	1	4	7		12	12			12	12			12
	100.0%				8.3%	33.3%	58.3%			100.0%				100.0%			
190	1			1	1				1	1			1		1		1
	100.0%				100.0%					100.0%					100.0%		
195	2			2		1	1		2	2			2	2			2
	100.0%					50.0%	50.0%			100.0%				100.0%			



uppermost 160 cm depth level, two thirds of the sherds do not present any surface treatment and the remaining third present smoothed surface.

Table 7.7 shows the rim and lip attributes from the TBN trench excavation. Rims are predominantly vertical (N=19), but direct rims also occur in minor proportions. Lips are mainly rounded (N=16), beveled (N=6), pointed (N=2), and flat (N=1). The same pattern is observed in the rest of the TBN trench ceramic assemblage. Vertical rims (N=31, 94%) and rounded lips (N=23, 52%) dominate the rim sherd assemblage (see Table 7.7). Figures 7.1b, 7.3a and b, 7.4a and b show the attempted reconstruction of the vessels's form from this sector of the site.

The analysis of the vertical distribution of the ceramic assemblage of the TBN indicates that the central sector of the TBN shows a gradual increase in ceramic density over time suggesting the gradual accretion of ceramic over time. In addition, in comparison with other sectors of the site, the TBN has the highest ceramic density. These two characteristics, along with its size, shape, location, stratigraphy, and soil chemistry analysis indicate that the TBN was an area that grew accretionally through the gradual accumulation of domestic refuse. This point will be further considered in the next chapter.

### ***Off-Mound Test Units***

Table 7.8 displays the technological attributes of the off-mound test units. Like Mound Gamma there is an increase in the medium and coarse-sand temper over time. In relation to the firing atmosphere, Table 7.8 shows an increase of ceramics fired in a reducing atmosphere with a concomitant decrease in those fired in an oxidizing atmosphere. Paste texture is exclusively homogeneous and overall, smoothed sherds are slightly more frequent than sherds displaying no surface treatment. Only 20 rim sherds were recovered from the off-mound test units. The rim forms mainly include vertical rims (N=17) and a few direct (N=2) rims. The morphology of the lip is mainly rounded (N=17), beveled (N=2), and only presents one flat type of lip. The attempted reconstruction of the ceramic vessel's shape from the larger rims are illustrated in Figure 7.2 a and b.

Table 7.7. TBN Central Sector Rim and Lip shape

Levels (cm)	Rim profile		Lip shape			
	Direct	Vertical	Flat	Rounded	Pointed	Beveled
160		1		1		
165	1	7		5		3
170	1	7	1	4	1	1
175	1	2		3		
180		1		1	1	
185	1			1		

Table 7.8. Test Units Ceramic Technological Attributes

Levels (cm)	Temper				Firing					Paste texture			Surface Treatment				
	Fine Sand	Medium Sand	Coarse Sand	Subtotal	Reducing		Oxidizing			Homogeneous	Heterogeneous	Lamellar	Subtotal	No surface treatment	Smoothed	Slipped	Subtotal
					Red. Incomplete	Red. Complete	Red. Incomplete	Red. Complete	Subtotal								
10	1	5	5	11	5	5		1	11	11			11	5	6		11
	9.1%	45.5%	45.5%		45.5%	45.5%		9.1%		100.0%				45.5%	54.5%		
15	40	2	3	45	2	17	14	12	45	45			45	19	26		45
	88.9%	4.4%	6.7%		4.4%	37.8%	31.1%	26.7%		100.0%				42.2%	57.8%		
20	43	7	5	55	6	13	21	15	55	50	5		55	14	41		55
	78.2%	12.7%	9.1%		10.9%	23.6%	38.2%	27.3%		90.9%	9.1%			25.5%	74.5%		
25	25	3	1	29	4	11	6	8	29	28			28	17	12		29
	86.2%	10.3%	3.4%		13.8%	37.9%	20.7%	27.6%		100.0%				58.6%	41.4%		
30	15	2		17	1	3	6	7	17	17			17	8	9		17
	88.2%	11.8%			5.9%	17.6%	35.3%	41.2%		100.0%				47.1%	52.9%		
35	1		1			1			1	1			1		1		1
	100.0%					100.0%				100.0%					100.0%		

Table 7.9. Test Units Rim and Lip Shape

Levels (cm)	Rim profile		Lip shape		
	Direct	Vertical	Flat	Rounded	Beveled
10				2	
15		6		6	
20	2	4		5	1
25		6		4	1
30		1	1		

### **Reconstruction of Vessel Shape**

As mentioned earlier, a small number of sherds in a highly fragmented state were recovered from Los Ajos. Despite this fact, we have attempted to reconstruct vessel shape on the basis of the few large rims obtained in the excavations. Figures 7.1-4 displays the drawings of the eight most complete sherds. The diameter at the mouth opening of the 8 reconstructed vessels ranges between 18 and 36 cm and has a mean diameter of 25 cm. It should be noted once again that these vessel reconstructions are tentative since none of the rim sherds, from which the vessel's shape diameter was estimated, reach 10% of the total vessel perimeter.

Making a general comparison with similar rims profiles reconstructed from more complete vessels recovered at other sites in Uruguay (Prieto et al. 1970: Figure 5; Hilbert 1991: Figure 66, 67; Bracco et al. 1993; Figure 5) and Rio Grande do Sul, Brazil (Schmitz 1976; Brochado 1984; Schmitz et al. 1991), it is likely that most of the vessel shapes probably correspond mainly to bowls, dishes, and plates. This suggests that some of the ceramics were likely used for serving, which was probably related to feasting activities. Only one sherd (Figure 7.5c) exhibits decoration in the form of incised small circles. This decoration is similar to the one associated with the Ceibos Phase described by Prieto et al. (1971) in Treinta y Tres Province, Uruguay. Another sherd (Figure 7.5a) exhibits a suspension hole, which is a common characteristic of Vieira ceramics reported in several sites in the area. A brushed decorated sherd was surface collected from the border of Laguna de los Ajos (Figure 7.5d). One sherd, found in Mound Gamma, sector 7/E, 155-160 depth presents an uncommon thickness of 2 cm (Figure 7.5b).

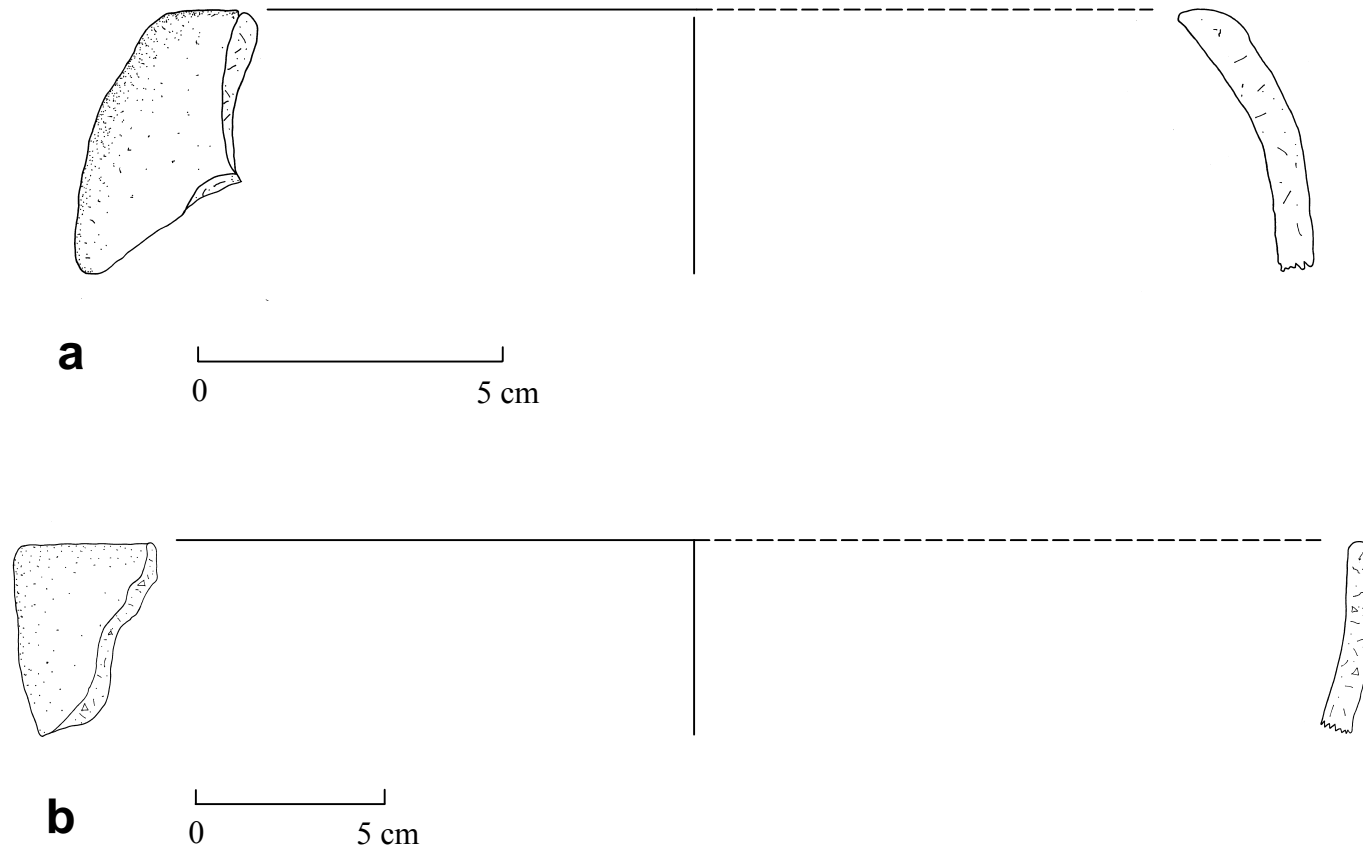


Figure 7.1. Reconstruction of vessel diameter. a: Mound Gamma, 130-135 cm depth, sector 4/B; b: TBN, 185-190 cm depth, sector 12.

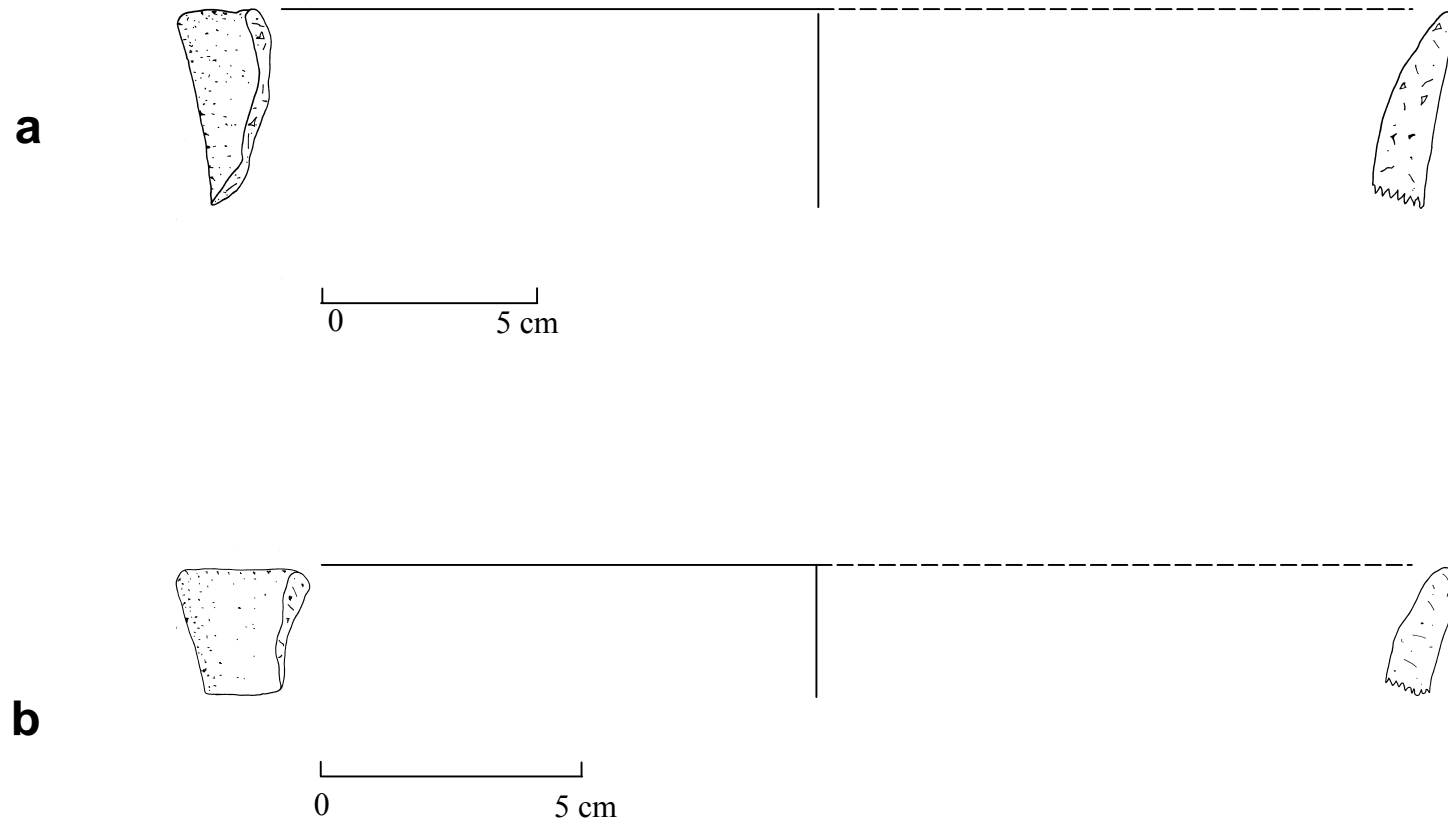


Figure 7.2. Reconstruction of vessel diameter. a: Test Unit N 100 E 200, 15-20 cm depth; b: Test Unit 10, 10-15 cm depth.

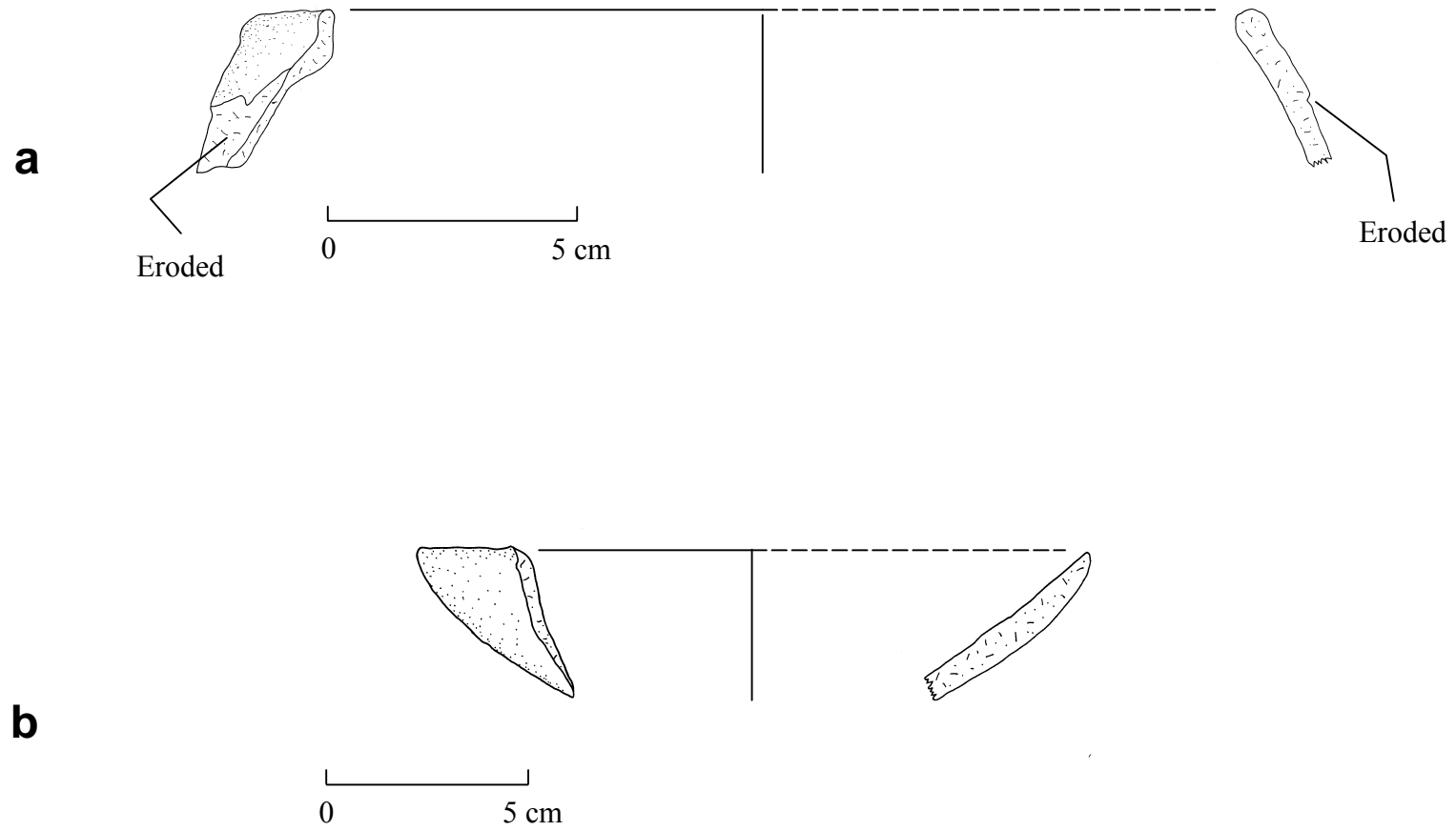


Figure 7.3. Reconstruction of vessel diameter. a: TBN, 160-165 cm depth, sector 8; b: TBN 190-195 cm depth, sector 10.



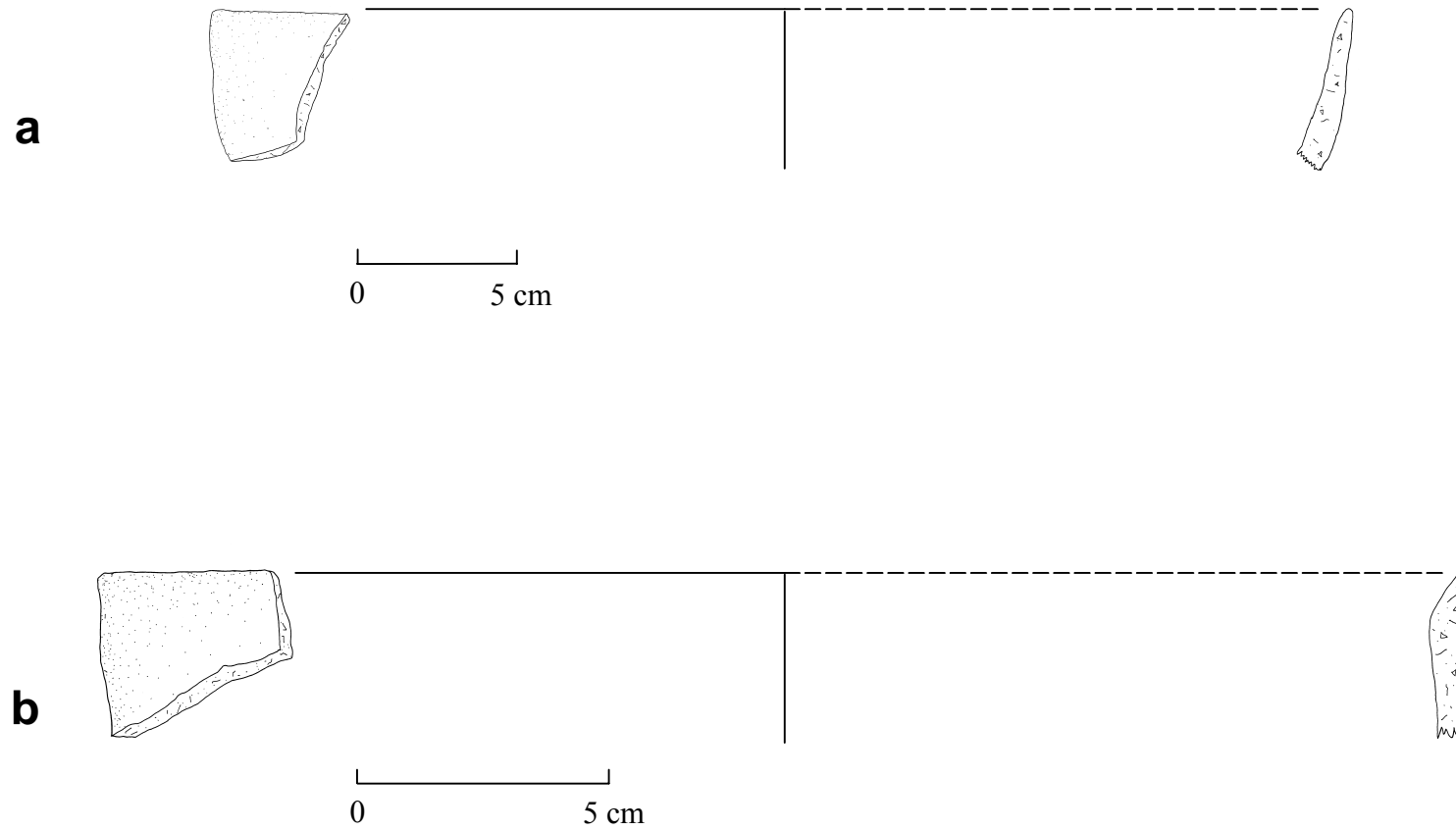


Figure 7.4. Reconstruction of vessel diameter. a: TBN, 185-190 cm depth, sector 12; b: TBN, 160-165 cm depth, sector A1.

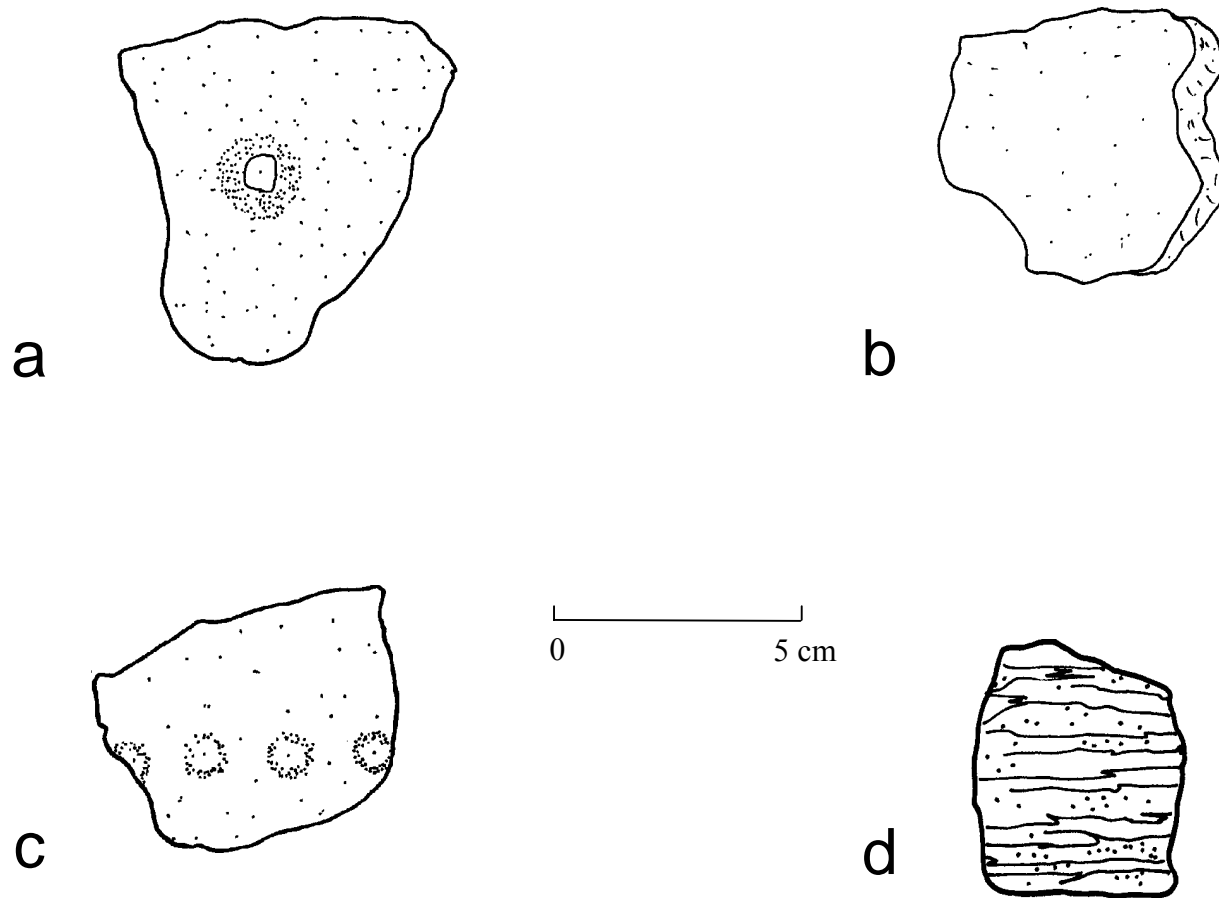


Figure 7.5. Selected sherds. a: ceramic sherd with suspension whole, TBN, 175-180 cm depth, sector 10; b: unusually thick sherd, Mound Gamma, 155-160 cm depth, sector 7/E; c: decorated sherd, Test Unit N 50 E 50, 15-20 cm depth; d: brushed decorated sherd, surface collected.

## Summary

Overall, this basic ceramic analysis indicates that the ceramic assemblage recovered from Los Ajos closely resembles the broadly defined Vieira Tradition ceramics (Brochado et al. 1969; Schmitz 1976; Brochado 1984; Schmitz et al. 1991). The ceramic assemblage is small, which possibly indicates that pottery played a secondary role as containers in relation to baskets or wooden containers. In agreement with all Vieira Tradition ceramics, decoration is exceptional. In Los Ajos assemblage, only one sherd was decorated. Its decoration is characterized by small-incised circles and resembles the Ceibo Phase's incised decoration that occurs in the northern neighboring province of Treinta y Tres (Prieto et al. 1970; Figure 10).

As mentioned earlier, the small and fragmentary nature of the assemblage precludes us from making significant inferences about vessel shape. In spite of this fact, the tentative reconstruction of vessel shape falls well within the parameters that have been described for Vieira ceramics in the region. They are mainly constituted by open, simple vessels, whose diameter at the mouth opening ranges between 18 and 36 cm. They likely represent bowls, dishes, and plates that predominantly have vertical rims and rounded lips, but they also present direct, expanded, and externally inclined rims as well as flat, pointed and beveled lips. Based on comparisons with the more complete reconstructed forms for the region, the overall shape of the bowls is probably globular and subglobular.

The fact that the ceramic assemblage is small and that the attempted reconstruction of vessel's shape indicates that ceramics were likely bowls, plates, and dishes probably used for serving, suggest the possibility that they may have been used for feasting associated to ritual contexts. It should not be forgotten that many sherds exhibit soot on their exterior surfaces, indicating that many of the vessels were used for cooking.

When comparing the different sectors of the site, it is notable that Mound Gamma ceramic assemblage exhibits more variability in temper, less homogenous past, and a major percentage of smoothed sherds in comparison to the off-mound areas ceramic assemblages, which are dominated by fine-sand temper, homogenous paste, and a major percentage of sherds without surface treatment.

Although the small sample of sherds recovered from Mound Gamma is very small (N=49), the ceramic assemblage show two major changes over time: (a) the use of coarse-sand

temper, though it is very limited in occurrence, increases in the upper levels and (b) the upper levels exhibit more variation in paste texture in comparison with the bottom levels of the CMC, where only homogenous paste is present. In general, in the TBN, the technological attributes do not show remarkable chronological differences. Fine-sand temper prevails in all the levels (88.9 to 100%); firing atmosphere is highly variable, as it is in all the levels of the site; paste texture is homogenous (100%) in all the levels. Moreover, in all but the uppermost 160 cm depth level, two thirds of the sherds do not present any surface treatment and the remaining third present smoothed surfaces. The analysis of the vertical distribution of the ceramic assemblage of the TBN indicates that the central sector of the TBN shows a gradual increase in ceramic density over time.. In addition, in comparison with other sectors of the site, the TBN has the highest ceramic density. These two characteristics, along with its stratigraphy and soil chemistry analysis indicate that the TBN was an area that grew through the gradual accretion of domestic refuse. Like in Mound Gamma, in the off-mound grid test units there is an increase in the medium and coarse-sand temper over time. Paste texture is exclusively homogeneous and overall, smoothed sherds are slightly more frequent than sherds displaying no surface treatment.

Because the appearance of ceramics took place concomitantly with major changes in site layout at Los Ajos in terms of the formalization and segregation of space in the inner precinct, I suggest that the differences between the ceramics recovered from the flat-topped, beveled-edged mounds from the inner precinct and the ones from outer more peripheral areas of the site may indicate that different activities took place in these different sectors of the site, as well as, possibly, an incipient differentiation of the material culture possessed by the people who lived in the inner precinct in comparison to the rest of the population that was spread in the vast outer off-mound areas. This aspect will be elaborated below.

Since Vieira ceramics in the region has long been interpreted as domestic in nature due to their simple manufacture, homogeneity, and lack of decoration, the hypothesis that they may have been used for serving in ritual contexts will undoubtedly meet with controversy. In this regard, the pattern suggested here, should be considered nothing more than a hypothesis in need

of testing that should await for more sophisticated ceramic analysis as well as the analysis of a major ceramic sample from the different contexts of the site. In the next Chapter 8, the horizontal and vertical density distributions of ceramics at Los Ajos will be explored in order to help unravel community organization and the occupational history of the site.

## Chapter 8

# Investigating Community Organization at Los Ajos: Studies of Artifact Density Trends, Distribution of Anthropogenically Altered Soils, and Artifact Assemblage Composition

### Introduction

The wetlands of India Muerta exhibit the largest, spatially most elaborate and oldest mound complexes in the region. However, prior archaeological work has been preliminary, limited in extent, and carried out with an ill-suited methodology to investigate community patterns, hampering our ability to understand both the nature of these sites (e.g., vacant ceremonial centers, well-planned villages) and the early Formative societies that built this mounded architecture. This study attempts to rectify this problem by implementing different field research strategies in order to investigate community patterns at the Los Ajos site.

The analysis of artifact density trends, the distribution of anthropogenically altered soils, and the artifact assemblage composition are the main classes of information used to examine settlement structure at Los Ajos. This approach has provided, for the first time, answers to some of the questions that revolve around the nature of early settlement structure at Los Ajos, including the demarcation of site limits and the definition, distribution, and articulation of residential occupation and public spaces. These data sets also have informed us on the social organization, the social construction and the use of space, the transformation of community organization, the uses and functions of the site, and the degree of permanence of the occupation. This chapter begins with an exploration of artifact density trends at the site level for the three temporal components defined at the site: Preceramic Archaic (PAC), Preceramic Mound (PMC), and Ceramic Mound (CMC) Components. Then it offers an analysis of the distribution of the human-produced soil accumulations and their spatial associations at the site-level with mounds, flat areas, and borrow areas. The results of the soil chemistry studies, which are briefly summarized in this section, are presented in detail in Appendix 7. The chapter then shifts focus to the analysis and interpretation of the horizontal lithic debitage density trends in the block excavation carried out in Mound Gamma; crucial to interpret the use/s and nature of sediment deposition in this key sector of the site. After that, I examine the vertical trends in lithic debitage, bone, and ceramic densities in Mound Gamma and in the TBN crescent-shaped rise. Finally, I

provide a summary of the artifact assemblage composition resulting from the analyses of the different classes of artifacts and ecofacts and discuss its implications for the interpretation of the uses of the different sectors of the site.

### **Artifact Density Trends at the Site-Level: Density Distribution of Lithic Debitage and Ceramics at Los Ajos**

Several studies have demonstrated how the analysis of the overall spatial structure of artifact assemblages can provide us with information about settlement organization (e.g., Simms and Heath 1990; Kimball 1993; Oetelaar 1993; Siegel 1995; Dillehay 1997). The spatial distribution of the density of artifacts recovered from mound and off-mound areas may provide us with a coarse-grained view of the internal structure of the site. Below I describe the rationale I followed to create the density distribution maps.

Due to the poor preservation of organic remains at Los Ajos, only lithic debitage and ceramics are plotted. Macrofossil botanical remains were not recovered at the site and bones only were recovered from Mound Gamma contexts. Thus, of all the artifact classes, lithic debitage and ceramic sherds were the most abundant, represented across in most of the sectors of the site, and thus the ones used to explore the spatial distribution of artifact density across the site. The lithic debitage density represents macrorefuse larger than 5 mm, which was recovered in screens of 5mm mesh size. Lithics and ceramics recovered from the heavy fraction of the flotation machine are not used in this analysis.

In addition, because the different excavation units (block excavation at Mound Gamma, grid test units, plaza area test units, and TBN trench) were not uniform in size and each temporal component in the various sectors of the site has different depths, density of artifacts was used to make comparisons across the different sectors of the site. Calculation of density was based on artifact count per cubic meter ( $/m^3$ ). Besides, given the discontinuous character of the data and the ubiquitous presence of mounded architecture at the site, the density of artifacts (lithic debitage and ceramic sherds) was plotted using proportional post maps such as Surfer Software instead of contour maps to display density trends. Proportional post maps show proportionally scaled values of artifacts/ $m^3$ , as seen in the size of circles, overlaid over the contour topographical map of Los Ajos from the three different components represented at the site:

Preceramic Archaic (PAC), Preceramic Mound (PMC), and Ceramic Mound (CMC) Components.

The different units and levels corresponding to each temporal component of the site that were used to create the maps were defined in Chapter 4 and are summarized in Tables 8.1-7, which are grouped in Appendix 8. Before proceeding with the description of the maps, I will briefly recapitulate the definition of these archaeological components at Los Ajos.

*Preceramic Archaic Component (Early Holocene – ca. 4,190 bp).* In mounded areas of the site, the PAC consists of the two lowermost layers that comprise the buried hilltop soil on top of which the mound sediments were deposited. This type of soil is common in the rocky knolls of the area and is constituted by a slightly developed, superficial, A-R horizon type soil. Its slightly developed surface A horizon is sandy with gravel inclusions, below which there is a gravel layer of decomposed rock that lies on top of the rhyolite bedrock. It is within the gravel layer and superficial buried A horizon that the cultural materials pertaining to the Preceramic Archaic Component are embedded. The Preceramic Mound Component sediments that were deposited later on top of them sealed these layers. This is the case for Mound Gamma (Layers 2 and 3, Figure 4.6) and Delta (Layers 2, Figure 4.19). In the TBN trench transect, the PAC artifacts are contained in the gravel layer (Layer 2, Figure 4.20) that were sealed by the deposition of midden-refuse sediments (Layers 3 and 4, Figure 4.20). As explained in Chapter 4, in the test units placed in the TBS, the artifacts contained and lying above the thin gravel lens (Layer 4) that is located immediately above a clay layer corresponding to a buried B-horizon (Layer 3) (Figure 4.22) were assigned a PAC age. In the off-mound areas, that lack an accumulation of anthropogenically altered soils (like the plaza area, the intermediate areas between mounds and the TBN and TBS, and most of the grid test units), all the levels that contain artifacts embedded or lying directly above the gravel layer (Layer 5, Figure 4.21) or thin gravel lens (Layer 3, Figure 4.22) have been assigned to the PAC. It should be noted that the definition of the Preceramic Archaic Component in the off-mound areas is coarse-grained. This is due to a lack of radiocarbon dates in these areas, the absence of few time-sensitive diagnostic artifacts such as the appearance of ceramics, the shallowness and compactness of the off-mound stratigraphy, and the fact that the materials contained in them could be representing several millennia.



*Preceramic Mound Component (ca. 4,190 to ca. 3,000-2,500 bp).* In mounds Gamma and Delta, the Preceramic Mound Component consists of a well-developed compact, very dark brown loam/silty loam organic sediment containing high concentrations of burned clay, ash lenses, and charcoal (Figures 4.6 and 4.19, Layers 4 and 3, respectively). In the TBN, the lowermost part of Layer 3, between 190-200 cm deep, has been assigned a PMC age due to the absence of ceramics (Figure 4.20). In the TBS, in Layer 7, the levels between the thin gravel lens and the ceramic bearing levels were assigned a PMC age (Figure 4. 21). In the off-mound areas that do not contain anthropogenically-altered soils, the levels between the ones assigned to the PAC and the ceramic-bearing levels have been assigned to the Preceramic Mound Component.

*Ceramic Mound Component (ca. 3,000-2,500 bp to contact period).* In mounds Gamma and Delta, the Ceramic Mound Component consists of a very dark brown sediment bearing medium to high concentrations of gravel within a silty loam matrix (Figure 4.6, Layers 5 and 6; Figure 4.19, Layers 4 and 5) containing ceramics. In the TBN, the uppermost part of Layer 3, between levels 190 to 135 cm deep, correspond to the Ceramic Mound Component (Figure 4.20). In Layer 6 of the TBS (Figure 4.21) and in the other off-mound areas, the ceramic-bearing levels were assigned a CMC age.

Figures 8.1-3 depict lithic debitage densities from the three main components of the site: Preceramic Archaic, Preceramic Mound, and Ceramic Mound components. Figure 8.4 illustrates the ceramic sherd density across the site. Tables 8.1-3 (Appendix 8) display the debitage and ceramic density for the off-mound areas, including the grid test-units and the plaza area units. Tables 8.4-7 do the same for Mound Gamma, Mound Delta, the central sector of the TBN and the TBS transect crescent-shaped rises. The tables present count (N) and density ( $/m^3$ ) for every 5 cm artificial level excavated as well as an average ( $\bar{x}$ ) for each temporal component of the site displayed in the right side of the tables. To aid the reader, I have highlighted the different temporal components that appear in Tables 8.1-3 in various tones of gray.

The densities plotted in Figures 8.1-4 correspond to an average of the densities of all the levels corresponding to each temporal component from each test unit, the block excavation at Mound Gamma, and the central part of the TBN trench. For example, the Ceramic Mound levels of the grid test unit N 50 E 250 correspond to 5-10, 15-20, and 20-25 cm deep having 9.1, 213.3, and 80 pieces of debitage/ $m^3$ , respectively. Therefore, the plotted mean for the Ceramic Mound

Component of this unit is  $100.8/m^3$ . In this regard, the proportional post maps represent a two-dimensional transformation of three-dimensional space. The maps represent the actual location of the horizontal E-N (X-Y) coordinates of the site. The third dimension, depth, is “collapsed” and represented by an average of the density of the different levels corresponding to each temporal component.

Before proceeding with the description and interpretation of the proportional post maps, some qualifying statements are warranted. In the first place, one must bear in mind the large scale of the site. In addition to the inner precinct consisting of the horseshoe arrangement of platform mound embracing a central plaza area, Los Ajos presents a vast outer area with more dispersed and less formally integrated mounded and flat-off mound areas covering ca. 12 ha. In spite of the fact that the most important sectors of the site were targeted (see Excavation Methodology in Chapter 4), the off-mound subsurface testing conducted at the site, which added up to  $135.75 m^2$ , only generated a sampling intensity of 0.09 %. Besides, the grid test units from the systematic interval transect sampling were spaced at 50 m intervals. This spacing is too great to ensure the detection of all artifact concentrations. As a result, many areas of the site have not been tested and at present, their chronological placement is uncertain, which precludes a full assessment of the overall variability of the site deposits. In this regard, given the large size of the site and the small amount of excavations conducted, it is likely that additional zones of behavioral importance are present.

One also must take into account the coarse temporal assignment of the artifact plotted in these maps. This is the result of few time-sensitive artifacts (e.g. the appearance of ceramics) and the absence of radiocarbon dates in the off-mound areas of the site. Therefore, the resulting proportional post maps presented below should be interpreted as an average of the surface distribution of artifacts accumulated during each temporal component indicated in each map. As a consequence, they only allow us to make some general statements of the nature of the occupation during the different temporal components. As will be shown below, the artifact distributions obtained from the block excavations, the trenches, in conjunction with the off-mound test units allowed us to gain a coarse-grained view of the settlement layout as well as a general idea of the intensity of occupation during the different temporal periods. However, based on the qualifying remarks made above, they should be considered tentative and subject to revision in the future.

## **Results and Interpretation of Artifact Density Trends at Los Ajos**

*Preceramic Archaic Component (Early Holocene – ca. 4,190 bp).* A close reading of Tables 8.1-7 and Figure 8.1 indicate that the Preceramic Archaic lithic debitage density is spatially discontinuous. Overall, the values of lithic debitage densities are lower than in the two succeeding mound components. This is particularly noticeable when comparing average densities of the PAC with PMC and CMC levels from mounded areas of the sites such as Mound Gamma and the TBN central sectors (see Tables 8.5 and 8.7). If we assume that an increase in artifact density corresponds to a more intense occupation of the site, the data obtained in this study suggests that there was an increase in the intensity of occupation at Los Ajos from the pre-mound PAC to the mound components. The contrast is even greater taking into account that the coarsely defined PAC may represent more than six millennia. The greater intensity of occupation during the mound components is further corroborated by the beginning of gradual accumulations of occupational refuse reflected in the appearance of mounds and the shallow accumulation of midden deposits represented by the TBN and TBS crescent-shaped rises that began to take place during the PMC.

*Preceramic Mound Component (ca. 4,190 to ca. 3,000-2,500 bp).* In comparison to the PAC, the PMC lithic debitage is more evenly distributed across the site and is represented in more test units. As mentioned above, in general, these data also indicate a greater density of lithic debitage during this temporal component. Importantly, in addition to the appearance of a central plaza area, the beginning of mound formation, and the accumulation of midden deposits in the TBN and TBS, the systematic trench transect results indicate that there is a vast outer area of continuous domestic debris covering ca. 12 ha, which probably represents more ephemeral occupations of the site. In addition, from the central sector of the site towards the east coordinates E250 and E400 coordinates, we observed a decrease in the density of artifacts, which then increased again as one reaches the periphery of the Mound 15 located to the east of coordinate E450.

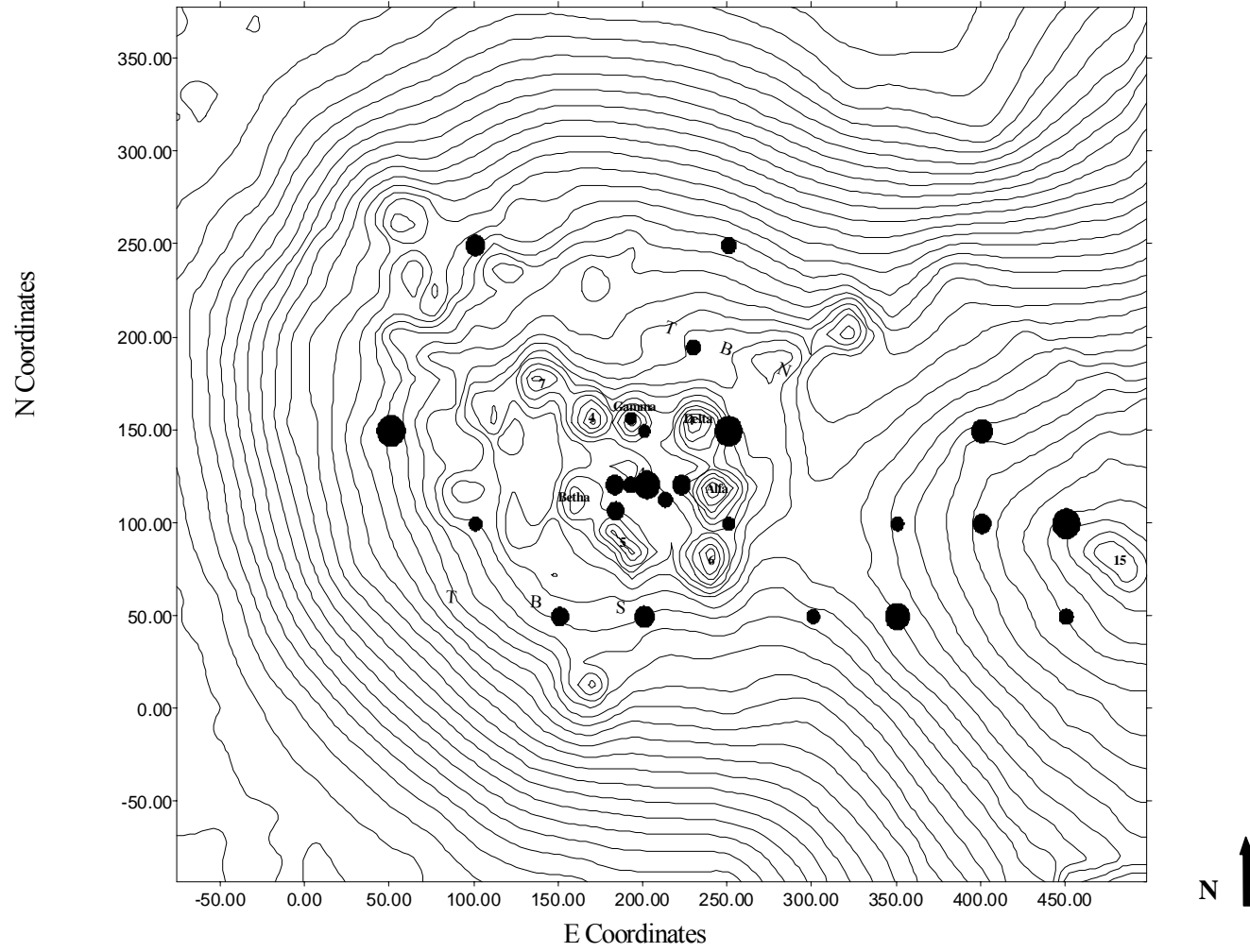


Figure 8.1. Proportional Post Map of Preceramic Archaic Lithic Debitage Density at Los Ajos.

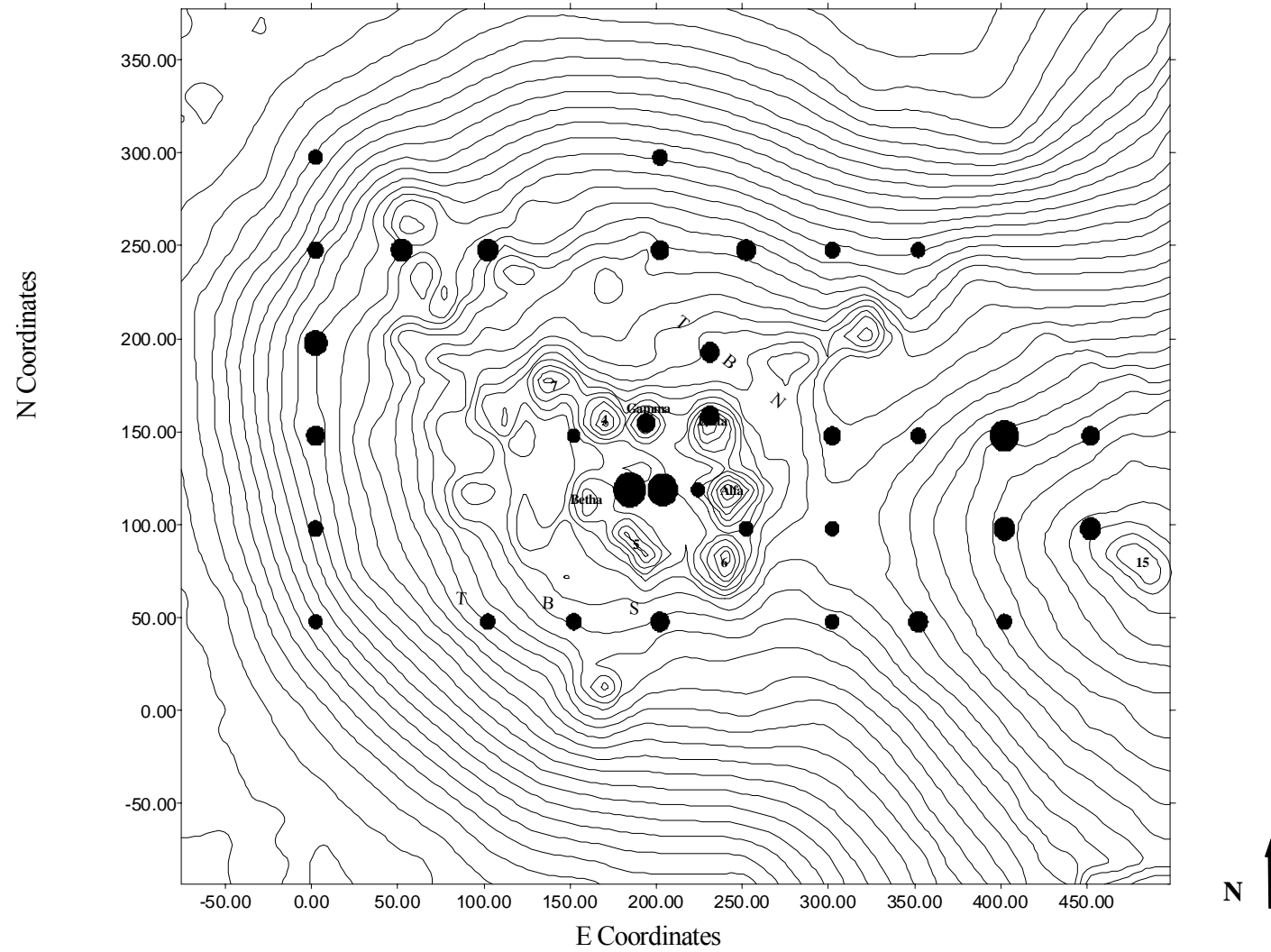


Figure 8.2. Proportional Post Map of Preceramic Mound Lithic Debitage Density at Los Ajos.

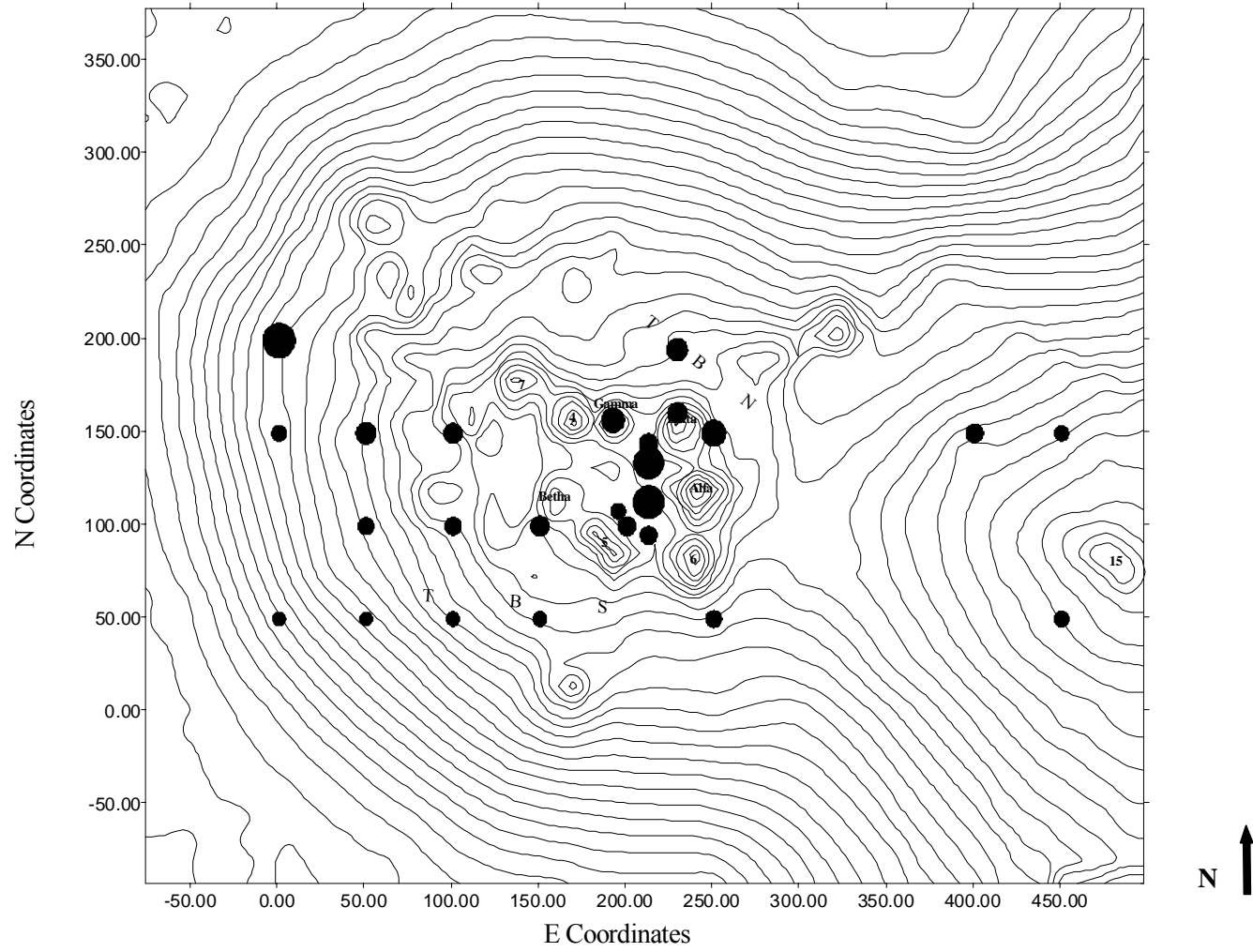


Figure 8.3. Proportional Post Map of Ceramic Mound Lithic Debitage Density at Los Ajos.

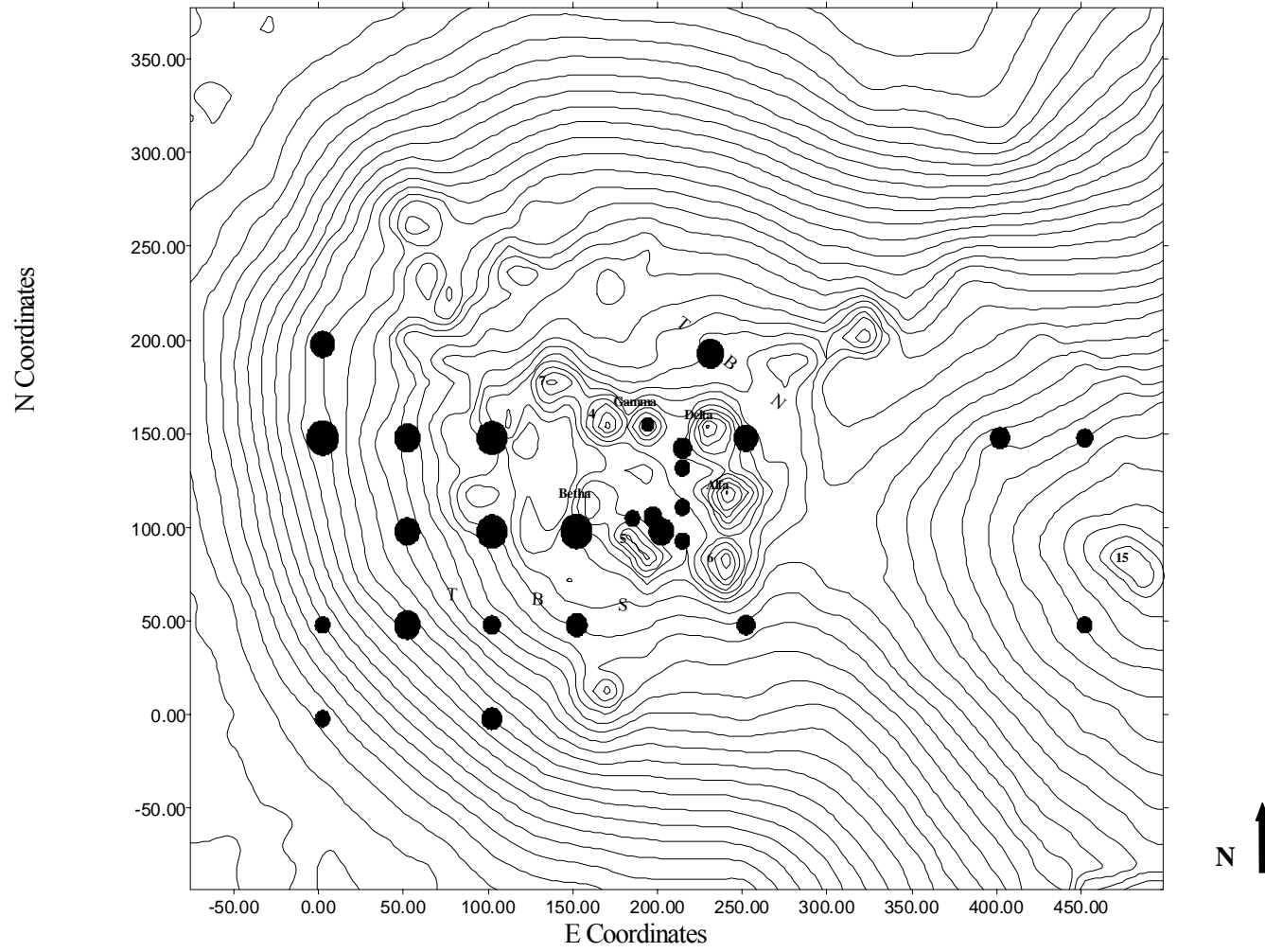


Figure 8.4. Proportional Post Map of Ceramic Density at Los Ajos.

This sector of low density of artifacts could represent the site limits and a separation from the other cluster of mounds that are located to the SE in SE-NW direction along the slope of Sierra de los Ajos. The fact that this portion of the site may be indicating the site's limits is also supported by the lack of mounded architecture and/or the accumulation of human-produced soils in this sector of the site.

*Ceramic Mound Component (ca. 3,000-2,500 bp to contact period).* A visual inspection of the lithic debitage and ceramic debitage density at Los Ajos shows that the Ceramic Mound Component occupation was biased to the western sector of the site. In particular, the density distribution of ceramics indicates that large portions of ceramic sherds were discarded in this sector of the site. Ceramics also were discarded in relatively high frequencies at the TBN and TBS crescent-shaped rises.

The lithic debitage density shows large circles in the plaza area indicating a high density of lithic debris in this sector. However, closer reading evidences that the only plaza area test units that present ceramics are the ones that are in or very close to the articulation of the mound slope with the plaza area. This is the case for Test units 1, 4, and 10 that were placed in the very end of the slopes of Mounds Alfa, Delta, and 5, respectively (see Figure 4.3). Due to the gravitational displacement of artifacts in the edges of the mounds, the "piedmont" of the mounds received material from the higher parts of the mound and thus, displays high artifact densities. If we do not take into account these test units, the plaza area present very low density and in parts becomes free of both lithic and ceramics refuse during the Ceramic Mound Component since the central units of the plaza area 2, 3 and 9 do not have any ceramic sherds.

In addition, it is noteworthy that during the Ceramic Mound Period, Mound Gamma and the TBN display similar lithic debitage densities, but when we compare ceramic densities, the central sector of the TBN trench has 35 times the density of Mound Gamma. This indicates that the TBN was an area of intense ceramic disposal. In addition, in general, ceramics from Mound Gamma exhibit greater percentages of ceramic sherds with coarser paste, less homogenous texture, and smoothed surface treatment. As in the PMC, there is a tendency to have a lower density of artifacts from the central sector of the site towards the east. Like in the PMC, the results of the systematic interval transect sampling indicate that there is a vast outer area of continuous lithic debitage and ceramic debris outside of the more central part of the site. As will



be discussed in more detail below, this large outer area presenting domestic debris may be representing less intense, more ephemeral occupations of the site. Last but not least, during the CMC, there is there is an absence of ceramics between coordinates East 275-300 and the periphery of Mound 15 which could be representing the site boundary between Los Ajos and the mound cluster that occur to the southeast of Los Ajos.

### **Summary**

On balance, the patterns observed in the proportional post maps of the off-mound areas can be summarized as follow. First, both the off-mound and the mounded areas of the site show increasing artifact densities and more widespread distributions of artifacts over time, which indicate, along with other lines of evidence presented previously, a more intense occupation of Los Ajos through time from the PAC to the CMC. Second, the distribution of lithics and ceramics shows that starting in the Preceramic Mound Component, there is a central plaza area characterized by very low densities of refuse and free of any refuse in some parts. Third, the results of the systematic interval transect sampling of test units indicates that the site is not restricted to the inner precinct consisting of the mounded architecture embracing the central plaza. The results of the systematic interval transect sampling of test units revealed an extensive outer area exhibiting continuous subsurface domestic debris. Fourth, the Ceramic Mound Component also shows an occupation biased towards the west of the site, closer to the Laguna de los Ajos. Lastly, the distribution of artifact densities at the site also indicated that low densities of artifacts and the lack of mounded architecture, between the coordinates 275-300 to the East, characterized the site's limits. This information will be integrated with the other classes of data examined in this chapter in the final section.

### **Distribution of Human-Produced Accumulated Soils, the Central Plaza Area, and Intermediate Areas Between Mounds and Midden-Refuse Areas.**

Figure 8.5 shows a sketch map of the distribution of human-produced accumulated soils at Los Ajos, referred to as TBN and TBS, respectively. The accumulation of human-produced soils only took place during the early Formative period (Mound components) and is associated with a more intense occupation of the site.

#### **Human-Produced Accumulated Soils**

##### ***TBN – Northern Crescent-Shaped Rise Trench***

As described earlier, the TBN is a 14 to 25 m wide and 150 m long crescent shape rise that surrounds Mounds Delta and Alfa at a distance of approximately 15-20 m. At its base, the crescent shape projects to the NE forming an elongated mound (Figures 4.2, 4.3, 4.4b), which faces in NE direction Mound 13. The TBN trench is constituted by a 2 x 40 m trench that bisected in a S-N direction the northern slope of Mound Delta and the TBN crescent-shaped rise (see Figure 4.20). From north to south, the TBN trench stratigraphy shows the articulation of Mound Delta, the intermediate flat area, and the crescent shape rise. In the TBN, both mound components, the PMC and CMC, are contained in Layer 3 (Figure 4.20).

The lowermost part of Layer 3, consisting of levels 190-200 cm deep, which lacks any ceramics were assigned a PMC age. The upper part of Layer 3, between levels 190 to 135 cm deep, correspond to the Ceramic Mound Component. Two dates were obtained from the TBN central sector, one from level 190-195 cm deep, corresponding to the middle-lower part of Layer 3 dating to  $1,660 \pm 40$  bp (ca. 1,550 cal.bp) and other from the upper part of Layer 3, level 160-165 cm dating to  $1,020 \pm 40$  bp (ca. 985 cal.bp). In the central sector of the TBN, the accumulation of anthropogenic deposits reaches a maximum thickness of 90 cm and do not exhibit any intervening non-cultural sediments or other evidence of long-term abandonment. In comparison to other parts of the site, this indicates a fairly rapid accretion of human-produced soils in the central part of the TBN during the later period of the occupation of

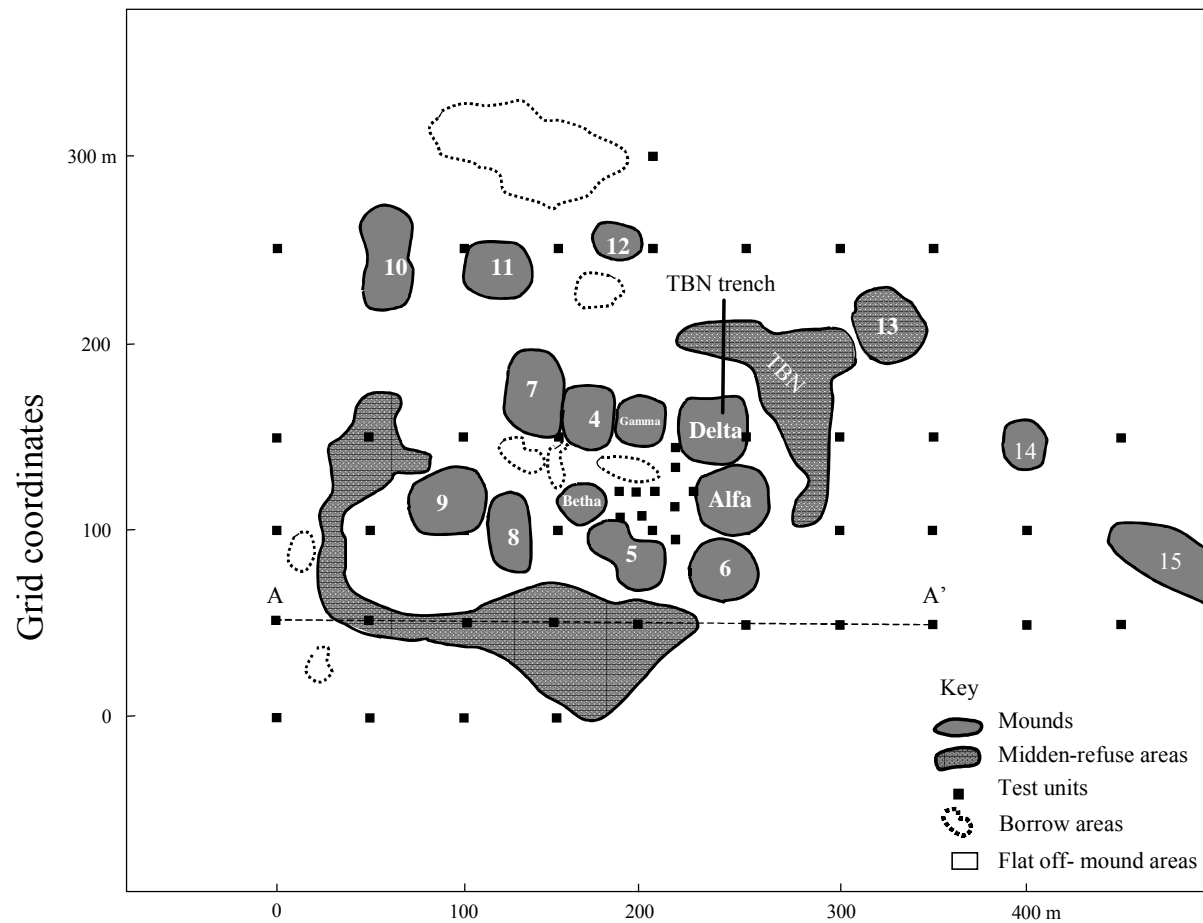


Figure 8.5. Sketch Map of Distribution of Mounds, Midden-Refuse Areas, Flat Areas, and Burrow Areas at the Los Ajos Site. Transect A-A' is Shown in Figure 8.6. TBN Trench Profile is Displayed in Figure 4.20.

the site. It is clear from it that the deposition of human-produced soils was restricted to the sector of the crescent-shaped rise because the area that separates Mound Delta from the crescent-shaped rise is free of any soil accumulation. In order to gain a better understanding of the TBN formation processes, a column sample of soil was extracted from the west wall of sector 7 in the central sector of the TBN for chemical analysis at 10 cm intervals (see Figure 4.18 and 4.20).

The results of the soil chemistry analysis are presented in Appendix 7. Briefly, the results show two main patterns. First, the TBN soils clearly show an enrichment of all the chemical elements and the percentage of organic content along the mound components when compared to the background natural soils in the area (Table 1, Appendix 7). Second, all the chemical elements tested show a vertical increase in its quantity over time along Layer 3. On the basis of its stratigraphy, the high frequency and the gradual accumulation of artifacts, and the gradual chemical enrichment of its sediments over time, the TBN is interpreted as a domestic area that grew through accretion by the gradual accumulation of occupational refuse. I will return to this point in the summary of this section.

### ***TBS- Southwestern Crescent-Shaped Rise***

In the southern part of the site, the TBS constitutes a semicircular rise that starts to the south of Mound 5 and continues for 150 m up to Mound 9, forming a partial ring that lies 20-50 m to the south of Mounds 5, 6, 8, and 9. Although no chemical analysis were carried out of the TBS, the similarities shared between these two areas in terms of shape, size, depth, location, the anthropic nature of its soils together with its artifact content led us to interpret the TBS as an area that grew through accretion by the accumulation of occupational refuse. In this regard, a comparison of soil depth, color, and texture of both the TBN and TBS set them clearly apart from the natural soils that we should expect in this locality. Both the TBN and TBS soils are deeper, darker, more loamy, and less sandy than the natural A horizon, characteristic of hilly soils in the region (Altamirano 1998). Figure 8.6 displays the toposequence N 50 E 300 presented in Chapter 4 (Figure 4.22) along with a topographical profile and graph that plots the average density of artifacts (lithic debitage and ceramic sherds) along the transect. For the sake of simplicity, both the Preceramic and Ceramic Mound Component, which are represented in Layer 5 (Figure 4.22), are put together.

The stratigraphic profiles along the transect show how as one approaches the TBS from the TU N 50 E 100 in an eastward direction, the dark, organic, loamy/silty loamy layer becomes deeper and darker. As one moves away from this crescent shape rise both to the east and to the west, changes in color, texture, and depth occurred. Starting in test unit N 50 E 100 as one gets to the higher part of the TBS, the color changes from very dark brown (7.5 YR 2.5/1) to black. As one walks away from the TBS toward the slope in E direction, the color changes to a dark brown (7.5 YR 3/2) (N 100 E 200), to brown (7.5 YR 4/3) (N 100 E 250) and to a dark gray (5YR 4/1) (N 100 E 300). We also noticed a change in the texture of the soil. While the sediments of the organic, dark sediments of the TBS are loamy to silty loamy, the sediments from the adjacent test units are mainly composed of fine sand with gravel. These changes are paralleled in the lithic debitage and ceramic density. The top part of Figure 8.6 shows an average of lithic debitage and ceramic density along the N 50 transect from E0 to E300 marked as A-A' in Figure 8.5. Density values are displayed in Table 8.3. The distribution of lithic and ceramic densities clearly shows an increase in both lithic debitage and ceramic sherds within the anthropogenic soils, and vice-versa. The artifact density decreases as one move away from this sector of the site. In summary, soil chemistry, color, texture, and distribution of these crescent-shaped rises indicates that these areas were intensively occupied. In addition, the gradual increase in the chemical elements towards the surface, a pattern that is paralleled by both the lithic debitage and the ceramics, further corroborates the gradual accumulation of occupational refuse in these areas.

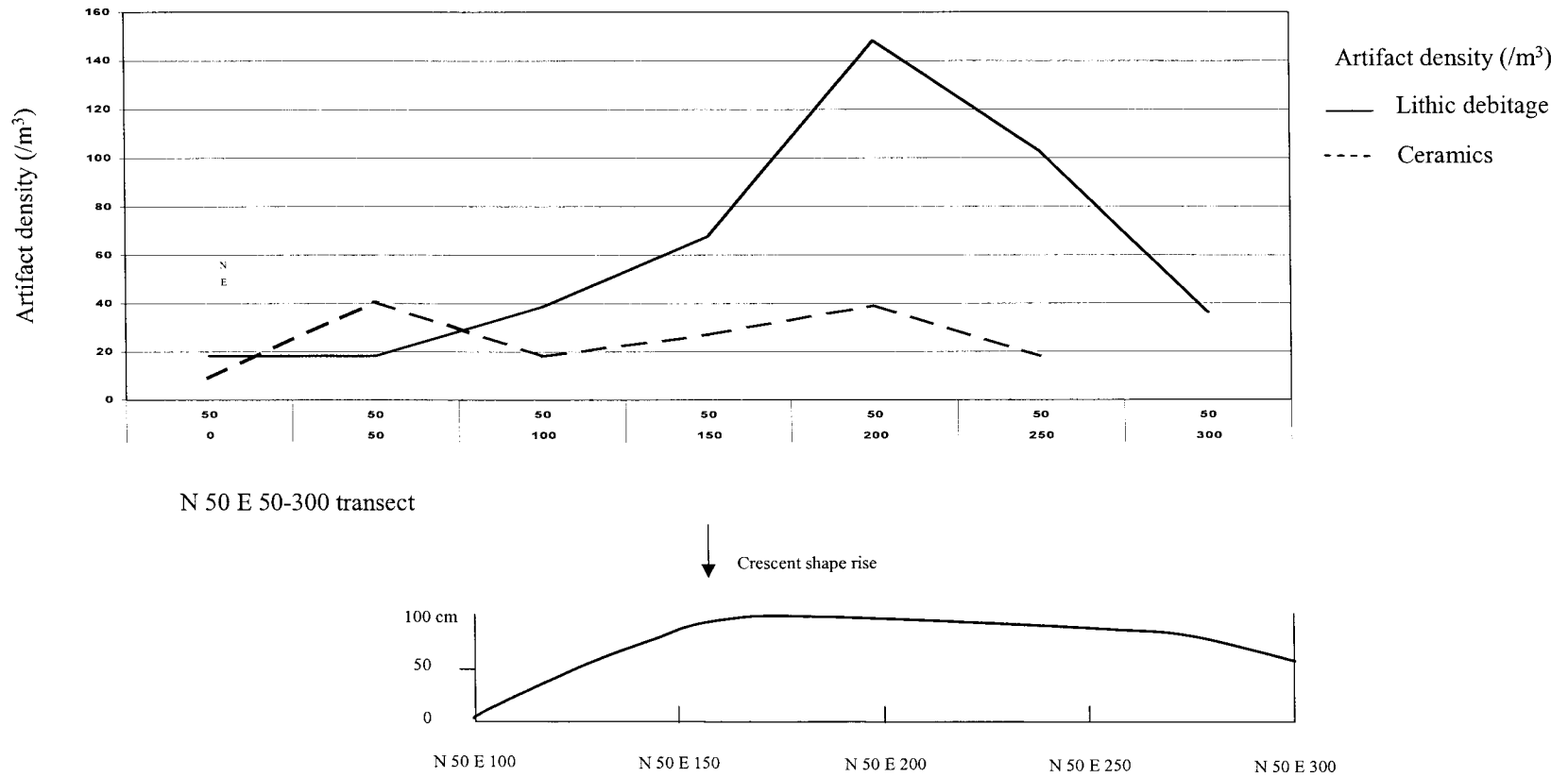


Figure 8.6. Transect W-E: N 0 E 300 Showing Topographic Profile and Lithic Debitage and Ceramic Density (Please Refer to Figure 4.22 to See the Stratigraphy of this Sector of the Site).

## **Central Plaza Area and Intermediate Area Between the TBN Crescent Shape and Mound Delta**

In marked contrast to these sectors of the site, which display accumulations of human-produced soils, the central plaza area, the area between the mounds, the TBN and TBS, or the areas outside the TBN and TBS do not show accumulation, darkening or chemical alteration of soils. As is often the case in spatial analysis, this type of “negative” spaces is just as informative as “positive” ones. The central plaza area is located in the highest part of a flattened circular knoll of Sierra de los Ajos, overlooking the wetlands of India Muerta. It is oval in shape, 75 x 50 m in size, and characterized by a leveled flatness. A general stratigraphy, based on all the test units for the plaza area, is described in Figure 4.21. To briefly reiterate, the stratigraphy of the plaza area could be described, from bottom to top, as follows. The rhyolite bedrock represents Layer 1. The second layer, Layer 5, corresponds to the decomposed bedrock gravel layer embedded in a sandy matrix. This layer extends from 10 to 15cm in deep. This gravel lens is thicker in the plaza area, which is the highest part of the site, where the bedrock is closer to the surface and where the soil is more superficial. The third layer, called Layer 7 in Figure 4.21, corresponds to a slightly developed A horizon characterized by a gravelly light gray (5YR 7/1) sand silt sediment extending ca. 7-12 cm deep. Layer 8 is composed of the surface humus, which extends from 5 to 10 cm in depth from the ground surface.

The presence of cultural materials embedded up to 15 cm within the gravel layer indicates that the soil has been deflated. In this study, its deflated nature has been interpreted as the result of both natural and cultural processes. Two major natural factors account for its deflation: (a) due to its topographic position, these are slightly developed superficial soils that are easily subjected to deflation and (b) the Mid-Holocene period of dryness, described in detail in Chapter 3 and Appendix 2, may have aggravated this condition, exposing the soil to further erosion due to a dramatic decrease in the vegetation cover. As a result of these factors, the finer sandy silty fraction of the A soil horizon, where cultural materials were embedded, may have been blown or removed down slope by surface flow; allowing for the coarser stony materials to accumulate. As a result of this process, it left a thick gravel layer with cultural materials embedded within it (Figure 4.21-22).

In addition, cultural practices may have contributed to the deflated and superficial nature of the central areas soils. In the first place, the extraction of soil borrowed from the A horizon to

build the mounds would have made the A horizon of this area even thinner. In the second place, since the area is interpreted as a public space, it must have been subjected to continuous walking. Hence, reducing the vegetation cover leaves this central surface of the site readily exposed to erosion. This is a phenomenon that has been observed in many circular villages of Amazonia (i.e., Myers 1973; Heckenberger 1996) and Central Brazil (i.e., Wüst 1998; Wüst and Barreto 1999). Overall, its central location, surrounded by residential structures, the paucity of cultural materials, and the lack of soil accumulation or alteration (darkening) strongly suggest that the central part of the site was an enduring feature of village organization, constituted by an open space, commonly called plaza. The social implications of plaza areas will be discussed in detail in the next chapter.

The intermediate area that separates Mounds Delta and Alfa from the TBN crescent shape rise is a flat area similar to the plaza area in profile with extremely low artifact densities and no midden accumulations or soil alterations (see Figure 4.16 and 4.21). By separating the inner precinct of the site consisting of the central plaza area and the mounds from the more peripheral areas of the site like the crescent-shaped rise and the outer vast area of domestic debris it adds a more formal layout to the inner precinct.

Last but not least, the borrow areas are located in the periphery of the site. As described in Chapter 4, borrow areas are fairly extensive (up to 4000 m<sup>2</sup>) bowl-shaped depressions where the bedrock is exposed (see Figure 4.23b). Unlike the natural hill top A-R litosol soils, in the borrow areas both the gravel layer and the A horizon are absent because they were extracted as filling material for the construction of the mounds. In contrast to the natural rock outcrops in the higher part of the hills, which are convex in profile (see Figure 23a), in the borrow areas, the bedrock is exposed within a slightly concave bowl shape depression (compare Figure 4.23a and 4.23b). Taking into account that the capping/filling episodes are visible in Mound Gamma and Delta during the CMC, we can suggest that the borrow areas were created during the CMC. The fact that they are located in the peripheral area of the site without altering central parts of the site further corroborates the careful planning and formality of the central part of the site.



## Summary

On balance, the distribution of human-produced accumulated soils and flat areas indicate that Los Ajos was partitioned in a number of discrete areas. Although, the types of soils described grade subtly into one another, a clear pattern of soil distribution is evident. In the plaza area, the interstitial zone between the mounds and the TBN/TBS rises, and the extensive outer area away from the TBN and TBS rises, the soils have less organic content, are lighter in color, contain more sand and silt, and bear lower artifact densities. On the contrary, the mounds and the TBN/TBS rises exhibit clearly anthropogenically-altered soils and both contain higher densities of artifacts. The evidence from the TBN and TBS rise several points for consideration that will be briefly discussed in chronological order.

During the Preceramic Mound Component, the TBN and TBS only present very shallow accumulation of midden deposits in these areas (ca. 10 cm in the central sector of the TBN). The focus of the residential occupation was centered on mound contexts in the central part of the site which show a gradual accumulation of occupational refuse during this period. The broad contemporaneity suggested by radiocarbon dates, artifact content, and similarities in stratigraphy among Mounds Alfa, Delta, and Gamma suggest that the placement of residential areas around the central plaza area was part of the planning process in designing the settlement layout of the Preceramic Mound Component occupants; a pattern that was later followed by the succeeding occupants.

Throughout the Ceramic Mound Component, the accretion of domestic refuse was greater (ca. 60 cm) suggesting more intense and permanent occupation in these sectors of the site during this. In comparison to other parts of the site, this indicates a fairly rapid accretion of human-produced soils in the central part of the TBN during the CMC. Besides, not only the depth of the anthropogenic deposits in the TBN is important, but also it should be taken into account that its dimensions, it extends for approximately 150 m with a width of 14-25 m. In addition, to these sectors of the site that present accumulation of human-produced soils, both during the PMC and CMC the site present a vast outer off-mound area of domestic debris as indicated by the distributional data obtained from the systematic interval transect sample of test units.

Conversely, both in the plaza area, as well as in the area separating the mounds from the crescent-shaped rises, there appears to have been an effort to keep the area clear of any accumulation of refuse. The presence of both a plaza area and a cleared area below the mounds,

in addition to the remodeling of mounds that became more imposing flat-topped platform mounds added formality to the inner precinct.

Notably, concomitant with a more intense occupation of the TBN and TBS during the CMC, the inner precinct of the site was experiencing substantial transformations. As reflected in Mound Gamma, the mounds of the central part of the site were the focus of new activities in addition to the residential one. The mounds in the central part of the site were remodeled through capping episodes converting them into flat-topped, beveled-edged mounds. The CMC also witnessed the appearance of partial burials as an integral and recurrent activity that took place only in mound contexts in the inner precinct mounds. Last but not least, ceramic from mound contexts not only present lower densities but also exhibit difference in paste, texture, and surface treatment in relation to the TBN ceramics.

As will be elaborated below, all this evidence suggest that during the CMC the inner precinct of the site experience a process of formalization and spatial differential in comparison to the rest of the site. Though it continue to be a residential area, it became more focused on public ritual activities and probably the larger occupation of the site took place outside of this central formal inner precinct. As mentioned above, during the CMC, the evidence suggest that the immediate areas surrounding the mounds like the TBN and TBS were the focus of a more intense occupation, while the vast area of domestic debris spread outside the central part of the site, may represent more ephemeral occupations, perhaps the remains of groups that visited the site sporadically for ceremonial purposes.

### **Horizontal and Vertical Distribution of Artifact Density at Mound Gamma and the TBN Crescent-Shaped Rise**

The characteristics of the different classes of artifacts, the artifact density distribution in both horizontal and vertical contexts along with features, stratigraphy, and chronology are crucial to interpret mound formation processes. In particular, artifact density and distribution are measures that are easily obtainable even with the large volume of material that characterizes the block excavation of Mound Gamma or the TBN trench, and may provide us with important information on formation processes.

### *Horizontal Density Trends of Lithic Debitage at Mound Gamma*

The results of several ethnoarchaeological (e.g., Yellen 1977; Hayden and Cannon 1987; Deal 1985) and archaeological studies (e.g., Kimball 1993; Simms and Heath 1990; Dillehay 1997) indicate that data from the overall spatial structure of artifact and ecofact assemblages rather than individual artifact categories provide information that more directly relates to contemporary models of utilization of space. However, the poor preservation of organic remains at Mound Gamma prevents us from carrying out such an analysis. Therefore, only the analysis of the horizontal density trends of lithicdebitage was carried out.

As described earlier, Mound Gamma was excavated down to the base of the cultural deposits, using shovel skimming and hand troweling techniques. Because of the dark homogeneous color of the sediments, cultural strata were extremely difficult to define and it was excavated in arbitrary 5 cm levels. All excavated sediments were screened through a 5 mm mesh sieve. Intensive hand excavation was carried out to uncover features such as stone-structures, hearths, and burials. However, in most instances, the accuracy of piece plotting was sacrificed in order to open a large block unit and favor the collection of a greater sample and wider range of assemblages.

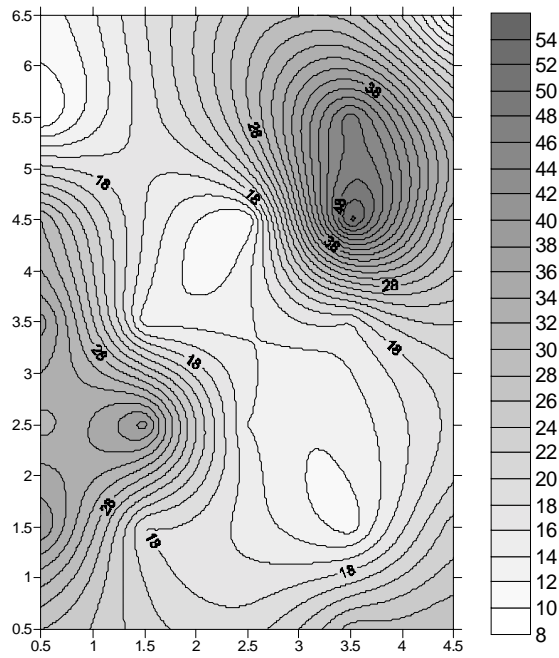
The density plots depicted in Figures 8.7-13, show the spatial density distribution ofdebitage in selected artificial levels of Mound Gamma block for the Mound Components. Surfer software was used to create the image maps of lithicdebitage density through the mathematical interpolation of densities from each of the 35 1 by 1 m sectors. In this respect, the density measures were coded spatially at the center of each sector of 1 x 1 m in the excavation block. The gray color scale provided to the right of the image maps indicates the density interval. The number in the Y coordinate from 1 to 7 designates the name given to the sectors from S to N. The numbers 1 to 5 in the X coordinate designates the letter A to E given to the sectors from E to W, respectively (Figure 4.5).

These maps should be interpreted taking into account the following preliminary remark. At present, we only have two radiocarbon dates that bound the Preceramic Mound Component at level 265 cm deep, ca. 4,190 ± 40 bp and at level 210 cm deep, 3,460 ± 100 bp (Figure 4.17 and Table 4.4). These data alone are insufficient to offer finer temporal assignments for these components. In this regard, the image maps shown in Figures 8.7-13 should be regarded as

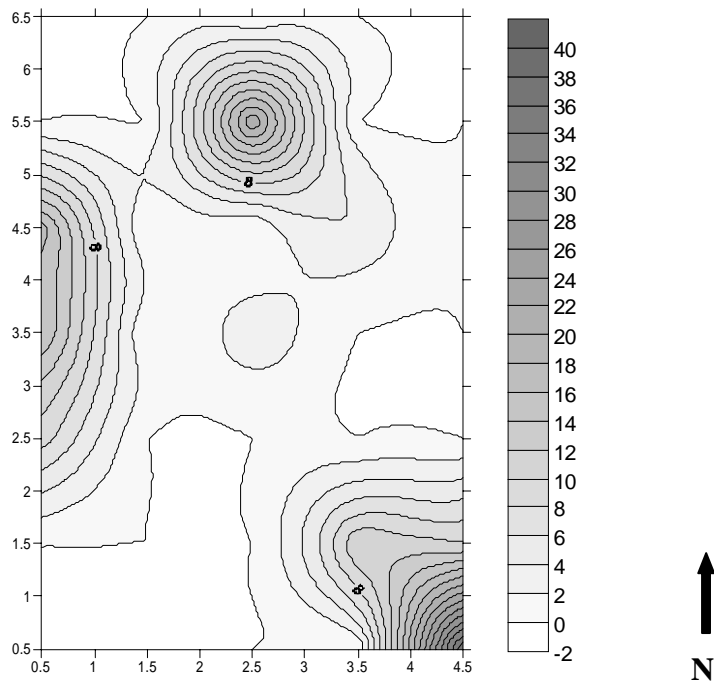
averages of superimposed occupational levels rather than as discrete “living floors” or occupational surfaces with little overlap.

*Results.* A visual inspection of the debitage density distributional map of both the Preceramic and Ceramic Mound Components indicate the existence of two distinct patterns. One is manifested in levels of the site that are interpreted as occupational middens characterized by the presence of a hearth or hearth rubble containing no burials or stone structures. As is apparent in Figures 8.7-11, in these levels, the horizontal density distribution shows a general pattern characterized by a low artifact density in the middle of the block excavation and high concentrations and spikes of debitage density in the peripheral areas. With some minor variations, all the debitage density distribution from these levels are remarkably similar in their spatial distribution in that they all display a central area with modest artifact densities and a major concentrations of artifacts in the peripheral areas of the block excavation. It should be mentioned that some exceptions to these general patterns occur in a few levels, however, these differences are relatively minor. Figure 8.11 shows these more “atypical” distributions from levels 155-160 and 210-215 cm deep.

In marked contrast, when debitage density trends are plotted over the levels that bear burials or stone structures, such as the partial burial in level 190-195 (Figure 8.12) and the partial burials and stone structure at 130-135 cm deep (Figure 8. 13), there is no clear pattern or any marked spatial configuration like the one displayed in the other levels of Mound Gamma. This latter pattern frequently occurs in the CMP, which is characterized by the recurrent presence of burials and the stone structures that appear to be associated to them.

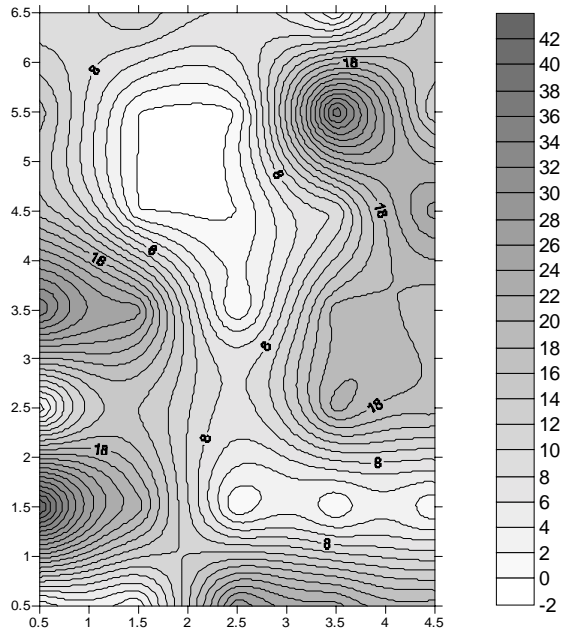


Mound Gamma 125-130 cm  
depth

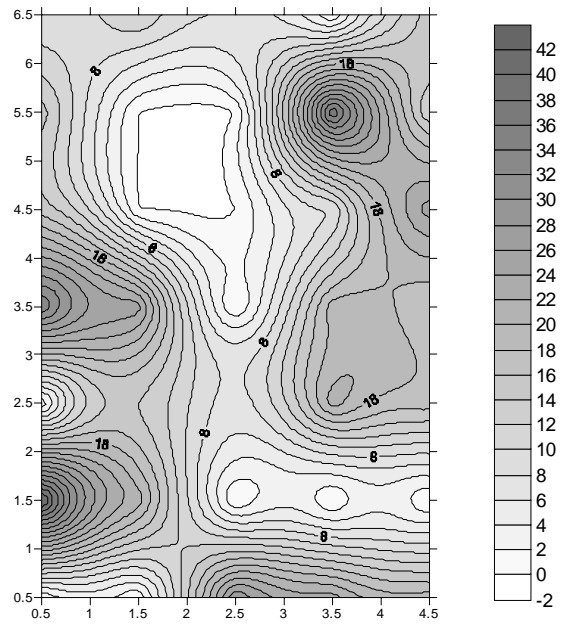


Mound Gamma 145-50 cm  
depth

Figure 8.7. Mound Gamma Block Lithic Debitage Density.



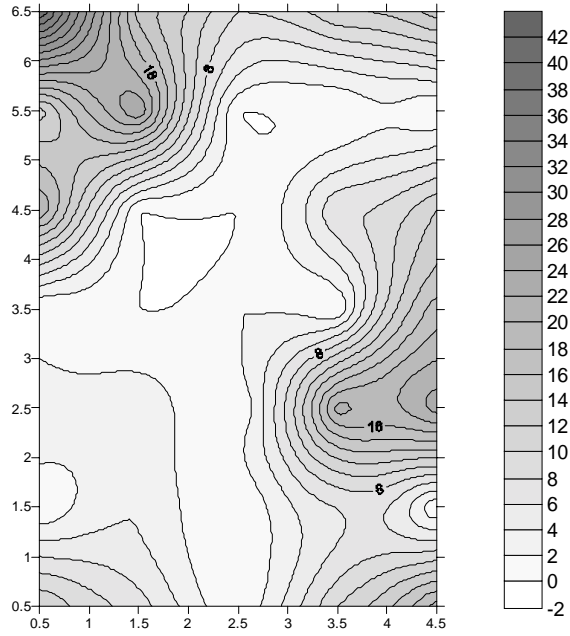
Mound Gamma 165-170 cm depth



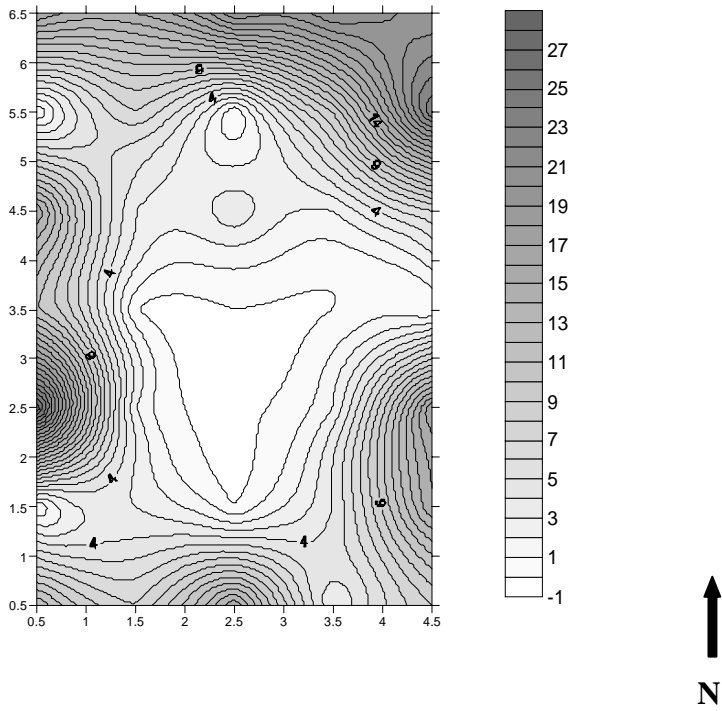
Mound Gamma 170-175 cm depth



Figure 8.8. Mound Gamma Block Lithic Debitage Density.

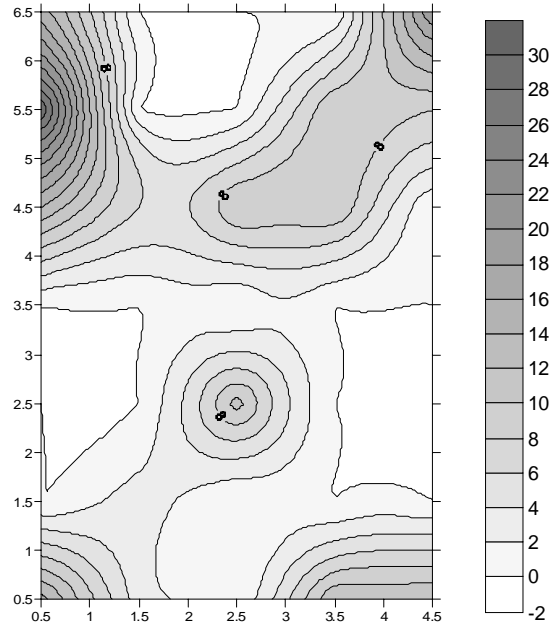


Mound Gamma 200-205 cm depth

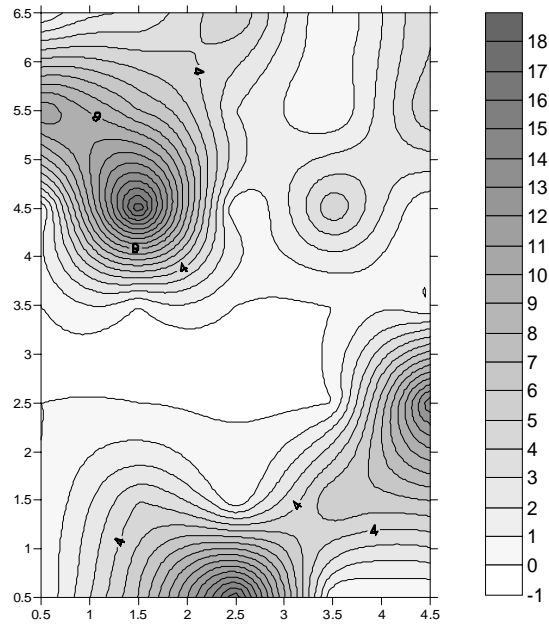


Mound Gamma 205-210 cm depth

Figure 8.9. Mound Gamma Block Lithic Debitage Density.



Mound Gamma 220-225 cm depth

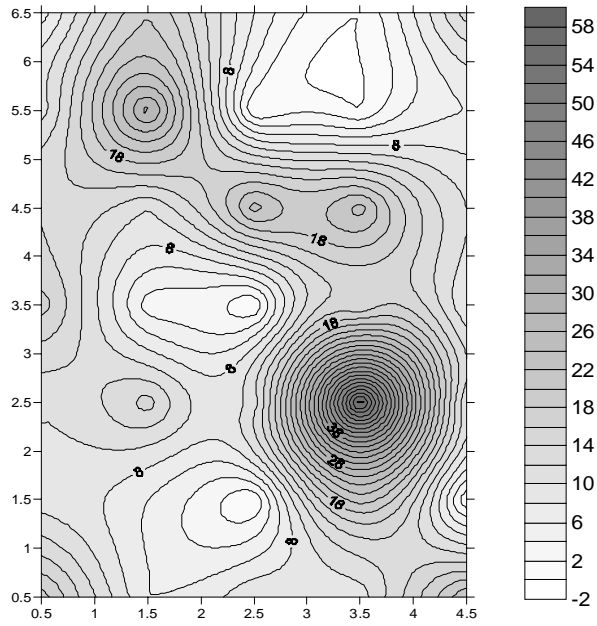


Mound Gamma 235-240 cm depth

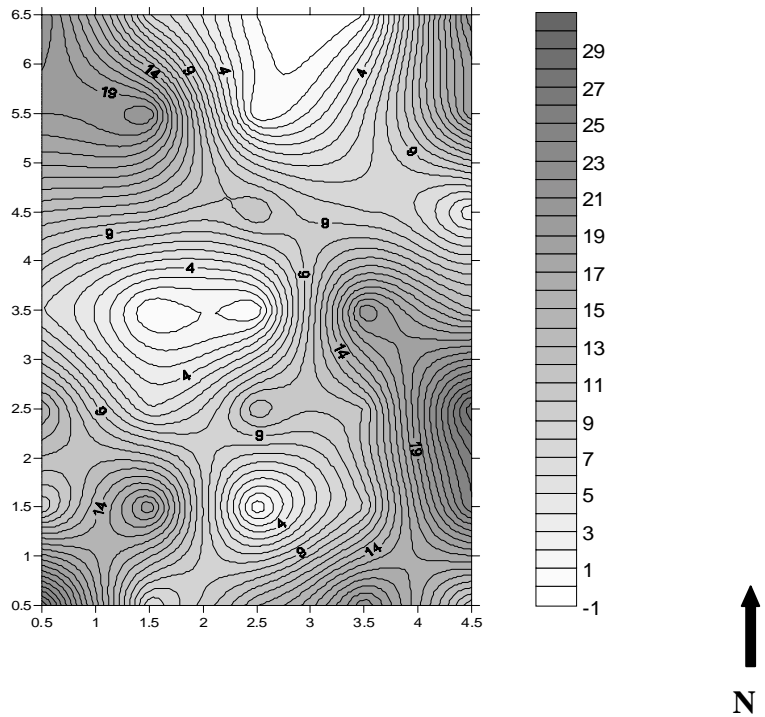


Figure 8.10. Mound Gamma Block Lithic Debitage Density.





Mound Gamma 155-160 cm depth



Mound Gamma 210-215 cm depth

Figure 8.11. Mound Gamma Block Lithic Debitage Density.

*Interpretation.* The spatial configuration of the levels that present relatively low densities of artifact in the central area and high densities of artifacts in the peripheral area in both the PMC and the CMP are interpreted as follows. Based on ethnoarchaeological studies, the central area is interpreted as a habitation space, which is regularly maintained and the peripheral area as a zone where trash is deposited. To reiterate, it must be kept in mind that given the coarse grain nature of the data, the distributional maps presented in Figures 8.7-13 are not interpreted as showing discrete “living floors” or occupational surfaces with little overlap, but should be viewed in terms of an average of superimposed successive residential occupations.

As noted by several authors (Schiffer 1972; Yellen 1977; DeBoer and Lathrap 1979; Murray 1980; Hayden and Cannon 1983; Zeidler 1983; Deal 1985; Roe and Siegel 1986; Simms 1988; Fisher and Strickland 1989), when a site is occupied long enough to produce secondary refuse disposal, the regular sweeping of house-floors removes almost all the materials that could be incorporated into the floor through trampling. Consequently, in general, habitation structures and household activity areas will yield little macrorefuse. However, as Zeidler (1983: 178) points out, based on his ethnoarchaeological study with the Achuar of Ecuador, in some cases “... even meticulous sweeping does not remove the accumulation of primary refuse from house-floors because between the moment that these materials are discarded (would it be a sherd, a stone, or a fish bone, etc.) and the moment that the floor is finally swept, a certain percentage of residual material is incorporated into the floor through trampling”. Zeidler (1983) also noted that artifacts could accumulate fairly rapid through trampling in soft ashy sediments in the vicinity of hearths. The gradual accumulation of artifacts in habitational floors also have been noted by Limbrey (1975:328) who notes that this situation is more likely to happen in unprepared floors and in humid soil conditions<sup>18</sup>. Zeidler (1984: 185) also noted that “... the size of the floor area is a critical factor that determines the ‘archaeological visibility’ of spatial patterning, this is more so in well-delimited social contexts, such as dwellings surrounded by walls and characterized by a permanent and intense occupation (Zeidler 1984). The smaller the floor area, the less the spatial segregation between discrete activity areas and the more the probability of mixing action caused by trampling, sweeping, etc.”

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<sup>18</sup> In her own words, “... Where there is no laid floor, or where the building was used for some purpose in which the hardness, regularity, cleanliness, or decorative value of the floor was of no significance, it is not difficult to envisage an accumulation persisting... If the floor is of trampled earth in the first place, even regular sweeping may fail to prevent an occupation deposit growing, since compaction of newly dropped material onto the surface occurs so easily, particularly in damp conditions.” (Limbrey 1979:328).

The aspects mentioned above are particularly relevant to interpret Mound Gamma formation processes and the spatial patterning observed in it. In the first place, although Mound Gamma is interpreted as a domestic, heavily maintained area, the ethnographic record shows how small quantities of artifacts are incorporated into living floor sediments. It is with this in mind that we suggest that the low artifact density in the central area of Mound Gamma block probably represents a habitation structure. In the second place, given the bounded, restricted space that a mound top surface imposed on a habitation structure and the activity areas tethered to it has, it is reasonable to suggest that we should expect an overlap of different activity areas in the bounded mound top residential space.

Overall, during the PMC, the combined presence of hearths in place or hearth rubble (ash lenses, charcoal speckles, burnt clay) in compacted areas of low artifact densities related to the remains of general, diverse activities (see next section on Artifact Assemblage Composition) are interpreted as the remains of a residential domestic area that grew by the gradual and continuous, mostly non-deliberate accumulation of occupational refuse and hearth rubble. In this regard, Mound Gamma is considered as a “mini-tell”. All these data give support to the idea that mounds started as residential, domestic occupations and questions the widely accepted models proposed by Lopez (2000), Lopez and Gianotti (1997, 2000), and Gianotti (2000) that envisioned the appearance of mounds to be related to ceremonial/monumental activities. Moreover, the presence of burials at the end of the PMC puts into question Pinto’s (2000) proposition that mound building started as a way of monumentalizing the dead. I shall return to discuss these aspects in full in the next chapter when Los Ajos is considered in regional context.

The lack of household demarcating features such as post-molds impede us from making a precise delimitation of house structures and, therefore, to infer its shape and approximate size. A rough approximation of the better-defined central areas with low debitage density ranges between ca. 14 and 20 m<sup>2</sup>. On the basis of this approximate size and the ethnographic data from the Neotropics (Curet 1998), it may be realistic to assume that the house structure represents the habitation of a single nuclear family and due to its reduced size, it probably corresponds to a single-room structure whose major entrance probably faced the central plaza area.

In contrast, the peripheral area of the block excavation, which grew as a result of the sediment and artifacts swept away to these marginal areas of the mound top surface could be considered as refuse toss zones. The spikes and high concentrations of artifacts may also be

representing household activity areas. In addition, though it seems very likely that this pattern (low density in the middle and high density in the periphery) is the result of systematic maintenance practices that swept away debris away from the household outward in a centripetal fashion, it seems reasonable to state that occasionally house refuse was used as fill to even out, cover over, or build up portions of the mounds. In other words, the accumulation of refuse sediments in the periphery may have served to expand and level the mound. This latter aspect of mound formation processes has been noted by Hall (1984) in the residential mounds of La Mixtequilla, Veracruz and observed in some shell-middens of coastal Brazil (Barbosa 1999; Gaspar 1998).

On the other hand, an irregular pattern, which started to appear in the upper part of the PMC and through the CMC the sectors of Mound Gamma associated with the presence of burials or stone structures. Figure 8.12 depicts the lithic debitage density of Mound Gamma level 190 cm deep, where a partial burial was defined below a circular stone structure and several isolated bones were recovered across the block excavation. The partial burial consists of a fragmented skull facing downward and four adjacent long bones lying horizontally and oriented ESE, ESE, SE and NNE direction (Figure 4.8b, 4.9). In addition to this, a bone cluster consisting of a long bone lying horizontally and oriented in NWW direction in conjunction with a small fragment of disintegrated, powdery, possibly human bone was defined at level 190, sector 7/C (Figure 4.10a); and at the same level, but in sector 6/B two other isolated bones were recovered (Figure 4.10b).

Figure 8.13 shows the lithic debitage density of Mound Gamma, level 130-135 cm deep over which the stone structure and the burials recovered in this level were plotted. The stone structure is mainly composed of three massive unworked stones. The two larger ones (36x25x17 and 45x20x18 cm) are located together in the southern portion of sector 5/D. The smaller one (25x25x14 cm) is located in the NE portion of sector 5/E. The three of them together form a semicircular arrangement. In addition to these large stones, other relatively large unworked stones were recovered from sectors 6/D (25x7x10 cm), 7/B (18x10x12 and 8x5x4 cm), 7/A (30x12x9 cm), 6/E (15x8x7 cm), 6/B (10x5x7 cm), 5/B (12x7x6 and 15x6x7 cm), 4/B (25x10x8 and 8x4x5 cm), and 3/E (10x4 x5 cm). Three fragments of long bones lying in a horizontal position were located in sectors 6/B and 5/B at depth 1.30 m.

Figures 8.12-13 clearly indicate that in the sectors of Mound Gamma where burial and associated features occur, the lithic debitage is uneven with no clear patterns. This could be the result of perturbation caused by the interments that were probably buried in pits below house floors. As will be seen below, when we look at the vertical distribution of artifact densities, we observe that most of the areas that were defined as habitational floors display a pattern of gradual increase in artifact density, suggesting the gradual accumulation of domestic debris; the areas that contain burials and associated features are highly fluctuating in artifact density; presenting sharp spikes or declines. This situation is particularly acute in the Ceramic Mound Component. This pattern reflects that the Ceramic Mound Component not only presents more burials, but also bears discrete filling episodes. The presence of burials in household areas indicates that Mound Gamma was simultaneously a space for habitation and a place for the dead. The presence of burials associated with houses is a common-place feature of lowland South America, which has been documented both in ethnographic (e.g., Nimandeju 1946; Wagley 1977; Seeger 1981; Da Matta 1982) and archaeological cases (e.g., Torres 1913; Lothrop 1932; Ottonello and Lorandi 1987; Spencer 1990; Schmitz et al. 1991). As will be argued in the next chapter, the interment of the dead in the mounds could have made these locations into “ancestor places”.

The lithic debitage horizontal density data at Mound Gamma presented in this section has important implications for the interpretation of Los Ajos occupational history. First, it indicates that the Preceramic Mound Component shows the first substantial settlement at Los Ajos around 4,190 bp. This early occupation was domestic and direct evidence for monumental mound construction during the Preceramic Mound Component is currently lacking. Second, the presence of regularly maintained areas suggests that the nature of the habitation at Los Ajos was more permanent. This is further corroborated by the result of the vertical distribution of domestic debris presented in the next section.

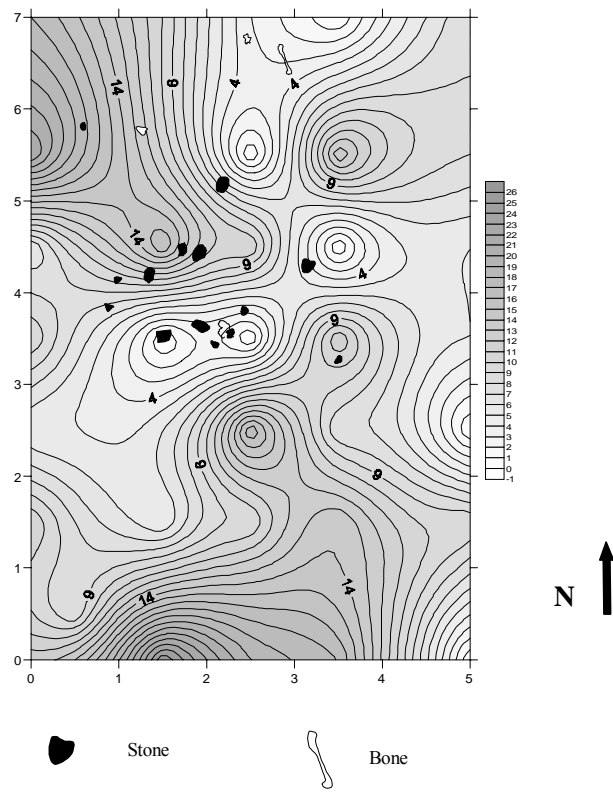


Figure 8.12. Contour Map of Lithic Debitage Density Displaying Circular Stone Structure and Partial Burials of Mound Gamma, 190 cm Depth.

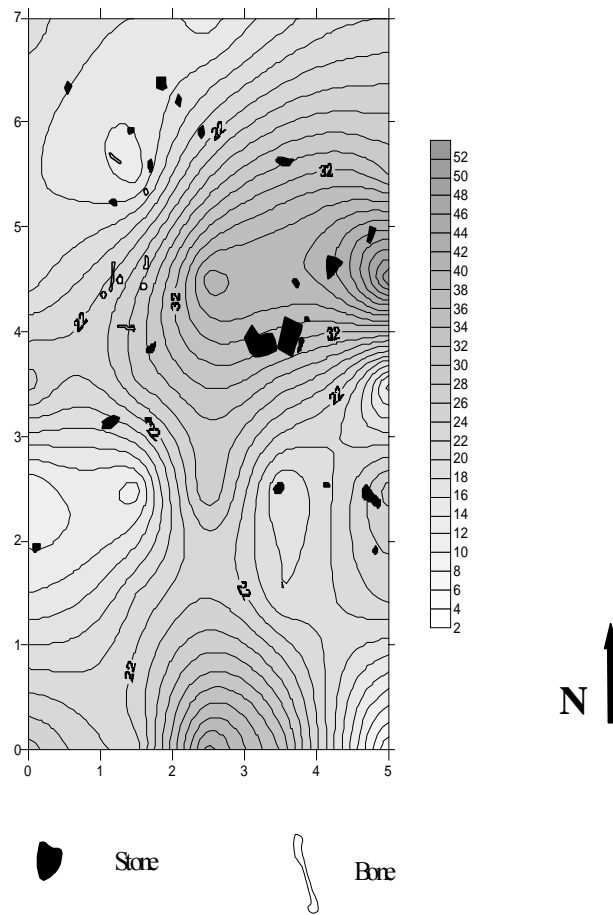


Figure 8.13. Contour Map of Lithic Debitage Density Displaying Circular Stone Structure and Partial Burials of Mound Gamma, 130-135 cm Depth.

## Vertical Distribution of Lithic Debitage, Ceramics, and Bone Densities at Mound Gamma

The vertical accumulation of sediments and artifacts was another aspect of artifact density that was explored in this study in order to understand formation processes at the site. The graph in Figure 8.14 plots the vertical distribution of lithicdebitage, ceramics, and bone densities in Mound Gamma.

*The Preceramic Mound Component.* Inspection of the graph indicates that there is an increase in the lithicdebitage density between the Preceramic Archaic Component ( $\bar{x}=11.2$ ; range=9.7-16/m<sup>3</sup>) and the Preceramic Mound Component ( $\bar{x}=109$ ; range=48-232/m<sup>3</sup>) (see Table 8.5) (Appendix 8). During the PMC, there is a general tendency for the lithicdebitage density to increase with minor fluctuations. In this component, the density of bones attains its major representation and peaks in level 225 cm deep, where it gradually declines.

*The Ceramic Mound Component.* At the bottom of Layer 4 (Figure 4.6), which marks the start of the CMC (185-190 cm deep), there is a gradual increase in the lithicdebitage density. After that, beginning in level 175-180 cm deep, it experiences a major drop followed by major negative and positive fluctuations. In level 140-145 cm deep, it presents the major spike of lithicdebitage density and after that it gradually declines up to the surface level. Overall, the average density ofdebitage of the CMC is higher than the one from the PMC. However, it exhibits major fluctuations. Both bone and ceramic densities are low in this component. However, in this component, ceramics show a general tendency to increase. On balance, there is an increasing tendency in thedebitage density from the PAC to the CMC. However, in the PMC, there is a more gradual tendency to increase with minor fluctuations, whereas, the CMC presents major oscillations characterized by sharp drops and spikes.

At the bottom of Layer 4 (Figure 4.6), which marks the start of the CMC (185-190 cm deep), there is a gradual increase in the lithicdebitage density. After that, beginning in level 175-180 cm deep, it experiences a major drop followed by major negative and positive fluctuations. In level 140-145 cm deep, it presents the major spike of lithicdebitage density and after that it gradually declines up to the surface level. Overall, the average density ofdebitage of the CMC is higher than the one from the PMC. However, it exhibits major fluctuations. Both bone and



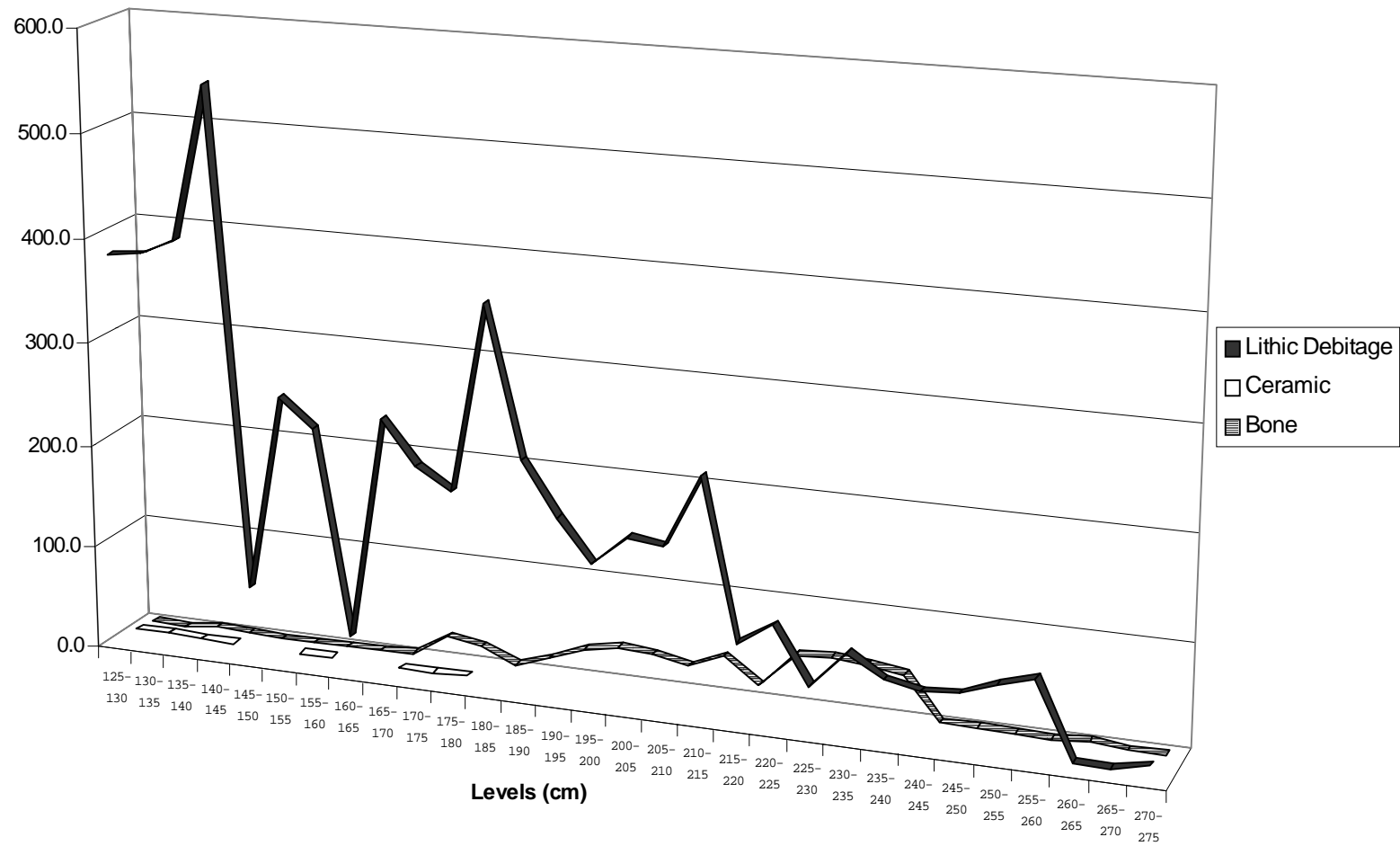


Figure 8.14. Vertical distribution of lithic debitage, ceramics and bone density in Gamma Mound.

ceramic densities are low in this component. However, in this component, ceramics show a general tendency to increase. On balance, there is an increasing tendency in the debitage density from the PAC to the CMC. However, in the PMC, there is a more gradual tendency to increase with minor fluctuations, whereas, the CMC presents major oscillations characterized by sharp drops and spikes.

*Interpretation.* The gradual increase in lithic debitage density in the PMC is in agreement with a gradual accumulation of occupational refuse in a domestic area. This also conforms well to the PMC stratigraphy (Layer 4, Figure 4.6) that does not show any abrupt changes in stratification, development of soil, or the deliberate use of fill.

In the upper part of the PMC and during the CMC, there are two major innovative cultural practices that altered the pattern observed during the PMC. One is the appearance of burials; the other, is the clear presence of filling/capping episodes marked by the presence of gravel layers. As revealed by the combined stratigraphy of Mound Gamma block excavation and trench (Figure 4.16) this is also accompanied by significant changes in Mound Gamma size and shape. As described earlier in Chapter 4, during the PMP, Mound Gamma was ca. 0.6-0.8 m tall, dome-shaped in profile, and much smaller in extension than during the succeeding CMP. In this latter period, as a result of the deliberate shaping of the mound with the use of fill, it attained its present platform mound characteristics, reaching 1.40 m high, its characteristic beveled edges, and an increase in extension. During the CMC, the mound was a place for habitation, for the placement of the dead, but also may have served to display social differences. As it will be argued in the next chapter, during the CMC, the deliberate construction of platform mounds may have served as “symbolic aids” to legitimize claims for a locus of residence. The capping episodes and the presence of burials explain the fluctuating patterns in artifact densities perceived during the CMC.

### *Vertical Distribution of Lithic Debitage and Ceramics Densities at the TBN Crescent-Shaped Rise*

As in Mounds Gamma and Delta, the central sector of the TBN shows a gradual increase in artifact density that also is reflected in the average artifact density of each component. During the Preceramic Archaic Component, the lithic debitage density ranges from 48.1 to 67.3 and averages 57.7/ m<sup>3</sup>. Density increases during the PMC attaining an average of 126/ m<sup>3</sup> (range=73.1-178.8) and increases again during the CMC with an average of 213/ m<sup>3</sup> (range=71.2-425). However, it decreases in an abrupt fashion up to the ground surface in level 145-150 cm deep. The ceramic sherd densities show a very similar pattern with a steady increase from level 180-185 cm deep up to 160-165 cm deep and then a sharp drop towards the surface. While the density of lithic debitage in both Mound Gamma and the TBN are fairly similar, the ceramic density in the TBN is 35 times higher than in the TBN. Overall, the artifact vertical density trend shows a general increasing tendency. This pattern, along with the sediment chemistry analysis, points to a gradual accretional nature of the TBN crescent-shaped rise.

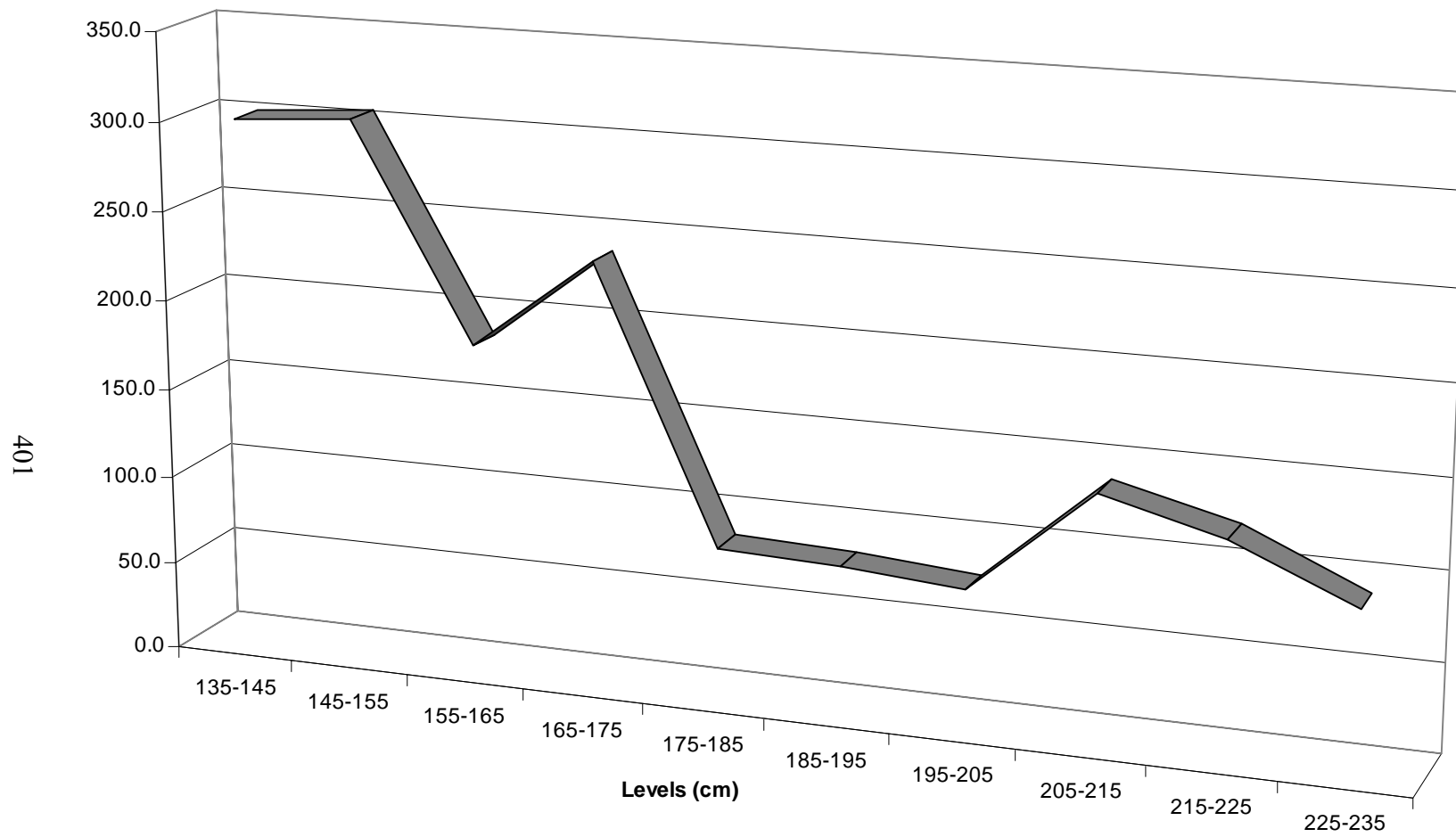


Figure 8.15. Vertical Distribution of Lithic Debitage Density in Mound Delta.

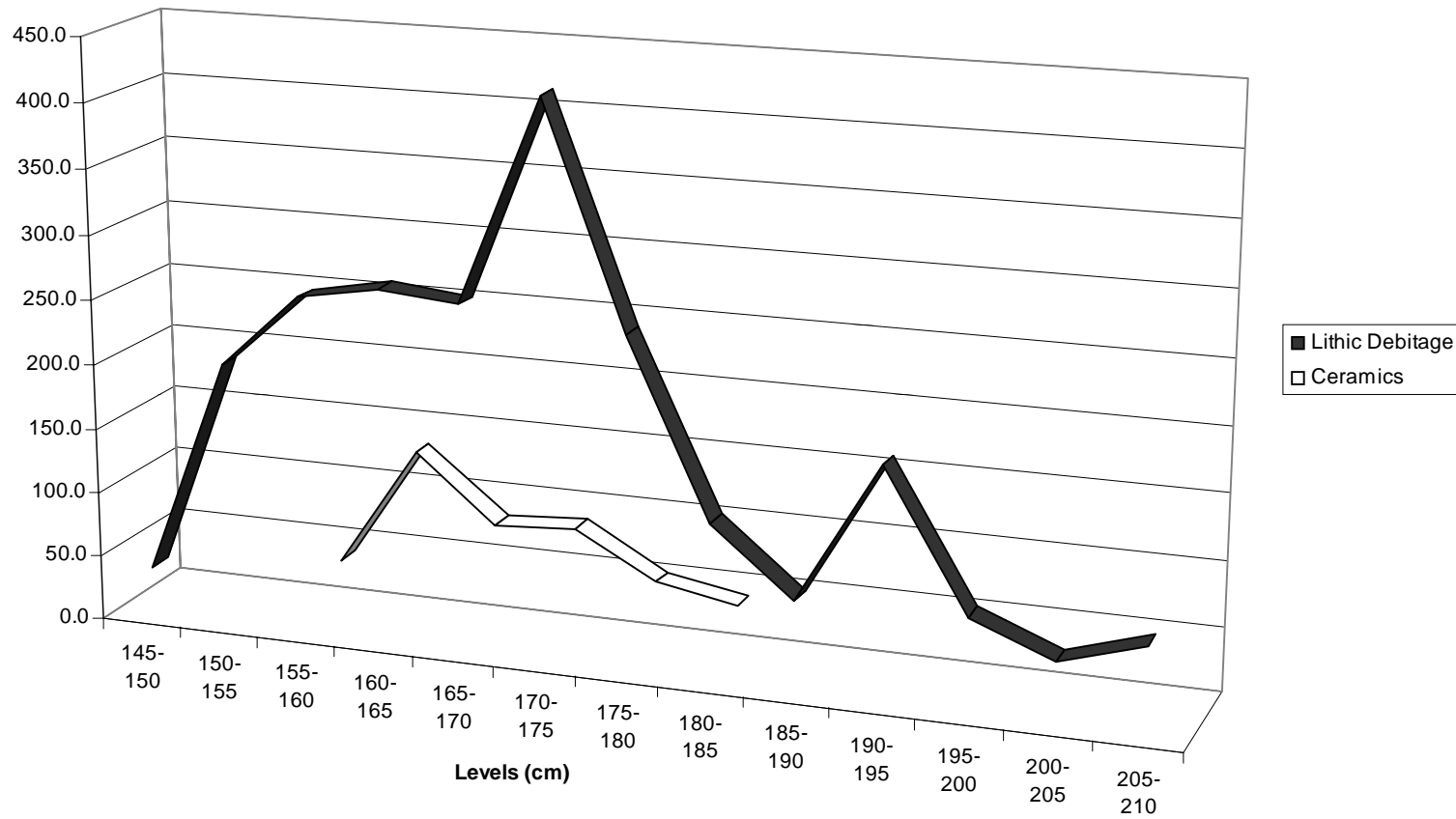


Figure 8.16. Vertical Distribution of Lithic Debitage and Ceramics Density in the TBN Crescent-Shaped Rise.

## Artifact Assemblage Composition in Mound Gamma

In considering the artifact assemblage composition at Mound Gamma, our broadest assumption is that a full range of both domestic and ceremonial activities should have occurred at a village site, while a more restricted range of activities would have taken place at a special-purpose site. Overall, the combined analysis of artifacts (chipped and ground/peck/polish stone and ceramics) and ecofacts (microfossil botanical data and faunal remains) presented in the preceding chapters indicate that the assemblage of artifacts recovered at Mound Gamma is consistent with the artifacts found where domestic activities took place.

In Mound Gamma, food preparation is evidenced by the presence of various kinds of equipment related to the preparation of plant and animal resources. Manos and milling stone bases together with the phytolith and starch grains extracted from their residues evidenced the preparation and consumption of corn in this sector of the site. Furthermore, the presence of a milling stone base turned upside down on a hearth (a practice that also has been documented in Mound Alpha (Bracco 1993) and the Estancia Mal Abrigo site) suggests that this piece of site furniture (*sensu* Binford 1979) was cached in the domestic dwelling.

In addition, the presence of charred bones with cut marks coupled with the large amount of large-sized mammal long bone splinters showing spiral fractures indicates that bone was processed at the site not only for meat but also for the extraction of marrow and grease. The large proportion of rhyolite flake-knives and sharp quartz bipolar flakes broken in use, lost, or wear-off that got trampled in the sediments further corroborates the processing of bones (butchering and consumption). Similarly, the wide variety of species consumed during both the Preceramic and Ceramic Mound occupations at Gamma also attests to the domestic nature of Mound Gamma. In addition, the exclusive presence of maize cob phytoliths and starch grains in the plant grinding tools' residue in Mound Gamma demonstrate that Mound Gamma represents a residential, domestic, living area where maize was prepared and consumed.

Turning to an analysis of the lithic assemblage, if we view Mound Gamma as a residential household within a village, then we would expect a full-range of flint-knapping activities to have been performed at the site along with a high diversity of tool types. The lithic assemblage recovered at Mound Gamma indicates that tool manufacture, use, and maintenance took place at the site. Local raw materials, mainly rhyolite and quartz were brought to the site,

where all stages of lithic reduction are represented including core reduction, tool manufacture, use, and maintenance/rejuvenation.

The tool assemblage recovered at Mound Gamma also is diverse, suggesting that a wide variety of activities took place at the site. In the absence of use-wear analysis, the author based the functional attribution of tools on their morphological similarities with ethnographically documented stone tools (e.g., White 1967; Gould 1971; Hayden 1979). It should be bore in mind that the uncritical acceptance of the functional attribution given to these lithic tools is problematic and should remain tentative. The lithic tool assemblage includes flake-knives appropriate for cutting; end-scrapers traditionally interpreted as hide-processing tools; scrapers, large scraper-planes, wedges, and notches commonly associated with woodworking activities, antler, and bone; point/borers associated with the work of hides; and hafted bifaces (projectile points) and bola stones likely used for hunting and war. This was further corroborated by the preliminary microscopic use-wear analysis (Appendix 4) on a small sample of selected tools that documented several activities, which represent the range of simple domestic activities including the working of soft plant materials probably to extract starch, hard-wood working most likely related to the manufacturing of wooden implements, butchering of animals, and the scraping fresh hide and bone working possibly related to the maintenance of organic equipment such as spears, clothing and animal gutting tools, were carried out at the site.

Particularly interesting is the association of end-scrapers, end-scrapers rejuvenation flakes, and ochre (powdered hematite) at the site. It is interesting to note that one of the uses of ochre is to finish hides, a process known as “tawing” (Roper 1991:295-296), which helps preserve the hides. Keeley (1980: 170-172) has also observed at many Upper Paleolithic sites the association of ochre with end-scrapers, proposing that ochre was used as a pigment rubbed into the hides during the final stages of scraping. In the Americas, the association of ochre and end scrapers is well documented in many Paleoindian and Early Archaic sites (e.g., Goodyear 1974). Other ethnographically documented uses of ochre include body, hide, and ceramic decoration among many groups of Native Americans (e.g., Swanton 1946). In sum, the lithic assemblage recovered at Los Ajos evidenced a broad range of activities, including manufacture, use, and maintenance of tools. This is in agreement with what we should expect at a residential site where daily task are performed.

Taken as a whole, the artifact assemblage composition of Mound Gamma indicates that the mound was a residential unit, where a wide range of domestic activities were carried out. In the next section, I combine all the different lines of evidence to attempt a comprehensive interpretation of the site.

### **Summary**

Overall, the combined analyses of the spatial distribution of artifact density, anthropogenically-altered soils, and artifact assemblage composition have provided us with a coarse-grained view of the history of community organization at Los Ajos.

#### **The Preceramic Archaic Component (Early Holocene-ca. 4,190 bp)**

The studies of artifact density trends indicate that the PAC show the less intense occupation at Los Ajos characterized by a low and spatially discontinuous debitage densities which does not show accumulation of anthropogenically altered soils. In general, from the lithic analysis of this component we learn that the lithic assemblage of the PAC groups was typified by a less diverse tool assemblage, including the presence of more carefully manufactured bifaces, bifacial thinning flakes, and utilized bifacial thinning flakes, in addition to a greater reliance on fine-grained raw materials. All of these indicate that the PAC lithic technology was more formal and curated than the PMC and CMC lithic technologies, suggesting that the PAC groups were possibly more mobile and probably practiced a more specialized subsistence.

#### **The Preceramic Mound Component (ca. 4,190 to ca. 3,000-2,500 bp)**

The comparisons between the proportional post maps in the off-mound areas between the PAC and the PMC indicate that the occupation during the PMC was more extensive and more intensive across the site. It is at this early point in time, during the emergence of the early Formative, that Los Ajos was partitioned in a number of discrete areas with the incorporation and centralization of a communal space surrounded by residential mounded areas. In Mound Gamma during the PMC the horizontal density trends of lithic debitage show the presence of a central area of low density interpreted as a habitation space regularly maintained and a periphery exhibiting higher artifact density inferred as a zone where trash was deposited. The vertical density trends show a general tendency to increase within minor fluctuations. Overall, the



combined analyses of stratigraphy and features presented in Chapter 4, the horizontal spatial configuration of lithic debitage density, vertical artifact density trends, and artifact and ecofact compositions strongly suggest that during the PMC, Mound Gamma was a residential area that grew through the gradual accumulation of occupational refuse.

In the absence of post-molds, the horizontal lithic debitage density trends offered us a coarse delimitation of the house structures on top of Mound Gamma, ranging between 14 and 20 m<sup>2</sup>. Only on the basis of this approximate habitation structure size, it is safe to suggest that the house structure possibly represents the habitation of a single nuclear family and that due to its reduced size it probably corresponds to a single-room structure. In the last part of the PMC of Mound Gamma, its occupants developed an innovative cultural practice of burying the dead in mound residential contexts. Commencing at this time, Mound Gamma is not exclusively a place for habitation but also incorporates the burial of the dead.

Mounds Gamma, Delta, and Alfa share the following characteristics: (a) they all present a Preceramic Mound Component with similar stratigraphy, (b) the dates from the lowermost PMC levels of Alfa and Gamma could be considered broadly contemporaneous, and (c) spatially, these three mounds are closely arranged around a central plaza area. All these shared similarities lend support to the idea that the process of early village formation started at Los Ajos with the placement of domestic areas around a central open space. Given the rough contemporaneity among Mounds Alfa, Delta, and Gamma, they appear to start accretion at roughly the same time as contemporaneous households and were apparently coeval with the creation of a central public space at the center of the village. The low artifact density, the lack of soil accumulation, and its central position surrounded by residential areas demarcated the central clear area of the site that since early PMC times was a heavily maintained open space that was served as a communal space.

The presence of a shallow PMC in the TBN and TBS indicates that occupational refuse accumulations also started during this period. The information obtained from the systematic interval transect sampling strategy of test units also indicate that the site was not restricted to the inner precinct. It documented the presence of a vast outer area of domestic debris covering ca. 12 ha. Moreover, from the central sector of the site towards the east coordinates E250 and E400 coordinates, a decrease in the density of artifacts is perceived, which then increased again as one reaches the periphery of the Mound 15 located to the east of coordinate E450. This decreasing

gradient of artifact density appear to be representing the site limits and a separation from the other cluster of mounds that are located to the SE in SE-NW direction along the slope of Sierra de los Ajos. In summary, the PMC witnessed the process of early village formation coupled with the incorporation and centralization of a communal space.

### **The Ceramic Mound Component (ca. 3,000-2,500 bp to Contact Period).**

During the CMC, Los Ajos experienced many significant changes. The overall shape of Mound Gamma changed through the intentional remodeling of the mound through filling/capping episodes of gravel. This converted the 0.6-0.8 m tall, probably circular, dome-shaped mound that grew through accretion into a larger, quadrangular, 1.40 m tall, flat-topped, beveled-edged platform mound. In addition, interments became an integral and recurrent activity that took place only in mounds. Together, this suggests that during the CMC, Mound Gamma and, probably, all the flat-topped, beveled-edged mounds at Los Ajos were not only a place for habitation and the placement of the dead, but also may have served as a locus for public rituals. These new different uses and activities played out at Mound Gamma during the CMC are also reflected in stratigraphy and features, the analyses of the horizontal and vertical distribution of lithic, ceramic, and bone density distribution, and the artifact assemblage composition. During the CMC, due to occurrence of capping episodes and the interment of bodies, the horizontal density trends of lithic debitage are irregular and do not show any clear pattern. Similarly, the vertical density trends do not show the regular increasing gradient characteristic of the PMC but show major fluctuations characterized by abrupt drops and major spikes, which are associated to the capping episodes, burial, and placement of stone structures.

With this transformation in the central part of the site, we perceive a formalization and spatial segregation of activities that lead to the consolidation of a formal inner precinct at Los Ajos site. Concomitantly, during this period the TBN and TBS experienced the most significant growth. As presented earlier, the overall size, shape, soil alteration in terms of chemical enrichment, darker color, and more loamy texture, the gradual increase in artifact density and the high artifact density that they display suggest that these were midden deposits that grew through accretion. The extent and depth of them indicate that Los Ajos may have been home to fairly permanent occupations. In addition, during this period, the plaza area became more clearly

defined, in part caused by the remodeling of mounds that made them more imposing, suggesting that this communal open space was an enduring feature of village organization at Los Ajos. Both in the plaza area, as well as in the area separating the mounds from the crescent-shaped rises, there was an effort to keep the area clear of any accumulation of refuse. In addition, the systematic interval transect sampling in off-mound areas revealed a vast outer area of continuous domestic refuse that cover ca. 12 ha. indicating that domestic occupation of the site is not restricted to the inner precinct of the site and their immediate crescent-shaped rises. As will be suggested in the next chapter when these data is considered, these may be representing less intense more ephemeral occupational of the site. To the east of the site between coordinates E 250-300 there is a sharp drop in ceramic that reappeared close to Mound 15, likely representing the site boundaries.

Summing up, the overall articulation of the central plaza area, the residential mounds, and the midden deposit areas is a strong testimony that these structures form part of an integrated whole, both in terms of public and domestic spaces. If during the PMC, Los Ajos was the locus were a household-based community village unfolded which integrated a central communal space, the CMC was characterized by the formalization and spatial segregation of the inner precinct of the site, which acquired new uses and was converted into a more formal arena for public rituals.

The data summarized above suggests various scenarios about settlement planning and organization, uses, and the duration of the occupations at Los Ajos, the consideration of which will allow the author to gain a better understanding of the emergence of early Formative societies in the region. These key topics are discussed in more depth in the next chapter.

**Chapter 9**  
**Summary, Final Considerations, and Implications**  
**The Emergence of Early Formative Societies in Southeastern Uruguay during**  
**the Mid-Holocene**

**Introduction**

The preceding chapters form the theoretical, methodological, and data cores of this study, crucial to examine the long-term historical trajectory of the rise and development of the early Formative societies of southeastern Uruguay. The focus of this chapter is threefold. In the first place, I briefly summarize the main themes of each chapter with the goal of recapitulating the most outstanding topics of discussion of this study. Second, I offer an interpretative framework to better understand the environmental and cultural processes that unfolded at Los Ajos, which together triggered the development of village life in southeastern Uruguay during the mid-Holocene. Finally, I conclude this chapter suggesting several research questions for future investigation.

In Chapter 1, I began with a consideration of the theoretical conceptualizations employed in this study in order to understand the emergence and dynamics of intermediate-level societies. I also highlighted what I think are the three most outstanding theoretical and methodological problems inherent in previous works carried out in the area. First, from a theoretical standpoint, researchers portrayed these societies as either simple/egalitarian or complex/hierarchical. These oppositional frameworks did little to reveal their variability and precluded researchers from exploring the ecological and historical circumstances that gave rise to them. Instead, in this study, I embrace a broad characterization of intermediate-level societies (e.g., Fowles 2002; Parkinson 2002), one that allowed us to accommodate the organizational variability that intermediate-level societies exhibit in the economic, social, and political realms. To paraphrase Nelson (1995:599), this flexible interpretive framework is useful to explore not just how complex these societies are, but more importantly, how these societies are complex. This approach is more appropriate in light of the diverse social formations that the early Formative period exhibits. Second, from a methodological standpoint, in the absence of archaeological investigations that focused on site structure researchers have not been able to adequately assess the nature of the large, formal, and spatially elaborate mound complexes in the region. This has

been particularly the case at the large multi-mound sites in the upper freshwater wetlands of India Muerta, which contains not only the oldest and best developed Preceramic Mound Component but also exhibits the most spatially complex site plan in the region.

Notwithstanding, important questions crucial to elucidate the nature of the Los Ajos site and by extension the large multi-mound sites in the area have remained unanswered, until now. Notably, what do these large, formally laid out multi-mound sites, encompassing tens of mounds and covering dozens of hectares represent? Are they well-planned villages, vacant ceremonial centers, or do they represent villages with public/ceremonial spaces? What are the formation processes and functions of these mounds? Are they residential, burial, or ceremonial in nature? What are the relationships between these complexes? Are they sequential or contemporary? Taking into account that Los Ajos was occupied over a period of ca. 3500 yr, what was the occupational history of the site and how do we account for the socio-economic transformations that occurred there and for the content and form of the site? More importantly, what was the nature and dynamics of the societies that built these complex mound sites? Lastly, what was the relation of these sites to broader processes taking place in the mid-Atlantic region and beyond? Third and lastly, without a paleoclimatic record for the region, researchers (Bracco 1992a; Bracco et al. 2000d; López 1998) were unable to appropriately assess the complex interplay between the transforming landscapes of the mid-Holocene and the human responses to them.

In Chapter 2, I provided a comprehensive overview of the history of the archaeological investigations carried out in the mid-Atlantic area, paying special attention to the research context that gave rise to my study questions and to the temporal, environmental, and cultural characteristics of my research site--Los Ajos.

In Chapter 3, I outlined the environmental characteristics of the study area with a special emphasis on the general geographic setting, the vegetation, the fauna, the geomorphology, and soil characteristics of the study area. I also provided a thorough description of the rich and abundant concentration of resources available in the wetlands of the region. This was followed by a presentation of the results of the combined 14,810 bp pollen and phytolith record, obtained from the sediment core extracted from the wetlands of India Muerta, which constitute the first pollen and phytolith paleoclimatic record for the region. The results of this study were fundamental to investigate the roles climatic changes played in the emergence of early Formative societies in southeastern Uruguay. Most importantly, it revealed that these societies experienced

significant transformations in settlement patterns, subsistence practices, social organization, and technology in the midst of mid-Holocene unstable and dry climatic conditions (see next section).

In Chapter 4, I presented the results of the archaeological investigations specifically tailored to reveal community organization at Los Ajos. I employed three complementary excavation strategies in order to reveal the internal spatial structure at Los Ajos. First, I targeted the shallow deposits of the off-mound areas through a systematic sampling strategy of fifty-seven small test units. Second, I excavated the deep mound deposits by placing a block excavation in Mound Gamma. Third, I placed two trench transects between the mound and the off-mound areas in order to articulate the stratigraphy and history of use of the site of both the mound and the off-mound contexts. Then, I combined the analysis of the stratigraphy, the C14 dates, and the artifact contents to infer the site chronology. This approach supported the chronological division of the site into three broad periods: (1) a Preceramic Archaic Component (PAC) (Early Holocene – ca. 4,190 bp), (2) a Preceramic Mound Component (PMC) (4,190 to 3,000-2,500 bp), and (3) a Ceramic Mound Component (CMC) (3,000-2,500 bp – Contact Period). Finally, I integrated both the paleoenvironmental and the archaeological data sets, which indicated that the rise of early Formative period communities took place in the midst of unstable climatic conditions, which triggered the development of formal circular/elliptical plaza villages around 4,190 bp, a process that will be explained in detail below.

In Chapters 5 through 7, I presented the analyses of the artifacts and the ecofacts recovered from the excavations. Chapter 5 was devoted to the analysis of the lithics. Chapter 6 offered an integrated multidisciplinary view, which combined the study of phytoliths and starch grains from plant grinding tool residues and selected sediments and the analysis of the bone assemblage, to infer the subsistence practices of the early Formative communities at Los Ajos. These studies showed that shortly after the PMC groups began to live in circular villages ca. 4,190 bp. Los Ajos denizens adopted a mixed economy combining hunting, gathering, and fishing with the growing of maize, squash, and possibly domesticated beans and tubers. Chapter 7 was dedicated to presenting the results of the ceramic analysis.

In Chapter 8, I investigated the spatial organization of the early Formative village through the study of artifact density trends, the distribution of anthropogenically altered soils, and artifact assemblage composition. This study revealed that beginning in the PMC, inhabitants of Los Ajos

partitioned the site into a number of discrete functional areas, including clearly demarcated domestic, public, and trash disposal areas.

I now concentrate on providing a summary and interpretation of the long-term changes in community and social organization at Los Ajos by integrating both archaeological and paleoecological data sets. I approach this analysis by conceptualizing the early Formative societies of southeastern Uruguay as intermediate-level societies and by examining the mid-Holocene transforming landscapes and the social constructions of space, as reflected in community organization. To achieve this, I have divided this chapter into the three main time periods that were the subject of this study: (1) the Preceramic Archaic Period (Early Holocene – ca. 4,190 bp), (2) the Preceramic Mound Period (ca. 4,190- ca. 3,000-2,500 bp) and (3) the Ceramic Mound Period (ca. 3,000-2,500 bp-Contact Period). Despite the intensity and scope of considered tentative until additional investigations are conducted at other sites in the region in order the research program I pursued at Los Ajos, many of the proposed interpretations must be to adequately evaluate the interpretations outlined below.

### **The Preceramic Archaic Period: Early Holocene – ca. 4,190 bp**

The Preceramic Archaic is one of the least understood periods in the region. In southern Brazil, this period is associated with the Umbu Tradition of generalized hunters-gatherers (Ribeiro 1990; Schmitz 1987; see Chapter 2). In Uruguay and in the southern sector of the Laguna Merin basin, this time period is poorly known. This is mainly the result of the dearth of investigations that focus on this period and the fact that, to date, deeply stratified Preceramic Archaic sites have not been identified. In the southern sector of the Laguna Merin basin, the Preceramic Archaic is generally found in the A horizon of the buried soil, on top of which, mound and midden sediments were deposited.

At Los Ajos, the Preceramic Archaic component is represented by the two lowermost layers that comprise the buried hilltop soil. This type of soil is common in the rocky knolls of the area and is constituted by a slightly developed, superficial, A-R horizon soil type. It exhibits a slightly developed A horizon surface, which is sandy and contains gravel inclusions. Below this surface, there is a gravel layer of decomposed rock that lies on top of the rhyolite bedrock. It is within the gravel layer and superficial buried A horizon that cultural materials pertaining to the

Preceramic Archaic Component are embedded. The Preceramic Mound Component sediments deposited on top of them later sealed these layers.

The Preceramic Archaic Component is a non-stratified component embedded in 10-15 cm of gravel and a shallow superficial A horizon, which could represent more than six millennia. It only contains lithic artifacts, which alone are insufficient evidence to infer subsistence practices and settlement patterns for this long time span. Overall, the lithic analysis revealed that the PAC groups displayed a more specialized technology, were probably more mobile, and occupied Los Ajos less intensively than the successive Preceramic and Ceramic Mound occupations. The analysis shows the following trends. First, the Preceramic Archaic lithic debitage is spatially discontinuous. The lithic debitage densities are lower than during the two succeeding mound components (PMC and CMP). If we assume that an increase in artifact density corresponds to a more intense occupation of the site, this suggests that the occupation at Los Ajos was less intense during the PAC compared to the succeeding occupations (see Chapter 8). Second, although the sample size is small (N=9), comparisons between the projectile points from the different components defined at Los Ajos indicate that the projectile points from the Preceramic Archaic Component are more carefully made. The projectile points from the PAC are bifacially manufactured and present thin biconvex longitudinal and transverse sections. They also display flat, regular, continuous, smooth lamellar and conchoidal scars, resulting in even edges. In contrast, the projectile points from the Mound components (PMC and CMC) are unifacially manufactured and show thicker, plano-triangular, plano-convex longitudinal, and transverse sections as well as deep, irregular, rather discontinuous large conchoidal scars. Aside from the points, a broken, non-hafted biface made of grainy rhyolite was recovered from the PAC levels of the TBN trench (TBN, sector A1, 200-205 cm depth) (Figure 5.8c). Local lithic analysts commonly refer to this type of biface as bifacial knife (Miller 1987; Schmitz 1987; Ribeiro 1990). Here, I follow this denomination without attributing any function to this tool. The biface is broken in the middle and presents a finely retouched crescent-shaped edge. It also is characterized by fairly thin biconvex longitudinal and transversal cross sections as well as an even outline. On the whole, these trends show that there was an impoverishment in the projectile point technology, characterized by an abandonment of finely manufactured projectile points and bifaces during the Mound temporal components. Third, it is interesting to note that the technological changes observed from the PAC to the PMC occurred alongside with a decline in



the presence of bifacial thinning flakes, a decrease in the number of utilized bifacial thinning flakes, and the introduction of plant-processing tools (see Chapter 6: Figures 6.9-12) in addition to important changes in settlement and subsistence practices. Fourth, the PAC tool assemblage displays a significantly larger percentage of projectile points and is less diverse than the tool assemblages of the mound components. Last but not least, fine-grained lithic raw materials are better represented in the PAC than in the Mound components.

To conclude, the lithic assemblage of the PAC groups was typified by a less diverse tool assemblage, including the presence of more carefully manufactured bifaces, bifacial thinning flakes, and utilized bifacial thinning flakes, in addition to a greater reliance on fine-grained raw materials. All of these indicate that the PAC lithic technology was more formal and curated than the PMC and CMC lithic technologies, suggesting that the PAC groups were possibly more mobile and probably practiced a more specialized subsistence.

Because our understanding of the Preceramic Archaic period is incomplete at present, we cannot offer a more conclusive statement regarding the nature of the transition from the Archaic Period to the early Formative Period. The dearth of information about the subsistence practices, settlement patterns, and social organization of the Preceramic Archaic Period precludes a deeper understanding of the transition to the Preceramic Mound Period. What has become clear, though, through previous studies carried out in the region (Bracco 1992a; Bracco et al. 2000a; López and Bracco 1992) and my own work at Los Ajos, is that we can no longer view continuity between the PAC and the PMC, as was previously proposed by Brazilian archaeologists (e.g., Copé 1991; Schmitz 1987; Schmitz et al. 1991). Investigating the environmental, social, economic, political, and technological changes that unfolded during the Preceramic Mound Period in the southern sector of the Laguna Merin basin is the subject that occupies me in the next section.

## **The Preceramic Mound Period: ca. 4,190 to ca. 3,000-2,500 bp**

### **The Transforming Landscapes of the Mid-Holocene: The Paleoclimatic Record of Southeastern Uruguay**

This is a multidisciplinary, collaborative study designed to foster an integrated view of human-environment interactions during the mid-Holocene in southeastern Uruguay. This study employed novel techniques in the study area, particularly, phytolith and starch grain analyses, to reconstruct the mid-Holocene landscape of this region. Paleocological data from “off-site” contexts, such as a sediment core obtained from Laguna de los Ajos, was used in conjunction with archaeological “on-site” data from Los Ajos in order to understand the complex interplay between changes in the physical environment and the cultural responses on it. The combination of paleocological and archaeological work has further informed us about the role that long-term ecological factors played in the rise and dynamics of early Formative cultures in this region. In this regard, the combined pollen and phytolith records indicate that changes in the environment provided the impetus for the emergence of early Formative societies in southeastern Uruguay. The paleoclimatic record indicates that the early and mid-Holocene were periods of climatic instability. It shows that the region experienced a period of environmental change characterized by drier climatic conditions around 6,500 bp, which resulted in the expansion of halophytic communities in the flat, low-lying areas of the wetlands of India Muerta. Then, around 4,040 bp, the pollen record marked a major and more severe period of dryness. The drier conditions of this period reduced precipitation and run-off, which may have caused a decrease in the surface water recharge of the inland wetlands and waterways. Both the pollen and phytolith records and the continued formation of peat, evidenced in the sediment core profile, indicate that during this period, the wetlands of India Muerta did not dry out but were significantly reduced. This aridity phase probably caused the desiccation of the upland grasslands, deepening the resource gradient between wetlands and upland prairies. Notwithstanding, wetlands, although reduced in size, continued to provide abundant and easily accessible aquatic resources and probably drew birds and terrestrial fauna to them.

Concomitantly with this aridity phase, the Atlantic coastal plain was subjected to marine oscillations during the mid-Holocene. As summarized in Chapter 3, two marine transgressions were identified in the region during the mid-Holocene. The first one took place between ca.

4,390 and 5,210 bp (Bracco 1992a; Bracco et al. 2000d; Gonzáles 1989) and reached 5 masl. The second one was around 3,000 bp and reached 3 masl (Bracco 1992a, Gonzáles 1989). These marine fluctuations also have been recorded at continental and regional levels both in Argentina (Gonzáles 1987, 1988; Gonzáles and Ravizza 1984; Gonzáles and Weiler 1982; Weiler 1995) and Brazil (Martin and Sugio 1989). As a consequence of these marine highstands, the wetlands that occurred below the 5 masl marine terrace were a highly unstable environment covered intermittently by waters of the mid-Holocene marine highstands. These conditions may have hampered pre-Hispanic populations from settling in and exploiting these lower zones more intensively prior to 3,000 bp.

### **The Emergence of Strategic Locations in the Upper Freshwater Wetlands of India Muerta during the Mid-Holocene**

In the midst of this mid-Holocene unstable and drier conditions, the interior freshwater wetlands, located above the 10 masl marine terrace, offered a more attractive environment than the brackish and salt marshes situated below the 5 masl terrace for the following reasons. The upper freshwater wetlands were not directly affected by marine highstands and also compared favorably with the lower salt marshes in several ways: (a) they support a higher diversity of animals, (b) they present the most fertile soils of the region (Altamirano 1998; Bracco et al. 1999; Durán 1970), which also are seasonally replenished with nutrients by floodwater and the overbank flow of the Cebollatí River that inundates the area (Juan Montaña, personal communication 2000), and (c) the distal part of the India Muerta alluvial fan is the least susceptible to water stress and probably the only one that remains with the highest water table during dry periods in comparison with other areas in the region. As noted before, this aridity phase probably caused the desiccation of the upland grasslands, deepened the resource gradient between the wetlands and the uplands prairies, and likely produced increasing diminishing returns for these latter habitats.

Overall, during the mid-Holocene, the upper freshwater wetlands were the most stable areas of the regional landscape that were not directly affected by the mid-Holocene marine transgressions. Although reduced in extension, they supported the richest and most abundant economic resources. Consequently, the upper freshwater wetlands must have become strategic

locations for the pre-Hispanic populations that were coping with a period of instability and dryness during the mid-Holocene.

Turning to the archaeological record at a regional level, our current data shows that the upper freshwater wetlands exhibit the oldest and most developed Preceramic Mound occupations, which began around 4,000 bp. These upper freshwater wetlands presented more favorable conditions during the mid-Holocene, promoting the aggregation of populations along these restricted and limited resource-rich wetland areas. As suggested by Brown (1985), Brown and Vierra (1983), and Jefferies (1987) for the mid-Holocene in Midwestern U.S., increased sedentism also could be a response to local resource abundance in wetland areas in the face of regional resource scarcity produced by the dry trend of the Altithermal. The combined archaeological and paleoclimatic data indicate that faced with this aridity phase, local populations did not disperse (e.g., disaggregate into smaller groups and increase mobility) or out-migrate to other regions, but opted for orienting their settlement towards wetland areas where they established more permanent communities in strategic locations.

Although our knowledge of the Preceramic Mound Period in the study region remains sketchy, the investigations carried out at Los Ajos and Puntas de San Luis (Bracco et al. 2000b) lend support to the above proposition. These sites present deep, well-developed Preceramic Mound Components dating between ca. 4,190 and 2,960 bp. In contrast, Bracco and his collaborators (1999) recorded a small density of sites in the low brackish and salt marshes that occur below 5 masl. As mentioned before, it was not until after 3,000 bp when the sea level started to stabilize that more intense occupations in sites located below the 5 m marine terrace, such as CH2D01 and Los Indios. Therefore, the sites located in the lower wetlands of Uruguay that were in close connection with the Laguna Negra (Los Indios) or the Laguna Merin (e.g., CH1D01, CH2D01) exhibit thin and slightly developed Preceramic Mound occupations. Similarly, the archaeological investigations in Rio Grande do Sul, Brazil indicate that these groups began to exert an intense exploitation of the marine resources from Lagoa dos Patos around 2,500 bp (Schmitz 1976; Schmitz et al. 1991).

A close look at the regional archaeological maps of the mid-South Atlantic further support the idea that the upper freshwater wetlands were more intensively occupied. As summarized in Chapter 2, the regional surveys carried out in southern Brazil (Camaquá [Figure 2.2, Rutschling 1989]; Jaguarao River valley (Copé 1991: Map 2) and Uruguay (Treinta y Tres

Province (Prieto et al. 1970) clearly mark the aggregation of mound sites in the upper interior wetlands that are close to the headwaters of the major streams that flow into the Laguna Merin and the Lagoa dos Patos. In contrast, the areas immediately adjacent to these lagoons' shorelines display a sparse distribution of sites. As mentioned previously, these low sectors of the site were a highly unstable environment that was covered intermittently by waters of the mid-Holocene marine highstands, which in turn, hampered pre-Hispanic populations from settling in and exploiting these lower zones more intensively prior to 3,000 bp. In the absence of archaeological excavations and indeed of site chronologies, we are currently unable to offer a more conclusive generalization of the mid-Atlantic area. However, the more intense occupations of the upper interior freshwater wetlands and the presence of deep Mound Preceramic occupations, recorded at some of these regions, notably, the Jaguarao River valley (Copé 1991), suggests that these sectors of the landscape along the mid-Atlantic region were privileged locations for human occupation. Further research in these areas is needed in order to generate chronological data crucial to assess these propositions.

I will now shift focus to a smaller area: the study area, which encompasses the upper freshwater wetlands of India Muerta. Current data shows that the placement of large mound complexes on the landscape was highly selective. In this regard, their location within the wetlands of India Muerta's landscape is not random but tightly constrained by topographic, hydrologic, and vegetation characteristics. The first observable pattern is the restriction of sites to fertile wetland floodplains (Bracco 1992a; Bracco et al. 2000d; López and Bracco 1992; 1994). In general, sites are located in ecotonal areas consisting of a mosaic of wet-prairies, upland prairies, riparian and palm forests, which contain a greater diversity and abundance of resources than the surrounding areas, a tendency that is known as the "edge effect" (Odum 1971:159) (Figure 3.12).

Second, Bracco (1993) and Bracco and his collaborators (1999) identified a dual settlement pattern in the upper freshwater wetlands of India Muerta. In the wetland floodplains, for instance, mounds are either isolated or in groups of two or three, are positioned on top of the most prominent levees, follow the courses of streams and display a linear or curvilinear pattern. In contrast, in the hills and flattened spurs adjacent to the extensive wetlands areas or in large topographical prominences (above 15 masl) in the wetland floodplains, mound sites are large, numerous, and spatially complex, and display circular, horseshoe, linear or combined

arrangements (see for example Figures 2.5-7). Copé (1992) described a similar pattern in the Jaguarao River Valley.

Hills and flattened spurs are privileged places for the establishment of larger and more permanent communities for several reasons. Unlike the wetland floodplains, which are subjected to seasonal inundations, the higher topographical positions constitute more stable locations, secure from seasonal flooding, and easily accessible to the rich-resource and fertile wetland area. Moreover, the flattened spurs of the eastern sector of the Sierra de Los Ajos that project into the wetlands do not exhibit natural boundaries that may constrain the size of settlements, such as stream levees in wetland floodplains, and thus facilitates the establishment of large communities in this unconfined spaces.

Within these flattened spurs and knolls that overlook the wetlands, we can highlight other benefits. For example, large sites are generally located at the intersections where the active channel of streams impinges against the slopes of the hills and where lagoons or oxbow lakes occur. These locations would have provided pre-Hispanic populations with easy access to water and riparian forest resources, which prosper along the major lagoons in the area as well as to excellent fishing grounds. The location of permanent communities on higher, more stable topographical areas adjacent to rich resource-zones is not unique to southeastern Uruguay. This strategy also has been documented in other areas with extensive wetland floodplains such as the Illinois River (Brown and Vierra 1983: 171, Figure 9.1), the lower Mississippi valley (Gibson 1994: Figures 3 and 6), and Amazonia (Denevan 1996).

In short, this section combined the paleoclimatic record obtained from the wetlands of India Muerta, the geomorphological studies that have defined the mid-Holocene marine terraces (Bracco 1992a; Bracco et al. 2000d; Gonzáles 1989; Montaña and Bossi 1995), and the general environmental features of the region, in addition to our current archaeological data. These multiple data sets revealed that the upper freshwater wetlands, although reduced in size, might have become strategic locations for the establishment of pre-Hispanic populations during the aridity trend of the mid-Holocene. These data further suggests that during this period, local populations did not disperse (e.g., disaggregate into smaller groups and increased mobility) or out-migrate to other regions, but opted for orienting their settlement towards wetland areas where they established more permanent communities in strategic locations, such as the upper freshwater wetlands. Interestingly, these “unfavorable” climatic conditions served to provide the

impetus for a more intense human occupation and an increase in their level of permanence at these strategic locations, which ultimately triggered the process of early village formation at Los Ajos around 4,190 bp. To anticipate a more detailed discussion of these aspects, I will briefly say that these changes in settlement pattern were likely accompanied by locational constraints, more restricted mobility, and an increase in the population density of these areas, as populations became “tethered” to these restricted and rich-resource wetlands’ locations. Consequently, as people were forced to live closer and closer together on the landscape, competition and interactions between groups increased. In broad terms, one can speculate that the process of “settling in” in the midst of an unstable and deteriorating environment during the earliest stages of the Preceramic Mound Period must have triggered a redefinition of intra- and intergroup relations, as reflected in the appearance of circular villages and the rise of tribal social formations. Moreover, these strategic locations, which began to be occupied more intensively during the mid-Holocene, take on, through time, particular sets of meanings and connotations in the process of early village formation. These aspects will be considered further in the next section.

## **Historical Processes Leading to the Rise of Formal Circular Communities**

### **Summary of Archaeological Evidence**

In the midst of the unstable and dry conditions of the mid-Holocene, the more intense occupations of selected locations in the upper freshwater wetlands in the southern sector of the Laguna Merin basin triggered the process of early village formation. The archaeological investigations at Los Ajos suggests that from the beginnings of the PMC, Los Ajos inhabitants began to live in a circular household-based communities, partitioning the site into a number of discrete functional areas characterized by the placement of residential units around a central plaza area. Before proceeding with the interpretation of the archaeological record, I will briefly recapitulate the main findings that resulted from the archaeological investigations of the Preceramic Mound Component at Los Ajos.

The excavations carried out at Mound Gamma indicate that during the PMC the mound was used as a domestic space. Despite the lack of direct evidence for residential structures, the combined analyses of stratigraphy, features, the horizontal and vertical spatial distributions of

lithic debitage, bone and ceramic sherds and the artifact assemblage composition indicate that the PMC was the result of the gradual accumulation of multiple overlapping domestic occupations. This process resulted in the formation of a 0.6-0.8 m possibly circular, dome-shaped mound. In the absence of household features, such as postholes or postmolds, we cannot either provide a more precise demarcation of the house structure or infer its shape and size. We can, however, roughly estimate the better-defined central areas, which contain a low density of debitage that range between ca. 14 and 20 m<sup>2</sup>. Judging from the size of the areas with low debris density, it is likely that the structure identified at Mound Gamma represents the habitation of a single nuclear family. Furthermore, taking into account the rather reduced size of this structure, it probably corresponds to a single-room structure.

Several characteristics indicate that the flat central oval sector of the site constituted a plaza. Notably, low artifact densities, lack of anthropogenically-altered soil accumulations, and centralized location around domestic accretional mounds typify this space. All this evidence suggests that this central cleared area was a heavily maintained open space that served as a public space. During this time, in addition to the central part of the site, there is a distribution of occupational refuse in off-mound areas like the TBN and TBS crescent-shaped rises. The site also presents a vast outer area with more dispersed and less formally laid out mounded architecture. In addition, the systematic interval transect sampling in the off-mound areas documented a vast outer area of domestic debris which does not show accumulation of anthropogenic soils.

The residential mounds around a central plaza lend support to the idea that from the beginning of the PMC, the village already exhibited clear elements of a planned design constituting a household-based community since early Preceramic Mound Period times. In addition, by the end of the Preceramic Mound Period, Mound Gamma witnessed the appearance of a novel behavior, the interment of the dead in residential mounds. A burial consisting of a fragmented skull facing downward and four adjacent long bones lying horizontally and oriented ESE, ESE, SE and NNE direction respectively, was defined below a circular stone structure (1.7 m diameter) composed of eight stones and two fine-grained rhyolite cores. The interment was devoid of any obvious offerings. I interpret the circular stone structure as part of a distinct mortuary practice based on its close spatial association with the partial burial and the lack of any other feature associated with the stone structure.



In sum, the broad contemporaneity shared by eight radiocarbon dates retrieved from the lower part of the PMC of Mounds Alfa, Delta, and Gamma; the similarity these mounds exhibit in their PMC stratigraphy; and the mounds' circular spatial arrangement, indicate that the process of early village formation started at Los Ajos ca 4,190 bp. The overall articulation among closely and regularly spaced residential mounds around a central, cleared, open plaza area and the presence of an extensive area of domestic debris behind the residential mounds strongly suggest that these structures formed part of a coeval integrated site plan, which represent the consolidation of a public/domestic space associated with the emergence of early villages.

### **Redefining Group Relations: The Incorporation and Centralization of a Communal Space**

Having briefly recapitulated the archaeological evidence for the development of circular/elliptical village layout, it is now pertinent to explore the social processes that may have led to its development. As mentioned above, the unstable and dry climatic conditions of the mid-Holocene promoted a reorientation of the settlements towards these restricted and limited resource-rich wetland areas, resulting in the establishment of more intense occupations and the aggregation of populations in these selected locations. When these populations became less mobile and began to aggregate more frequently in larger communities, the problems associated with forming and remaining in large groups for longer periods of time surfaced. Larger, more permanent settlements present organizational problems to people without "rulers". In the absence of a centralized political control, villages frequently disaggregate as a result of aggression, feuding, and/or adultery. Similarly, as several authors have noted (e.g., Brown 1985; Hayden 1992; Kelly 1994; Meillasoux 1982), tribal groups start to lose flexible social ties, which allow simple hunters-gatherers to move farther away, for example, to their relatives' residences, in case of resource stress or social conflict. To paraphrase Kent (1989), people start to have fewer options to "vote with their feet." Consequently, it seems reasonable to think that the loss of more fluid group membership ties, characteristic of highly mobile hunters-gatherers, may have begun as strategic locations started to "fill in", groups became more territorial, and population packing in wetland areas became more significant during the changing climatic conditions of the mid-Holocene.

Under these circumstances, group relations may have been redefined as the process of village formation unfolded. The integration of these groups into more permanent village life must have involved the development of temporal or permanent supra-household structures that link households to corporate groups (e.g., clans and lineages), arrange corporate groups into residential aggregates corresponding to villages, and interconnect these local groups in extensive interpersonal networks of exchange. As several authors have stressed (e.g., Aldenderfer 1999; Cohen 1985; Drennan 1976; Gross 1979; Johnson and Earle 1987), essential to these higher levels of social integration is the dependence on ceremonies to define groups and their interrelations. There is consensus among these authors (op.cit.) that the social institutions that cross-cut kin and locally-based affiliations diffuse tension among the different segments of villages and also serve to mobilize warriors for defense, raiding, and to pool labor for cooperative activities, such as hunting, house building, and planting.

The circular villages of Central Brazil and in particular, the model of village nucleation and dispersion proposed by Gross (1979) provides a provocative analogy to investigate how this type of non-hierarchical, semi-sedentary, autonomous villages may have resolved conflict through the rise of social institutions that cross-cut kinship boundaries<sup>19</sup>. Gross (1979) has shown how large, unstable, autonomous, and egalitarian Central Brazil villages remained together in the absence of centralized political controls ubiquitous in fully sedentary settlements of comparable size and composition. In his view, in Central Brazil, this is possible through “Elaborate village plans, cross-cutting moieties, social divisions, age sets, sporting events, frequent dances and ceremonials, and special ties between individuals may have served as cultural means for effectively integrating the semi-autonomous foraging units (and later refugee groups) into large unified village units”(op.cit.: 332). These social institutions cross-cut kinship boundaries and integrate temporal communities at a supra-household level. These social phenomena not only have been observed among Central Brazil groups (e.g., Crocker 1973; Da Matta 1973; Nimuendaju 1946; Oberg 1955) but also in many other societies with a dual pattern of seasonal dispersion in small groups and aggregation in fairly large circular villages. This is the case

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<sup>19</sup> Throughout this chapter, I make references to several ethnographic analogies with the ethnographic and archaeological circular villages of Central Brazil. These analogies should be taken as a point of departure to explore the social and political organization of the early Formative community at Los Ajos and not as analogies that directly translate to the spatial patterns observed at Los Ajos. Also, it should be kept in mind that circular villages developed in different environmental and historical circumstances. Moreover, the ethnographic record should not restrict our conceptualization of the kind of social relations that circular village/plaza may imply.

among the Plains Indians (e.g., Oliver 1968), the ethnohistoric Shawnee (Henderson 1999; Yerkes 2002), and several prehistoric cultures, for instance, the Fort Ancient cultures of the midwestern U.S. (Henderson 1999).

In this scenario, we can suggest that the appearance of formal site layouts with the incorporation of a centralized public space like the plaza area at Los Ajos, served to bring populations together to form villages. Plazas are key spatial settings for the performance of public interactions outside the domestic sphere (e.g., Adler and Wilshusen 1990; Dillehay 1992b; Moore 1996). In this regard, the early Formative central plaza area during the PMC at Los Ajos played a crucial role as a “social integrative facility” (*sensu* Adler and Wilshusen 1990), representing the formalization of a wider social field of interaction that transcended the household sphere of interaction. It is in this new arena of social integration, in this prepared space, socially acknowledged as a context for the integration of individuals above the household level, where communities diffuse tensions and promote social cohesion. But here, they also express, negotiate, and reaffirm their identities and goals through the practice of ritual activities, such as meetings of sodalities, initiation rites, group sponsored activities (e.g., dances or feast), and multi-village ceremonial activities. Moreover, as Dillehay (1992b) observed in South America, these early prototypes of public architecture, many of which are characterized by places that are used permanently but display flimsy or impermanent architecture (e.g., central plaza areas), constitute a threshold in terms of the appropriation and the transformation of social spaces, which take through time particular sets of meanings and connotations in the social realm. This type of incipient public architecture, symbolizing the tangible formalization of group-level integration, also represents a physical and metaphorical materialization and expression of community and identity. Moreover, these public places are situated in fixed locations usually adjoining living areas (e.g., the circular village with a plaza area at Los Ajos) represent the emergence of new cosmovisions, symbolisms, and community identity at a larger scale. As several studies indicate (e.g., Lawrence and Low 1990; Tilley 1994; Turner 1996) architecture and the built environment encode and reproduce worldviews. Thus, the regularities observed in the location of mounds in a circular arrangement around a central plaza area are archaeological observations whose significance resides not so much in the labor needed to build them, but in the ideas needed to envision them.

Los Ajos contains clear elements of a planned design since the early Preceramic Mound Component. This early village was characterized by the articulation of residential areas around a central cleared plaza area which denotes a form of social organization that implies integration into a household-based community. At this point, it is possible to ask: what type of household-based community is Los Ajos representing? What types of social relations are objectified in Los Ajos PMC layout? Many authors have proposed (Gregor 1977; Grøn 1991; Heckenberger 1995; Maybury-Lewis 1979) that the circular plaza depicts unity and egalitarianism. As Grøn (1991) has synthesized from several studies, the spatial structure of circular settlements containing a central public space denotes equal access to public activities and ritual performances as long as houses are equidistant to the central public area. This has been generally interpreted to mean that facilities were used by entire communities without restricting their access (e.g., Moore 1994). The central plaza at Los Ajos is the kind of public space where the whole community can participate in a democratic fashion. It is not the kind of public architecture that may be restricted to a handful of initiates. Another important aspect that needs to be mentioned about the circular/elliptical formal layout with its central plaza area is the concept of unity. The presence of a central plaza suggests the existence of communal institutions that embrace the community as a whole. Circular plaza villages gravitate toward the central plaza, which conceptually represents social unity. Furthermore, the formal layout of the village may have represented an organizing principle for community members. In this regard, as in the ethnographic documented Central Brazilian villages, the early Formative village at Los Ajos may have been the focus of a set of collective institutional structures or divisions (e.g., moieties) that framed the social group, the community as a cohesive whole.

However, it should not be forgotten that plazas also might mark social differences along lines of gender, age, and lineages. In Amazonian (e.g., Heckenberger 1995) and Central Brazil groups (e.g., Turner 1996), plazas materialize a series of ranked oppositions between an inner, public, sacred, male domain and an outer, domestic, profane, female space. Hence, circular plaza villages embody inherent structural contradictions and therefore, carry the seeds of incipient social differentiation; an aspect that, as we will see below, took place during the CMC.

In addition to the inner precinct, Los Ajos presents a vast outer area with more disperse and less formally integrated mounded and flat-off mound areas covering ca. 12 ha. In addition, to the presence of low, circular and elongated mounds in the peripheral area of the site, the

systematic interval transect sampling in off-mound areas found PMC subsurface domestic debris spread over the entire site. The limited extent of the excavations carried out in these areas prevents a full assessment of their nature. The fact that in general they present lower artifact densities and lack accumulation of human-produced soils indicated that they represent less intense more ephemeral occupation of the site. However, their presence indicates that the Los Ajos was not restricted to the inner precinct and the crescent-shaped rises that framed it but also posses a vast outer area of domestic debris.

Furthermore, looking beyond Los Ajos, the presence of other large, nucleated mound complexes containing well-developed Preceramic Mound Component like for example Estancia Mal Abrigo and Puntas de San Luis, reveal considerable population growth over early Preceramic Mound times, but also suggest an increase in the complexity of the regional organization in the wetlands of India Muerta.

Having out the general social and ecological circumstances that led to the emergence of early village societies at Los Ajos, I will now focus on the economic, social, and political life during the Preceramic Mound Period.

### **The Economic, Social, and Political Life during the Preceramic Mound Period**

Knowledge of the nature of early Formative societies in southeastern Uruguay during the mid-Holocene is beginning to surface. The data generated by this study builds up and complements prior research that investigates the subsistence practices, settlement patterns, and social and political life that characterized the Preceramic Mound period. I will now offer a succinct review of these aforementioned themes.

#### ***The Preceramic Mound Period Economy: The Adoption of a Mixed Economy and Changes in Lithic Technology***

The process of “settling in” in strategic locations took place in conjunction with changes in subsistence practices and technology. Phytolith and starch grain analyses from plant grinding tools residue and selected archaeological sediments recovered at Los Ajos document a shift to a mixed economy, including the adoption of maize (*Zea mays*) and domesticated squash (*Cucurbita* spp.) shortly after 4,190 bp. Faunal analysis indicates that these early Formative

societies also consumed a variety of species of mammals, reptiles, birds, and fishes. The combined microfossil plant analyses and the faunal record indicate that during the Preceramic Mound Component, these societies adopted a mixed economy, combining hunting, fishing, and gathering with small-scale horticulture of maize, squash, and possibly, domesticated beans and tubers. Additional starch grain and phytolith data from Isla Larga and Los Indios sites document the presence of *Phaseolus* spp. ca. 3,050 bp, *Canna* spp. ca. 3,660 bp, and *Calathea* spp. ca. 1,190 bp, indicating the practice of small-scale horticulture. Hunting, gathering, and fishing complemented this agricultural practices; further corroborating the adoption of a mixed economy (Iriarte et al. 2001).

The lithic technology exhibits a slight and gradual change towards a more expedient, informal technology between the PAC and the PMC, which can be briefly summarized as follows. There is (a) a minor but significant decrease in the use of non-local but regionally available fine-grained lithic raw materials, (b) an impoverishment of the projectile point technology characterized by an abandonment of finely manufactured projectile points during the Mound components, (c) a small but significant decline in the presence of bifacial thinning flakes, (d) a decrease in the percentage of projectile points, (e) a decrease in the number of utilized bifacial thinning flakes, and (f) a greater diversity of tool types. These changes are concomitant with the appearance of plant-grinding tools, mainly used to process maize, during the Preceramic Mound Component.

As in many other areas of the Americas, changes to a more generalized and expedient technology are associated with a subsistence shift towards a broader, plant-oriented economy (e.g., Bryan and Gruhn 1993; Ranere 1980; Richardson 1978; Rossen 1991, 1998). The fact that wild animal resources continued to play an important role during the Preceramic Mound Component subsistence strategy may explain, in part, the gradual change the lithic industry experienced throughout this period. This gradual shift to a more expedient technology and a greater reliance on local raw materials are associated with more permanent residency at Los Ajos. This is in agreement with the expectations of conceptual advances in the analysis of lithic technologies (Binford 1977; Bamforth 1986; Parry and Kelly 1987; Shott 1986; Torrence 1989), which indicate that more sedentary populations tend to opt for more informal, non-standard, and expedient technologies.

The results of these analyses indicate that the Preceramic Mound Period peoples practice a mixed economy. In this context, it is reasonable to suggest that in the long-term, as human occupations became more intense and permanent in wetland areas (e.g., Los Ajos), local resources were increasingly depleted possibly pushing early Formative societies to increase their reliance on domestic crops. Consequently, the adoption of a mixed economy, which involved the ability to manage one's food supply and the region's rich and abundant resources, may have encouraged the possibility of forming and remaining in larger groups for longer periods. In addition, the more stable climate of the succeeding millennia that followed after the unstable and drier mid-Holocene may have encouraged groups to practice flood-recessional small-scale horticulture. Alternatively, the partial dependence on horticulture may have "tethered" populations to areas with rich fertile soils, encouraging the consolidation of more fixed territories. In turn, becoming more sedentary would have demanded the development of a more formal village arrangement. Using Kent's (1991, 1992) anticipated mobility concept, the formality of Los Ajos layout indicates anticipated staying.

### ***Settlement Patterns***

Defining how permanent the occupation at Los Ajos' early Formative village was is not an easy question to answer with our current data. However, several lines of evidence suggest that the human occupations at Los Ajos were fairly permanent. Although recurrent site abandonment and reoccupation undoubtedly occurred throughout time, our data indicates that relatively fixed occupations were established in Los Ajos by at least 4,190 bp.

In the first place, the planned nature and structural elaboration of Los Ajos, consisting of well-defined domestic, public, and trash areas show a higher degree of permanence by its inhabitants. The formal layout of the site lends support to the presence of rather permanent occupations at Los Ajos. Indirect evidence points out the existence of more permanent occupations. In the first place, there is a correlation between the locations of large, spatially elaborate mound complexes in areas not subjected to seasonal flooding, which are suitable for the establishment of more settled communities. The close proximity of sites to more permanent and reliable sources of water, such as the Laguna de Los Ajos, also lends support to the idea that Los Ajos' village was a long-term occupation. As stated above, the adoption of a mixed economy may have created a greater dependence on domesticated plants, which resulted in the

establishment of more permanent communities. This is further corroborated by the location of large, multi-mound complexes in the most fertile soils in the area, such as Estancia Mal Abrigo, Colina da Monte, and Campo Alto (Figures 2.5 and 2.4, respectively). Unfortunately, we currently lack a regional database and refined temporal controls of these other sites at the regional level to characterize the settlement patterns of these early Formative societies during the Preceramic Mound Component.

### ***Social and Political Life***

There were no marked changes during the Preceramic Mound Period. This indicates that the PMC groups may have remained fairly stable for at least 1,000 years, between ca. 4,190 and 3,000-2,500 bp. Furthermore, we have not yet found any archaeological evidence to argue for the existence of ranked societies in the early Formative village of Los Ajos nor is there archaeological evidence for clearly differentiated elite residential areas, differential mortuary patterns, specialized craft production, exotic/prestige goods, and corporate architecture that may require a body of authority to mobilize and organize large labor pools. On the contrary, the residential areas within the village share, in general, similar size dimensions. The analyses of domestic assemblages from Mounds Gamma, Delta, and the excavation of Mound Alfa by Bracco (1993) are consistent with the interpretation that there was limited personal household status differentiation during this period, suggesting a fairly egalitarian society, beyond the distinctions of gender and age. Probably any attempts at individual aggrandizement would have been mitigated by rituals and ceremonies aimed at reinforcing group cohesion. At the moment, we only have one CMP burial, which was not accompanied by burial goods. There is an absence of prestige goods, craft specialization, and/or exotic goods. And, although the village exhibits a formal ground plan, there is no indication that it was a massive project requiring corporate labor (*sensu* Feldman 1992).

In terms of the site layout, I have already argued that the appearance of the plaza area may be reflecting the development of group-oriented societies. The formal circular village plaza is indicative of the importance of group ceremonialism and ritual, practices may have served to strengthen community ties, fighting to oppose the divisive forces of fragmentation. However, the incipient spatial asymmetry between the residential mounds flanking the central communal space



in the inner precinct and the lack of mounded architecture in the vast outer off-mound areas with domestic debris may represent emergent pattern social differentiation at Los Ajos.

### ***The Emergence of Tribal Societies***

Taking a long-term historical perspective, I believe that intra-group relations were redefined concomitantly with inter-group relations during the Preceramic Mound Period. The “in-filling” of the landscape at a regional level with an increased number of sites with a deep Preceramic Mound component (e.g., Puntas de San Luis) suggests that population numbers were on the rise. Under competitive circumstances, such as the mid-Holocene unstable environmental changes and the emergence of rich and limited strategic zones, it is difficult to escape the conclusion that conflict among groups is likely to have flared up as different groups fought for this restricted rich-resource zones.

In the midst of this conflictive environment, the formation of tribal groups may have entailed advantages. As proposed by several authors (Anderson 2002; Braun and Plog 1982), the emergence of regional tribal networks could be seen, at a general level, as a way of dealing with uncertainties brought about by environmental change, warfare, and population increase. As noted by some authors (e.g., Carneiro 2002; Flannery 1972; Gross 1979), nucleated settlements lead to larger population numbers and, in turn, to increased security. Moreover, at a regional level, it seems reasonable to suggest that villages engaged in situational alliances and confederated into larger cohesive political bodies under this type of conflictive conditions. Further, as noted by Anderson (2002) once these tribal societies were in place, it was likely that they were adopted through a process of competitive emulation.

Although these groups must have been politically autonomous and economically self-sufficient, they must share ideological and social beliefs with other social groups at a regional scale, forming a tribal society. There are different ethnographic groups that share these characteristics. In South America, the horticultural Gê and Bororo groups of Brazil (e.g., Crocker 1973; Da Matta 1973; Nimuendaju 1946; Oberg 1955), the Yanomami groups of Venezuela (Chagnon 1992), and the Mapuche groups of Chile (Dillehay 1992a) best represent these characteristics. In Asia, the Tsembaga Maring (Rappaport 1967) and Arapesh of New Guinea (Tuzin 2001) exemplify these aspects. Finally, in Africa, the Nuer of southern Sudan (Evans-Pritchard 1940) also exhibits these features.

There is a suite of common features associated with these sites that may indicate that these societies are integrated through pan-tribal institutions at a regional scale. Perhaps, the clearest evidence of the emergence of tribal societies in southeastern Uruguay during the mid-Holocene is the appearance of recurrent geometrical layout (circular, elliptical) such as in Estancia Mal Abrigo, Colina da Monte, Cinco Islas, and Campo Alto. As suggested above, the circular village/plaza served to integrate household-based communities, but also may have played a crucial role in promoting a regional identity. Again, comparative data from other mound complexes in the region, which is not currently available, are essential in order to evaluate these interpretations. Archaeological excavations at the Estancia Mal Abrigo, Colina da Monte, Cinco Islas, and Campo Alto sites, to mention a few, will be fundamental to determine if these sites are contemporary or were sequentially built.

The paleoclimatic record at Los Ajos indicates that after 4,000 bp, dry conditions ameliorated returning to more humid conditions, resembling the current climate. At least, in the long-term, this climatic change did not reverse the social processes initiated at Los Ajos during the mid-Holocene, but seemed to have accelerated them, as described in the following section. The rich and abundant wetland resources combined with the ability to manage part of the food supply through the adoption of domesticated plants also may have enhanced the possibilities of forming and remaining in larger groups throughout longer parts of the year.

### **The Ceramic Mound Period (3,000-2,500 bp – Contact Period): The Formalization and Spatial Differentiation of the Inner Precinct**

#### **Summary of Archaeological Evidence**

In the preceding sections, I examined the ecological and historical circumstances that gave rise to the development of early Formative villages during the Preceramic Mound Component, ca. 4,190 bp, and how they remained stable for approximately 1000-1500 years. However, during the Ceramic Mound Period, around 3,000 bp, Los Ajos's layout experienced significant structural changes, which were accompanied by changes in technology and subsistence. Exploring the nature of these transformations is the focus of the following sections.

Before I initiate an examination of this topic, I need to point out that the Ceramic Mound Component lacks sufficient temporal controls because (a) we have inadequate radiocarbon dates

for this component at Los Ajos, (b) we have not built a ceramic chronology to further subdivide the CMP into finer temporal components, and (c) there is no agreement on the timing of the introduction of ceramics into the region among researchers working in the area. Some authors, notably, López (2001) argue that ceramics were adopted 3,000 bp while others contend that the Ceramic Mound Period, referred to as the Vieira Tradition in southern Brazil, started around 2,500 bp (Schmitz 1976; Schmitz et al. 1991).

Having made these preliminary remarks, we can now concentrate on investigating the structural and technological transformations that Los Ajos exhibited during the CMP. Several important innovations took place at Los Ajos during this period. Notably, changes in site layout, elaboration of mounded architecture in the inner precinct, greater intensity in site occupation, the practice of interring the dead in mound contexts, and changes in technology and subsistence practices.

### **Changes in Site Layout**

If the PMC witnessed the incorporation and centralization of a communal space within a household based community, during the CMC, we observe the transformation of this space into a more formal and differential area with respect to the rest of the site. In general, the formal and more compact layout of the inner precinct contrasts with the less formal and more dispersed arrangement of architecture in the outer precinct, which lacks an integrated formal arrangement.

First, in addition to the accretion of occupational refuse by domestic occupations, mounds experienced clearly intentional, deliberate capping episodes indicated by the deposition of layers of gravel. As a result, the overall shape of Mound Gamma changed from the extant 0.6-0.8 m high, probably circular, dome-shaped accretional mound to a larger, quadrangular, 1.40 m tall, flat-topped, beveled-edged platform mound. The presence of the same gravel layer also was identified in a test unit in Mound Delta and in a similar stratigraphic position in Mound Alfa by Bracco (1993), which further demonstrates that mound remodeling was a generalized process that occurred across the site. Moreover, the presence of extensive borrow areas (see Figure 8.5) attest to the scale of mound building that occurred during this period.

In addition, during this period, interments became an integral and recurrent activity that took place only in mounds. So far, excavations in the off-mound areas did not find burials, which restrict this practice to the mound located in the inner precinct. Layers 5 and 6 in Mound

Gamma are characterized by the presence of clusters of disarticulated and fragmented human bone clusters, most of which are severely shattered bone fragments. The strongly acid nature of the sediments, their coarse texture, and the extensive bioturbation present in Layers 5 and 6 prevents us from carrying out a full evaluation of the nature of the human bones' deposition. However, the poor preservation conditions of the finding make it difficult to talk about "burials" in the ordinary sense of the word, they are rather pieces of disarticulated human skeletons. It is not unlikely that these remains represent the bodies of captives or sacrificial victims that were dismembered and interred in the mound fill (e.g., Spencer and Redmond 1994; Stark 1999). In the upper part of Layer 6, a large stone structure, composed of three massive unworked stones forming a semicircle was defined. No burials were recovered from the stone structure or immediately below it. However, three bone clusters and isolated human bones were defined at the same depth of this structure. Overall, unlike the early stages of the PMC, where mounds were only used for habitational purposes alone, during the CMC, mounds became a place for habitation, burial, and ritual practices. I will consider these changes below.

During the CMP, the TBN and the TBS crescent-shaped rises experienced a more substantial accumulation of occupational refuse. The 14-20 m wide TBN crescent-shaped rise that extends over 150 m in length, surrounding both Mounds Alfa and Delta, attained 0.80 m of anthropic deposits in its central sector. The smaller 4 to 8 m wide TBS crescent-shaped rise that covers 150 m in length, reaches 0.35 m in depth. Both TBN and TBS crescent-shaped rises indicate a more intense and permanent occupation of the site.

The enduring plaza area became more clearly defined during the CMP mainly due to the effect created by the now remodeled flat-topped, beveled-edged mounds that surround it. Both in the plaza area and in the area separating the mounds from the crescent-shaped rises, there is no accumulation of domestic refuse, which shows that its inhabitants made a continued effort to keep these areas clear of any debris. The formal ground plan of the central sector of Los Ajos, which included a central plaza area, flat-topped, beveled-edged mounds, and the TBN and TBS crescent-shaped rises is a strong testimony to the existence of public and domestic spaces, which together formed part of an enduring integrated whole.

In the inner precinct, the horseshoe arrangement of more imposing flat-topped, beveled-edged mounds, the TBN crescent-shaped rise, and Mound 13 seem to form part of an integrated architectural plan. Mound Delta at the base of the horseshoe arrangement of platform mounds,

the base of the TBN and the orientation of Mound 13 all point to the NE. Altogether, they appear to represent an emergent and idiosyncratic form of public architecture possibly used to perform centralized public ceremonies during the CMC at Los Ajos. Significantly, this architectural plan also marked a prominent spatial asymmetry within the inner precinct. On the one side, the NE sector of the inner precinct is more formal and prominent, characterized by the steep-sided, relatively high platform mounds presenting a flat, fairly rectangular area at the top. These are framed by a larger, wider, and taller crescent-shaped rise, which articulates with Mound 13. On the opposite side of the plaza, the SW end is less formal and conspicuous, being characterized by low, dome-shaped, circular mounds, which are surrounded by less visible TBS crescent-shaped rise. To what extent these spatial differences reflect incipient social inequalities between two possible distinct residential wards, one located to the SW and the other to the NE of the inner precinct are question that will be discussed below.

The results of the systematic interval transect sampling in off-mound areas indicates a continuous distribution of domestic debris in a vast outer area comprising ca. 12 ha. These outer sectors of the site, peripheral to the inner precinct, present a variety of architectural and topographical features, which are more dispersed and less formally laid out, including five circular and three elongated dome-shaped mounds and several borrow areas. Together they contrast and accentuate the spatial differentiation between the inner formal precinct and the vast outer area of domestic debris.

## **Changes in Technology and Subsistence**

### **The Appearance of Ceramic Technology: Ceramics for Feasting?**

Overall, this basic ceramic analysis indicates that the ceramic assemblage recovered from Los Ajos closely resembles the broadly defined Viera Tradition ceramics (Brochado et al. 1969; Schmitz 1976; Brochado 1984; Schmitz et al. 1991). The ceramic assemblage is small, which possibly indicates that ceramics played a secondary role as containers in relation to baskets or wooden containers. The fact that the ceramic assemblage is small and that the attempted reconstruction of vessel's shape indicates that ceramics were likely bowls, plates, and dishes probably used for serving, suggests the possibility that they may have been used for feasting

associated to ritual contexts. It should not be forgotten that many sherds exhibit soot in their exterior part indicating that many vessels were used for cooking.

When comparing the different sectors of the site, it is notable that Mound Gamma ceramic assemblage exhibits more variability in temper, less homogenous paste, and a larger percentage of smoothed sherds in comparison to the off-mound areas ceramic assemblages, which are dominated by fine-sand temper, homogenous paste, and a major percentage of sherds without surface treatment. The interpretation of these differences needs to await a more sophisticated analysis of the ceramics.

Although the small sample of sherds recovered from Mound Gamma is very small (N=49), the ceramic assemblage shows two major changes over time: (a) the use of coarse-sand temper, though it is very limited in occurrence, increases in the upper levels and (b) the upper levels exhibit more variation in paste texture in comparison to the bottom levels of the CMC, where only homogenous paste is present. In general, in the TBN, the technological attributes do not show remarkable chronological differences. Fine-sand temper prevails in all the levels (88.9 to 100%); firing atmosphere is highly variable like in all the levels of the site; paste texture is homogenous (100%) in all the levels; and in all, but the uppermost 160 cm depth level, two thirds of the sherds do not present any surface treatment and the remaining third presents smoothed surface. The analysis of the vertical distribution of the ceramic assemblage of the TBN indicates that the central sector of the TBN shows a gradual increase in ceramic density over time. In addition, in comparison with other sectors of the site, the TBN has the highest ceramic density. These two characteristics, along with the stratigraphy and soil chemistry analyses indicate that the TBN was an area that grew through the accretion of domestic refuse. As in Mound Gamma, in the off-mound grid test units there is an increase in the medium and coarse-sand temper over time. Paste texture is exclusively homogeneous and overall, smoothed sherds are slightly more frequent than sherds displaying no surface treatment.

Because the appearance of ceramics took place concomitantly with major changes in site layout at Los Ajos in terms of the formalization and segregation of space in the inner precinct, I suggest that the differences between the ceramic recovered from the flat-topped, beveled-edged mounds from the inner precinct and the ones from outer more peripheral areas of the site may be representing the different activities took place in different sectors of the site or possibly an incipient differentiation of the material culture possessed by the people who lived in the inner

precinct in comparison to the rest of the population that was spread in the vast outer off-mound areas. This aspect will be elaborated below.

Since Vieira ceramics in the region has long been interpreted as domestic in nature due to their simple manufacture, homogeneity, and lack of decoration, the hypothesis that they may have been used for serving in ritual contexts will undoubtedly be met with controversy by colleagues. In this regard, the patterns suggested here, should be considered nothing more than a hypothesis in need of testing that should await more sophisticated ceramic analysis as well as the analysis of a major ceramic sample from the different contexts of the site.

### **Lithic Technology**

In general terms, the lithic assemblage recovered from the CMC at Mound Gamma is characterized by a more expedient, diverse, and generalized technology. This trend is similar to the one that differentiates the PAC from the PMC. However, some minor differences could be observed. The CMP shows a minor increase in the use of quartz, concomitant with a decrease in the use of rhyolite and fine-grained raw materials. The tool assemblage recovered at the CMP, like the one of the PMC, is diverse and consists of a generalized, non-specific assemblage that includes a broad range of different tool types displaying a wide variety of edge angles. The CMC shows a major presence of unmodified utilized flakes with an edge angle higher than 45° scraper-planes, flake-scrapers, and notches, and in turn, only presents one grossly made projectile point.

### **Subsistence: A Mixed Economy**

The starch grain and phytolith residue analyses from two milling stone bases and a mano, recovered from the CMP contexts (Mound Gamma and TBN crescent-shaped rise), indicate that these plant-grinding tools were used to process maize. The phytolith analysis of selected archaeological sediments in Mound Gamma marked the presence of maize cob and domesticated squash rind phytoliths. In the CMP contexts of the TBN crescent-shaped rise, domesticated squash phytoliths and a maize leaf signature were documented. The bone assemblage in the CMP contexts in Mound Gamma is far less preserved than the PMP one. Two main factors may account for the poor preservation of bones in the CMP in comparison to the PMC. The first factor is the finer-grain silty loamy sediments of the PMC, which are less abrasive than the

coarser gravelly layers present in the CMC. The second factor is that the finer-grained ashy sediments of the PMC create a more alkaline environment, which promotes bone preservation (Gordon and Buikstra 1981; Woods 1982). In spite of the poor-preservation of the faunal assemblage in the CMC, the faunal analysis indicates that the CMC groups continued to rely extensively on a wide assortment of natural resources, including deer, small and medium rodents, and fish.

### **The Social and Ritual Life**

While it is easy to recognize the changes that occurred in the stratigraphy and site layout during the CMC in the archaeological record at Los Ajos, it is difficult to interpret the changing social relationships that this novel construction of space objectified. The transformations that occurred at Los Ajos during the CMC bear important points for consideration. What are the deeper social and cultural expressions that these material realities objectify? What does the appearance of the internal site stratification mean? Are mounds changing from the domestic to the public arena? Are the off-mound outer areas domestic areas representing lower ranking people or ephemeral occupations by outlying groups that returned periodically to the site? Is the remodeling of mounds directed toward the aggrandizement of a few individuals, or was it instead intended to reinforce traditions of egalitarianism and corporate cohesion? Is the dual spatial asymmetry indicating that certain households/individuals may have begun to distinguish themselves in a manner that was previously resisted? And in turn, did this differentiation offer an opportunity for households and individuals to enhance their position in ways that were previously discouraged by the community at large? While Los Ajos' current data do not offer answers to all these questions, these inquiries guide most of the discussion that follows.

### ***The Elaboration of Ritual Public Architecture***

During the CMC, the inner precinct at Los Ajos acquired a strong public ritual character marked by the appearance of elaborate public architecture in the inner precinct at Los Ajos coupled with a vast outer more disperse peripheral areas exhibiting domestic debris, which covers ca. 12 ha. Before addressing this development, I must acknowledge that given the small-



scale of mound building during the CMP, the presence of intentional public construction should not by itself be viewed as an index of cultural complexity. I am not inclined to interpret the intentional construction of mounds as the result of corporate labor (*sensu* Feldman 1985) and consequently, the emergence of a hierarchical body of authority. The capping/filling episodes documented at Mound Gamma are not an unusual amount of household labor for a minimally stratified society. This small amount of labor would not have presented a problem in terms of labor shortages or unavoidable scheduling difficulties (see for example, experiments carried out by Page (1959), Erasmus (1965), and the estimates provided by Muller (1997: 274)). A review of the ethnographic record of group level, egalitarian societies from Central and South America show the existence of social institutions, such as cargo systems (Burger and Burger 1986), ceremonial sodalities (Flannery 1979, see also Wolf's (1957) concept of closed corporate community), and ceremonial moieties (Wagley 1977: 112), which cross-cut kinship boundaries and are capable of pooling labor from households without the existence of hierarchical relations. Moreover, the evidence suggests that the remodeling of the site was a slow accretional process over a long period of time. Therefore, what is important at Los Ajos is not its size, but the formal, standardized plan it exhibits.

What is clear, as stated above, is that the inner precinct took on new roles in the constitution of the social and ritual life of Los Ajos during the Ceramic Mound Period. While during the PMC we saw the appearance of a household-based community distributed around a central public space, the CMC witnessed the appearance of internal site stratification characterized by a formalization and spatial differentiation of the inner precinct with respect to an outer, more dispersed, and less formally integrated peripheral area. The most conspicuous feature of the site during this period is the seven flat-topped, beveled mounds arranged in horseshoe format. The steepness of their slopes facing the plaza makes them more impressive, emphasizing mound height, accentuating the differences with other mounded architecture, and in turn, defining more clearly the central plaza area. Throughout this process, they became dominating, somewhat commandeering architectural features of the community. Concomitantly, both the central plaza area and the intermediate areas were kept clear of any accumulation of refuse to maintain the demarcation of space adding formality to the inner precinct. Altogether, the horseshoe arrangement of platform mounds, the TBN, and platform Mound 13 constitute a formal ground plan oriented to the NE represent an emergent and idiosyncratic form of public

architecture possibly used to perform centralized public ceremonies. The inner precinct of the site also shows a marked dual spatial asymmetry. The NE sector became more formal and prominent characterized by the steep-sided, relatively high platform mounds presenting large, fairly rectangular summits framed by a larger, wider, and taller crescent-shaped rise, which articulates with platform Mound 13. In contrast, on the opposite SW end of the inner precinct, there is a less formally integrated area characterized by low, dome-shaped, circular mounds surrounded by a less prominent TBS crescent-shaped rise. These patterns also have been observed in other large mound complexes in the region like Estancia Mal Abrigo and Colina da Monte.

While during the PMC, the central mounds were arguably the residential areas of the site; during the CMC these mounds also incorporated other ritual and burial functions, which were not performed in the outer areas of the site. Concomitantly, the TBN and TBS exhibited rapid growth of occupational refuse. The data suggest that the inner precinct was less intensively occupied and the peripheral areas became a major focus of domestic habitation. The data indicates that during the CMC, the formal inner precinct of the site became more public/ceremonial in nature and the TBN and TBS mainly represented the residential areas of the site. The lack of midden accumulation and the lower density of artifact suggest that the vast outer off-mound area of domestic debris covering ca. 12 ha. likely represents less intense and more ephemeral occupations.

I interpret these new transformations in the site layout as an indication that the inner core of Los Ajos became a major focus for ritual public activities. As pointed out before by many students of ritual and religion, formality is one of the most essential characteristics of ritual and the way it operates in society (e.g., Bell 1997; Bloch 1974, Bradley 1998). Public ritual communicates through very specific media, it follows a set pattern, and its contents are standardized to the extent that they allow little modification. Formalism reflects an adherence to restricted modes of activities, often viewed by participants as timeless, invariant, and tradition-laden. Formalized activity can also be important in the reproduction of social power. The apparent contradictions between competition and cooperation are not atypical of intermediate-level societies (e.g., Fowles 2002; Tuzin 2001). Moreover, as Dietler (2001) has stressed, ritual may promote social integration and cohesion, but also may encourage exclusion, appropriation, and inequality. As argued by social theorists (e.g., Bourdieu 1977; Giddens 1979), social actors

and groups can manipulate public architecture to legitimize their political power drawing on the fact that architecture is an effective tool for structuring the activities that form social organization by expressing or restricting relations among individuals and groups. As noted by Tilley (1994:11): “Spatial experience is not innocent and neutral, but invested with power relating to age, gender, social position, and relationships with others. Because space is differentially understood and experienced, it forms a contradictory and conflict-ridden medium through which individuals are acted and acted upon.” Architecture may be used as a set of mnemonic devices constructed by those in power to represent and maintain their political agenda. By behaving in the “accepted way” in formally built environments, people continuously reaffirm the social order. As indicated by Dillehay (1992a:418), formal ceremonial contexts “create opportunities for social control, more complex architectural expressions, social stratification, exchange, and centralized leadership...” More so, if these circumstances are accompanied by population growth, population pressure on fertile lands, technological change, and territorialism (idem.); all processes that appear to be taking place at a regional level in the wetlands of India Muerta during the Ceramic Mound Period.

Based on these considerations I suggest that the differences in architecture at Los Ajos may represent an internal expression of ranked, dual opposition associated with the emergence of a new ideology. It is significant that the most elaborate mound architecture was built in the central sector of the site flanking the central plaza area. The formal and asymmetrical public area was the focal point around which these social transformations took place.

### ***The Inner Precinct as an Arena for Religious and Political Power: The Emergence of a Dual Ranked Society?***

As emphasized during the discussion of the Preceramic Mound Period, plazas viewed as public/ceremonial spaces may represent community unity and the integration of larger social units, but at the same time, public communal spaces may create conditions for inequality and opposition within different sectors of the community. Communal spaces may become particularly important when seen as an arena of political control by different factions within the community. The ethnographic record of South American lowland communities provides a provocative analogy to consider this aspect. Several ethnographic observations (e.g., Heckenberger 1995; Levy-Strauss 1973; Turner 1996) indicate that plazas embed inherent

structural contradictions along the lines of gender, age, and other social dimensions. They materialize several *viz a viz* ingrained hierarchical oppositions: center/periphery, sacred/domestic, public/profane, and male/female. Moreover, recent archaeological work in Amazonia gives us some hints about the emergent non-egalitarian processes that could be unfolding in circular/village plaza conditions. Heckenberg's (1995) study on the changing construction of social space in circular villages in the late prehistoric villages in the Upper Xingu in Brazil is particularly instructive. He (op.cit: 343) argues that changes in the configuration of the standard circular village/plaza through the addition of a new ring of houses or mounded architecture had the following implications:

“... the domestic precincts (neighborhoods) closer to the plaza had privileged access to the plaza, and hence public ritual and political control. Such village segmentation would break the pattern of equal access provided by a ring of houses equidistant from the plaza, leading to increasingly restricted access or privatization of the central plaza and, hence, public ritual political action (...). The Upper Xingu example thus provides insight into the process by which incipient patterns of hierarchy, based on principles of gender and seniority and embodied in the plaza could be transformed into actual control of public, ritual and political action/process by certain segments of the society.”

It is important to note at this point that although the complex settlements documented in the Upper Xingu (Heckenberger 1995; Heckenberger et al. 2003) and the circular villages of Central Brazil (Wüst and Barreto 1999) serve as a point of departure to reflect on the social processes that may have unfolded in early village societies, the Los Ajos data and the wetlands of India Muerta show a clearly different pattern from these areas. In general, numerous, mound complexes in southeastern Uruguay are larger, exhibit complex and elaborated mounded architecture around central plaza areas, and display vast outer areas of continuous subsurface domestic debris covering tens of hectares. Interestingly, the emergent complexity in Uruguay appears to be earlier than in Central Brazil and Amazonia. Though the public architecture is different in kind and scale to the early developments in the Central Andes, Los Ajos and the other multi-mound complexes in the region are reminiscent of them because they exhibit an inner formal central precinct with elaborate public architecture accompanied by a vast outer informal area of domestic debris. Analogous to early developments of public architecture in the central coast of Peru, the socio-spatial hierarchy reflected in the mounded architecture at these sites is

not accompanied by differential material culture associated with elite (Burger 1999; Quilter 1991).

Does the appearance of more formal residential areas in the inner precinct of the site and the burials encountered in them represent the emergence of an elite? Does the internal site stratification represent a focusing of authority or power within a narrower social circle? And more importantly, is the dual asymmetrical pattern manifested in the mounded architecture of the inner precinct evidencing the emergence of a ranked dual division of the early Formative societies in Uruguay?

Ritual and its expression through public architecture may act as “social integrative facilities” to promote social integration and cohesion, but also may lead to exclusion, appropriation, and inequality (e.g., Dietler 2001; Hayden 1995). During the CMC, the formal asymmetry and spatial differentiation of the inner precinct of the site reveals a major focus on public ritual probably associated with the reproduction of social power. In this context, I suggest that if power asymmetries developed, they were possibly configured on ritual privilege and socio-spatial segregation associated with the appropriation of the means of expressing ideological knowledge (e.g., Aldenderfer 1993; Drennan 1976; Earle 1991), which were played out in the central communal space.

The mounds that are closer to the plaza area had privileged access to public ritual and political control. Given its advantageous location, the architectural elaboration that the platform mounds located in this sector experienced, and the segregation of activities that they materialize, we could suggest that the members of this segment of the society enjoyed a somewhat higher social standing than those living in more peripheral areas of the site. Following this line of reasoning, the remodeling of mounds through deliberate capping episodes was probably associated with cyclical ritual practices linked to concepts of renewal. Its end products, the more imposing, centrally located, flat-topped, beveled-edged mounds may have been utilized as “symbolic aids” to legitimize these privileged central sectors of the site by an elite sector of the population. These formal ritual performances and their associated mnemonic devices may have served to establish a social memory of place and perpetuated asymmetrical social relations. The overall process may represent the typical pattern (e.g., Burger 1999) of vertical growth through ceremonial interment and the subsequent renovation through construction so pervasive in the Americas. These practices not only materialize a continuity of place but also indicate ideological

continuity within the cyclical patterns of sacred time. The appearance of ceramics possibly used for serving, associated with feasting in ritual contexts, in addition to the likely presence of sacrificial burials in the mound fill also bolster the importance of public ritual in this sector of the site.

The socio-spatial dual asymmetry between the more architecturally elaborate NE and the less conspicuous SE end of the inner precinct may be an internal expression of a ranked dual opposition, indicating the emergence of an incipient social differentiation of the population that lived at Los Ajos. Given the widespread ethnographic (e.g., Da Matta 1982; Nimandeju 1946; Seeger 1981; Turner 1996; Wagley 1977) and archaeological (e.g., Flannery and Marcus 1976; Knight 1990; Moore 1995; Netherly and Dillehay 1986) presence of dual organization both in South and North America I suggest that the spatial patterning at Los Ajos possibly represents an expression of a ranked dual social organization. The internal contradictions within dual division of societies, such as moieties, are a common feature in the ethnography of the Americas. For example, Knight (1990:6) in theorizing on the emergence of inequalities among southeastern U.S. pre-Hispanic intermediate-level societies, has noted, based on the previous work of Levi-Strauss (1973), how a common characteristic of egalitarian exogamous clans is that they generally present a dual organization where one of the divisions is believed to be superior to the other. On the one hand, they embody equivalence and complementarity. On the other hand, they usually mark a latent ranking between a “senior” or “upper” moiety and its “junior” or “lower” counterpart. This is what Levi-Strauss (1963) referred to as the “ingrained notion of hierarchy”. As Knight (1990: 7) hypothesizes, “... it is not difficult to imagine how such hierarchical conceptions could form the basis for the emergence of genuine social inequalities where the control of resources and production is at stake.” Even more provocative for the interpretation of the inner/formal vs. outer/informal layout of Los Ajos is the observation of Levi-Strauss (1973) paraphrased in Moore (1995: 171) regarding the fact that while symmetric dualism might be expressed by two social groups of equal size that occupy opposite side of the village, ..., diametric dualism could be reflected in a concentric plan in which a “superior” social group occupies the central core of the settlement surrounded by an “inferior” social group that rims the periphery” (Moore 1995:171).

While it is tempting to jump to the inference that southeastern Uruguay had ranked societies characterized by a “superior” group that lived in the inner precinct and a “lower”

ranked population spread in the vast outer peripheral area, the archaeological evidence suggests that such a presumption may be unwarranted. These differences between the two areas may also simply represent a permanent group inside and impermanent groups coming and going outside. This may be part of the social structure and of a changing hunter-gatherer to horticultural economy. While the Los Ajos displayed the development of internal site stratification, the absence of other distinctive traits of personal ranking such as the presence of exotic exchange goods, prestige technologies, descent-based social differentiation, and/or corporate architecture that may require a body of authority to mobilize and organize large labor pools. The analysis of non-perishable artifact assemblages from mound contexts indicated very limited if any personal household status differentiation aside from the fact that the ceramics from mound contexts are different from the ones in off-mound areas. The artifact assemblage composition from these contexts evidences that the residents of these flat-topped, beveled-edged mounds were engaged in a broad range of domestic activities. Similarly, the data obtained from burials indicates the absence of differential mortuary practices. Burials do not include grave goods, which may suggest that the individuals interred in the mounds held no special position. Furthermore, the recurrent presence of partial and disarticulated body pieces gives the impression that the people interred in mound contexts were sacrificial victims.

Taking into account these facts, during the CMC, leadership was likely situational and based on social status personal charisma and sacred knowledge associated with public rituals, lacking the connotation of power and coercion that is seen in chiefdoms and states. If the people who lived on the platform mound summits during the CMC held a differential status, it did not translate in long-term differences of power and wealth. The lack of evidence for personal ranking and long-distance exchanges suggests that the power aspirations of individual political actors may have not been successful. The absence of prestige technologies and exotic goods show that agent-based competitive strategizing activities, such as long-distance exchange (e.g., Helms 1994), did not crystallize in the early Formative societies of southeastern Uruguay.

With our current data, it is best to conceptualize the early Formative societies as group-oriented (Renfrew 1974), corporate (Blanton et al. 1996), communal social formations (Saitta 1997) who may have resisted individual aggrandizers in their path to power (Lee 1990; Weissner 2002). I argue that if social differentiation appeared reflected in differential mounded architecture, it was “subsumed” by the commune since there are no archaeological correlates of

personal ranking at Los Ajos. Perhaps, these societies “channeled” the surplus labor through the construction of mounded architecture without implying a hierarchy. As demonstrated by the long-term study of Dillehay (1986, 1990, 1992a, 1995a) on the Mapuche ceremonial fields of south-central Chile, monumental architecture does not necessarily imply centrality and verticality, but may be reflecting horizontal relationships between the different lineages. The standardization of ceremonial sites provides a suitable context for the social and religious regional integration of populations who lack a centralized political authority.

To move forward in our interpretations of the CMP groups, we need to advance our archaeological work at the site and regional levels. The lack of accumulation of midden refuse and the lower density of artifacts in the vast peripheral off-mound areas indicate less intense and more ephemeral occupations. Whether this is evidence that people from outlying areas came to the site periodically to celebrate ceremonies and camp outside the inner precinct or represents a lower ranked population supporting the people that lived in the inner precinct are hypothesis that need further research. However, it seems more plausible, that the ceremonial inner precinct of Los Ajos, while retaining a local, fairly permanent population, may have served a larger outlying population. The large number of small mound sites constituted by isolated and two-paired sites in the region may represent individual homesteads or dispersed hamlets whose inhabitants periodically returned to Los Ajos (and possibly to the rest of the large, spatially complex, mound complexes) to perform cyclical ceremonies. Nevertheless, this hypothesis cannot be convincingly evaluated until we acquire more detailed regional data. Detailed investigations at other multi-mound sites in the region, such as Colina da Monte, Campo Alto, Estancia Mal Abrigo, Cinco Islas, among others are sorely needed to gain a deeper understanding of the role that Los Ajos played in the regional settlement patterns and, in turn, in refining the nature of the social formations that developed during the early Formative in southeastern Uruguay.

### **The Wetlands of India Muerta: A Complex and Integrated Regional Settlement System?**

As reviewed throughout this study, Los Ajos is not an isolated mound complex. The site layout patterns described in the literature (Bracco 1993; Bracco et al. 1999; Dillehay 1995b; Iriarte et al. 2001) and my own survey of the area reveal unexpectedly complex regional settlement patterns in southeastern Uruguay. Here I only focus on the wetlands of India Muerta.



These studies show that the layout of the large nucleated mound complexes in the India Muerta wetlands is variable. Because of the relatively small number of sites mapped in detail so far, consistent patterns can only be identified on a trial basis. Although most of the sites display the recursive geometrical layouts (circular, elliptical, and horseshoe) there is considerable variability not only in the formal structure of the sites, but also in the dimensions and shape of mounds (see Bracco 2000b: Photo 2 and Figures 2-6). Site layouts vary according to the position of the landscape in which they are placed; for example, some are positioned in circular knolls like Los Ajos (Figure 4.1), others in elliptical, elongated knolls like Colina da Monte (Figure 2.4), and others in irregular forms such as Estancia Mal Abrigo (Figure 2.5). Another factor is the overall size of the site; some larger complexes like Estancia Mal Abrigo or Colina da Monte exhibit several distinct groups or arrangements contiguous to one another. Besides, most of the largest sites also contain all the different types of mounds, while smaller ones seem to exhibit less diverse mounded architecture. Also, there appears to be a consistent pattern in large multi-mound sites characterized by an inner more formal and compact precinct and an outer more dispersed peripheral area. Furthermore, several of them, such as Estancia Mal Abrigo and Colina da Monte exhibit large peripheral areas bearing more dispersed and less formally laid out mounded architecture that may be representing outlying domestic areas.

Similar to Los Ajos, in Colina da Monte, the central mounds of the site, which flank the clear plaza area, are flat-topped, beveled-edged platform mounds fairly quadrangular in plan. In contrast, the most peripheral mounds are low, dome-shaped, circular, and more dispersed. Likewise, the dimensions and shapes of plaza areas vary from circular to elliptical. Some central spaces are tightly enclosed by mounds like in Los Ajos while others are larger and more open as in Puntas de San Luis. In addition, while most of the sites with a geometrical layout (circular, elliptical, and horse-shoe) enclose a clear plaza area, in some sites, such as Colina da Monte, the plaza contains a central imposing mound reminiscent of the central public architecture of early complex sites in the Late Preceramic Peru (e.g., Burger 1999; Dillehay 1992b; Moore 1996; Quilter 1991) (Figure 2.7b). In general, the recurrent and regular layout of these large mound complexes suggests a planned construction of these sites.

One other major site type represented in the region is the large and tall platform mounds that can reach 150 x 50 x 7m (length, width, and height, respectively) like Isla de Alberto (2.8a), which consists of two well-defined platforms connected by a ramp. These sites are commonly

associated with two or three low dome-shaped mounds. Notably, most of these sites are oriented SE-NW with the highest platform located to the NW and the low mound positioned in the SE sector of these sites. The high conical mounds represent another site type, for example, Cerrito de la Viuda (Bracco and Ures 1999) (Figure 2.9a), which can attain 7 m high. Other sites, such as Cinco Islas exhibit a combination of circular and linear arrangement of mounds (Figure 2.9b). Variations in site plans and mound types also has been documented in other regions like of southeastern Uruguay like headwater of the Rio San Luis (see also Bracco 2000b: 296-301, Photo 2 and Figures 2-6), the Laguna Negra and El Potrerillo (López and Pintos 2000), in the Laguna de Castillos (Pintos 1999) and also in the wetland floodplains of the Arroyo Yaguari (Gianotti1999).

The differences among this diversity of large, spatially complex mounds may be representing temporal and regional variations that will only be resolved with more archaeological work. However, the presence of well-developed Preceramic Mound components in Los Ajos, Estancia Mal Abrigo, Puntas de San Luis, and Isla Larga indicate that they were broadly contemporaneous. The general contemporaneity of these large multi-mound sites reveals considerable population growth since early Preceramic Mound times suggesting an increase in the complexity of the regional organization in the wetlands of India Muerta. If the different site-types mentioned above proved contemporaneous they would indicate a complex and integrated regional system. Some of these sites may have been used as special-purpose ceremonial sites, such as the large double-platform mounds or the high conical mounds. Alternatively, it is possible that the large multi-mound sites represent nucleated villages like Los Ajos and the small mound clusters represent dispersed hamlets, outlying populations to the large nucleated sites that return periodically to larger sites to practice public ceremonies. If many of the large multi-mound sites exhibit a vast outlying domestic component represent fairly permanent contemporaneous villages, then the population of the Bañado de India Muerta may have reach the low thousands even if we take the more conservative “guesstimates”.

Similarly, the differences in site layout played out against a more ubiquitous geometrical formats (circular, elliptical, or horse-shoe format), which possibly reflect a shared worldview, may represent a local reinterpretation of these broader traditions triggered by individual or group agency. All these hypotheses deserve future testing as more regional data becomes available in the following years to come.

## **Implications and Issues**

Given the fact that this is the first community-focused archaeological investigation carried out in a large multi-mound site in southeastern Uruguay, the data generated by this study not only raises significant theoretical and methodological questions, but also has important research implications. Examining the cultural and environmental histories of southeastern South America, the dispersal and early adoption of cultigens into this region, and the emergence and dynamics of intermediate-level societies and the meaning of complexity and its limited material reproduction are the most outstanding implications of this study. These issues are the focus of the next section.

### **Culture History: Challenging Traditional Assumptions of “Stability, Stasis, and Marginality” of Pre-Hispanic Cultures in the La Plata Basin.**

This multidisciplinary investigation has provided an entirely new perspective on the nature and timing of the emergence of cultural complexity in the La Plata Basin. It challenges the long-held assumption that portrays the lowland Pampa groups of Uruguay as simple hunters-gatherers organized in small, egalitarian, and highly mobile groups (Copper 1942; Meggers and Evans 1983; Steward 1946; Steward and Faron 1959). While the neotropical lowlands and Central Brazil have traditionally “...been portrayed by ethnographers and archaeologists as passive receptacles of time-lagged cultural influences (Carneiro 1995; Lathrap 1970; Meggers 1972:162; Roosevelt 1991a, 1991c:1624)” (Barreto and Wüst 1999: 4), the Pampas of the southern cone have been depicted as inhabited by simple hunters-gatherers (Orquera 1987) that did not experience significant changes since the end of the Pleistocene. As mentioned above, in the early 1990s, Uruguayan archaeologists (Bracco 1992a; Bracco et al. 2000a; López and Bracco 1992; see also Dillehay 1993, 1995b) began to seriously call into question the view that these societies were marginal hunters-gatherers. Complementing this previous and on-going research, the new results presented in this study document, for the first time, that the mid-Holocene was a period of environmental flux and increased aridity and that the Preceramic Mound Period (around 4,000 bp) was a time of significant cultural change that led to the emergence of early Formative societies in the region.

The organizational features displayed by the Preceramic Mound Period groups at Los Ajos revealed that it is no longer adequate to view continuity between the Archaic Umbu Tradition (10,400-2,500 bp) and the beginning of the Preceramic Mound Period (ca. 4,190 bp). Comparable to other regional developments in the South American lowlands like the Sambaqui shell-midden complex (Andrade and López 1999; DeBlasis et al. 1998; Fish et al. 2000; Gaspar 1998; Massi 1999), the circular villages of Central Brazil (Wüst 1998; Wüst and Barreto 1999), the mound-building cultures of the Pantanal (Schmitz et al. 1998), and Amazonia (Heckenberger 1995; Heckenberger et al. 2003; Roosevelt 1999), the “Constructures de Cerritos” are beginning to unravel the existence of a long sequence of cultural developments; characterized by a more diverse, sophisticated, and autonomous cultural trajectory than previously thought.

The data presented in this study shows that during the PMC and continuing during the CMC, selected places of the landscape in the wetlands of India Muerta became more intensively and permanently occupied. This phenomenon triggered the process of early village formation, the adoption of a mixed economy marking the earliest appearance of *Zea mays* and *Cucurbita* spp. in southeastern South America, and the appearance and elaboration of formal public ritual spaces. At a regional level, the presence of large nucleated mound complexes containing a well-developed Preceramic Mound Component, such as in Estancia Mal Abrigo and Puntas de San Luis, reveal not only considerable population growth over time, but also suggest an increase in the complexity of the regional organization in the wetlands of India Muerta. By the CMC, Los Ajos exhibited a formal inner precinct comprising seven flat-topped mounds distributed around a central cleared plaza area and a less formal and more dispersed peripheral area containing prominent crescent-shaped rises, low circular and elongated mounds, and a vast off-mound area of continuous domestic debris spreading ca. 12 ha. During this time, the site shows signs of internal site stratification, characterized by the formalization and spatial segregation of the inner precinct. The inner precinct, which acquired a major focus on public rituals, displays an asymmetrical dual architecture that may be an expression of a ranked dual social structure.

This new picture of the La Plata Basin pre-Hispanic past clashes with traditional notions that portrayed the area as a marginal one. On the contrary, the results of this study show that the southern sector of the Laguna Merin Basin was a locus of early emergent complexity with distinct regional idiosyncrasies. This research complements ongoing investigations that

document the development of diverse traditions on the early appearance of monumental architecture in the Americas and elsewhere.

### **Environmental History: The First Pollen and Phytolith Paleoclimatic Record for the Area**

As described in Chapter 3, the dynamic interactions between human populations and their changing physical environments have played a major role in the development of early Formative societies in the Americas during the mid-Holocene (e.g., Aldenderfer 1999; Anderson 1995; Bray 1995; Brown 1985; Brown and Vierra 1983; Carr and Gibson 1997; Damp 1984b; Dias 1992; Erickson 1995; Hamilton 1999; Lathrap et al. 1977; Plazas and Falchetti 1987; Sandweiss et al. 1999; Stothert 1985, 1992). These studies show that in order to understand the emergence of early complex societies, we need to focus on both the relationships between humans and global and local climatic changes as well as on how early Formative societies locally managed the environment to meet their needs (e.g. Crumley 1994; Ashmore and Knapp 1999; Feinman 1999).

As previously reviewed, the relationship between climatic changes and the emergence of “Constructores de Cerritos” has long been hypothesized (Bracco 1992a; Bracco et al. 2000a; 2000d; López 1998). In the absence of a paleoclimatic record for southeastern Uruguay, archaeologists have mainly relied on the uncritical extrapolation of paleoclimatic records from the adjacent region of Brazil (mainly Bombin and Klamt 1976) and Argentina (e.g., Gonzáles and Weiler 1984; Iriondo and García 1993;) in order to assess the nature of environmental interactions and the emergence of “Constructores de Cerritos” in this region. To address this problem, I developed a multidisciplinary project designed to reconstruct the paleoclimatic record of the mid-Holocene in southeastern Uruguay. To achieve this, I employed the paleoecological methods of core drilling and the combined pollen and phytolith records from a core obtained in the wetlands of India Muerta, Rocha Province, Uruguay. This data generated the first combined 14,810 bp pollen and phytolith record for Uruguay. It revealed that the unstable and dry climatic conditions of the mid-Holocene triggered important changes in settlement and subsistence patterns, which gave rise to the emergence of early Formative societies in this region. This study also showed that the paleoclimatic record of southeastern Uruguay is different from the ones reconstructed from southern Brazilian and Argentina (Iriondo and García 1993; Prieto 1996).

This regional variability further reinforces the need to obtain local paleoclimatic records in order to explore human-environment interactions at a regional level.

### **Implications for the Dispersal and Early Adoption of Cultigens into Southeastern South America**

The development of new techniques such as phytoliths and starch grains are allowing archaeologists to overcome the tyranny of poor-preservation biases, permitting us to explore in more depth the use, manipulation, domestication, and adoption of plants by past peoples (e.g., Deham et al. 2003; Mindzie et al 2001; Piperno and Pearsall 1998a). The combined analyses of phytoliths and starch grains from Los Ajos and other sites in the region (Iriarte et al. 2001) indicate that maize, squash, and possibly, domesticated beans and tubers were adopted by local populations shortly after 4,190 bp. The analysis carried out in this and another previous study (Iriarte et al. 2001) marked the earliest occurrence of at least two domesticated crops, *Zea mays* and *Cucurbita* spp. in southeastern South America. They also documented the presence of *Phaseolus* spp. beans and *Canna* spp., and *Calathea* spp. tubers in the region for the first time.

This novel data raises new questions about the antiquity and the routes of introduction of the prehistoric cultigens adopted by the early Formative societies in southeastern Uruguay during the mid-Holocene. Also, it contributes significantly to the on-going debate about the timing and nature of the adoption of domesticated plants in southern South America.

It is becoming increasingly apparent that the use of domesticated plants was a more important aspect of subsistence long before previously recognized temporal and cultural placements suggest. This latest evidence also forces us to reevaluate the common conception that the dispersal of agriculture into southeastern South America is associated with the arrival of tropical horticulturalists in the region around 1,000 bp, who practiced slash and burn agriculture along the subtropical forests of rivers (e.g., Acosta y Lara 1970; Brochado 1984; Cabrera 1995; Schmitz 1991). Along with other studies in the Americas, this study also indicates that the ancient use and manipulation of wetlands along lakes, rivers, and swamp margins was a much more important and frequent activity than previously thought (Blake 1999; Niedeberger 1979; Pohl et al. 1996; Siemens 1999). As mentioned before, although the practice of flood-recessional agriculture remains hypothetical, it should be mentioned that the wetlands of India Muerta represented an ideal scenario for the practice of flood recessional agriculture. During the spring

and summer months, the moist, highly fertile, and easy to till, wetland margin soils are exposed, constituting a privileged location for the practice of flood-recessional horticulture.

Unfortunately, basic data are still lacking in order to propose a route for the spread of these early cultigens into southeastern South America. Potential routes such as the Atlantic coast, southern Amazonia or the Gran Chaco are waiting for more studies to define more precise chronologies and the nature of settlements. However, there are three aspects regarding the contexts and chronology of the domestication of crops in the Americas that favors an early adoption of these cultivars in southeastern Uruguay during the mid-Holocene. First, there is mounting evidence that shows that the domesticated plants present in southeastern Uruguay were domesticated elsewhere in the Americas during the early Holocene several millennia before they were adopted by the local populations of southeastern Uruguay (see Piperno and Pearsall 1998a for a detailed summary of the evidence). Second, all these studies show how early domesticates dispersed quickly between their centers of origin and other areas, for example, maize (e.g., Piperno and Pearsall 1998a; Piperno and Holst 1998) and manioc (Pohl et al. 1996). Last but not least, there are no major geographical barriers for the spread of these cultigens into southeastern South America. On the contrary, the second major river system, constituted by the Paraguay-Paraná-Uruguay basin, may have facilitated the exchange of plants among different populations at an early age.

Overall, the results of this on-going 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, squash, and possibly, domesticated beans and tubers. In this respect, the application and development of new techniques employed in this study, such as phytoliths and starch grains, should make possible the direct investigation of the plant food component of the diet of early Formative societies in southeastern Uruguay in sites where preserved plant remains are rarely found as macrofossils.

## Future Research Questions

Given the fact that this was the first in-depth study of a large mound complex in the region, this study has given rise to more questions than answers. I would like to conclude this investigation by succinctly suggesting several lines of research, which would help strengthen or falsify the interpretations made throughout this dissertation. First, more archaeological investigations at Los Ajos aimed at recovering a greater sample and wider range of assemblages from mound and off-mound contexts are needed in order to assess the interpretations laid out in this study. In addition, the refinement of local chronologies will be extremely important to provide temporal control for site and regional analyses. The definition of projectile point types that takes into account morphological changes caused by resharpening (see Iriarte 1995; Iriarte and Femenías 2000) appears to be a fruitful avenue to pursue. If confirmed with future studies, the change from carefully manufactured Preceramic Archaic bifacial projectile points to unifacial projectile points during the PMC may be used as chronological markers for these time periods. Similarly, the proposition that Polonio type points are diagnostic of the Ceramic Mound Component must await archaeological confirmation.

Second, regional data from other multi-mound sites in the region is sorely needed since comparative data from other sites in the region are essential to evaluate the interpretations made in this study. Only future work at a regional level will be able to clarify what is now a rather complicated picture of settlement variability. More detailed site maps, accurate dating, and in-depth artifact analyses of multi-mound sites such as Colina da Monte, Campo Alto, Estancia Mal Abrigo, and Cinco Islas to mention a few, are crucial to understand the role Los Ajos and these other sites played in the emergence of early Formative societies in the region. Detailed archaeological maps should include the presence/absence of mounds, different types of mounded architecture, presence of village plazas, their size, shape, midden widths and depths, the location of residential, public, mortuary, and trash-disposal zones in yet unknown areas. Moreover, gaining a deeper appreciation of what triggered this precocious emergent complexity will lie in a better understanding of the events occurring along the largely archaeologically unexplored La Plata Basin fluvial system. It is not unlikely that occurrence of contacts and large population movements over vast areas of South America took place; like it has been suggested from the tropical regions to the altiplano and the coastal desert (Lathrap et al. 1977; Rivera 1984).



Research in this largely forgotten but crucial area, the La Plata Basin, is critical to address issues of intercultural contacts in southeastern South America during the mid-Holocene and bring light into the early dispersal of cultigens into this part of the continent.

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# Appendix 1 -- Plant Species and their Occurrence in the Vegetation Formations of the Wetlands of Southeastern Uruguay

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Appendix 1. Plant species and their occurrence in vegetation formations of the wetlands of southeastern Uruguay (1=present, 0=absent)

Scientific name	Wetland	Wet Prairies	Upland prairie	Rock Outcrops	Riparian Forest	Mound Forest	Palm Forest	Salt marsh
<b>HERBACEOUS DICOTS</b>								
<b>Aizoaceae</b>								
<i>Sesuvium portulacastrum</i> (L.) L.	0	0	0	0	0	0	0	1
<b>Acanthaceae</b>								
<i>Hygrophila costata</i> Nees	1	1	0	0	0	0	0	0
<i>Justicia laevilinguis</i> (Nees) Lindau	1	1	0	0	0	0	0	0
<b>Amaranthaceae</b>								
<i>Philoxerus portulacoides</i> St. Hil.	0	0	0	0	0	0	0	1
<b>Apiaceae</b>								
<i>Apium leptophyllum</i> (Pers.) F. Müll.	0	0	1	0	0	0	0	0
<i>Bowlesia incana</i> Ruiz & Pav.	0	0	0	0	0	1	0	0
<i>Eryngium ebracteatum</i> Lam.	1	1	0	1	0	0	1	0
<i>E. echinatum</i> Urban	0	0	1	0	0	0	0	0
<i>Eryngium pandanifolium</i> Cham. & Schlecht.	1	1	0	0	0	0	0	0
Hydrocotyle	1	1	0	1	0	0	0	0
<i>H. bonariensis</i> Comm. ex Lam.	1	1	0	1	0	0	0	0
<i>Lilaeopsis carolinensis</i> Coulter & Rose	1	1	0	1	0	0	0	0
<b>Asclepiadaceae</b>								
<i>Telminostelma foetidum</i> (Cav.) Fontella & E.A. Schwarz	0	1	0	0	0	0	0	0
<b>Asteraceae</b>								
<i>Arctium minus</i> (Hill) Bernh.	0	0	0	0	0	1	0	0
<i>Aster squamatus</i> var. <i>graminifolius</i> (Spreng.) Hieron.	0	1	0	0	0	0	0	0
<i>Baccharis juncea</i> (Lehm.) Desfontaines	0	0	0	0	0	0	0	1
<i>B. microcephala</i> Baker	1	1	0	0	1	0	1	0
<i>B. spicata</i> (Lam.) Baillon	0	1	0	0	0	0	0	0

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<i>Cirsium vulgare</i> (Savi) Ten.	0	0	1	0	1	1	0	0
<i>Cotula coronopifolia</i> L.	0	0	0	0	0	1	0	0
<i>Cynara cardunculus</i> L.	0	0	1	0	0	1	0	0
<i>Eclipta megapotamica</i> (Spreng.) Sch. Bip. ex S.F. Blake	0	1	0	0	0	0	0	0
<i>Facelis retusa</i> (Lam.) Sch. Bip.	0	0	0	1	0	0	0	0
<i>Gymnocoronis spilanthoides</i> DC. var. <i>spilanthoides</i>	1	0	0	0	0	0	0	0
<i>Hypochaeris microcephala</i> (Schultz-Bip.) Cabrera var. <i>albiflora</i> (Kuntze) Cabrera	0	0	1	0	0	0	0	0
<i>Jaumea linearifolia</i> (Jussieu) DC.	0	0	0	0	0	0	0	1
<i>Micropsis spathulata</i> (Pers.) Cabrera	0	0	1	0	0	0	0	0
<i>Mikania involucrata</i> Hook. & Arn.	0	0	0	0	0	1	0	0
<i>M. periplocifolia</i> Hooker & Arnott	1	1	0	0	0	0	0	0
<i>Picosia longifolia</i> D. Don	0	1	0	0	0	0	0	0
<i>Pterocaulon interruptum</i> DC.	0	0	0	0	1	0	0	0
<i>Senecio tweediei</i> Hooker & Arnott	0	1	0	0	0	0	0	0
<i>Soliva anthemifolia</i> (Juss.) R. Br. ex Less.	0	1	0	0	0	0	0	0
<i>S. pterosperma</i> (Juss.) Less.	0	0	1	0	0	0	0	0
<i>S. sessilis</i> Ruiz & Pav.	0	0	1	0	0	0	0	0
<i>Spilanthes decumbens</i> (Smith) A. H. Moore	0	1	0	0	0	0	0	0
<i>Vernonia incana</i> Less.	0	0	0	0	0	0	0	0
<b>Bignoniaceae</b>								
<i>Macfadyena unguis-cati</i> (L.) A.H. Gentry	0	0	0	0	1	1	0	0
<b>Boraginaceae</b>								
<i>Heliotropium curassavicum</i> L.	0	0	0	0	0	0	0	1
<i>H. elongatum</i> Hoffm. ex Roem. & Schult.	0	1	0	0	0	0	0	0
<b>Brassicaceae</b>								
<i>Cakile maritima</i> Scop.	0	0	0	0	0	0	0	1
<i>Cardamine chenopodiifolia</i> Pers.	1	1	0	0	0	0	0	0
<i>Lepidium aletes</i> Macbride	0	0	1	0	0	0	0	0
<i>Rorippa bonariensis</i> (Poir.) Macloskie	1	1	0	1	0	0	0	0
<b>Buddlejaceae</b>								
<i>Buddleja thyrsoides</i> Lam.	1	1	0	0	0	0	0	0
<b>Cactaceae</b>								
<i>Opuntia arechavaletae</i> Spegazzini								
<b>Callitrichaceae</b>								
<i>Callitriche rimosa</i> Fassett	1	1	0	0	0	0	0	0
<b>Calyceraceae</b>							0	0
<i>Calycera crassifolia</i> (Miers) Hicken	0	0	0	0	0	0	0	1
<b>Campanulaceae</b>								
<i>Pratia hederacea</i> (Cham.) G. Don	1	1	0	1	0	0	0	0

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<b>Caprifoliaceae</b>								
<i>Sambucus australis</i> Cham. & Schtdl.	0	0	0	0	0	1	0	0
<b>Clusiaceae</b>								
<i>Hypericum brasiliense</i> Choisy								
<b>Caryophyllaceae</b>								
<i>Cerastium humifusum</i> Cambess. ex A. St.-Hil.	1	1	0	1	0	0	0	0
<i>Paronychia brasiliana</i> DC.	0	0	0	1	0	0	0	0
<i>Spergularia marina</i> (L.) Grisebach	0	0	0	0	0	0	0	1
<i>Spergula ramosa</i> (Cambess.) D. Dietr.	0	1	0	0	0	0	0	0
<b>Chenopodiaceae</b>								
<i>Atriplex hastata</i> L.	0	0	0	0	0	0	0	1
<i>Atriplex montevidensis</i> Spreng.	0	0	0	0	0	0	0	1
<i>Chenopodium macrospermum</i> Hooker f.	0	0	0	0	0	0	0	1
<i>Salicornia ambigua</i> Michx.	0	0	0	0	0	0	0	1
<b>Commelinaceae</b>								
<i>Tradescantia fluminensis</i> Vell.	0	0	0	0	1	1	0	0
<b>Convolvulaceae</b>								
<i>Aniseia argentina</i> (N.E. Brown) O'Donell	1	1	0	0	0	0	0	0
<i>Calystegia sepium</i> (L.) R. Br.	0	1	0	0	0	0	0	0
<i>C. soldanella</i> (L.) Roem. & Schult.								
<i>Cressa truxillensis</i> Kunth								
<i>Dichondra sericea</i> Swartz var. <i>microcalyx</i> (Hall.) Buck	0	1	1	0	1	1	0	0
<i>Evolvulus sericeus</i> Sw.	0	0	1	1	0	0	0	0
<i>Ipomoea alba</i> L.								
<b>Crassulaceae</b>								
<i>Crassula peduncularis</i> (Sm.) Meigen								
<b>Eremolepidaceae</b>								
<i>Eubrachium ambiguum</i> (Hook. & Arn.) Engl.	0	0	0	0	1	1	0	0
<b>Euphorbiaceae</b>								
<i>Acalypha communis</i> Müll. Arg.	0	1	0	0	0	0	0	0
<i>Chamaesyce rochaensis</i> Croizat	0	0	0	0	0	1	0	0
<b>Fabaceae</b>								
<i>Ornithopus micranthus</i> (Benth.) Arechav.	0	0	0	1	0	0	0	0
<i>Senna corymbosa</i> (Lam.) Irwin & Barneby	0	1	0	0	1	1	0	0
<i>Vicia graminea</i> Sm.	0	1	0	1	0	0	0	0
<i>Vigna luteola</i> (Jacq.) Benth.	1	1	0	0	0	0	1	0
<b>Haloragaceae</b>								
<i>Myriophyllum aquaticum</i> (Vell.) Verd.	1	1	0	0	0	0	0	0
<b>Hypoxidaceae</b>								

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<i>Hypoxis decumbens</i> L.	0	0	1	1	0	0	0	0
<b>Lamiaceae</b>								
<i>Marrubium vulgare</i> L.	0	0	0	0	0	1	0	0
<i>Mentha pulegium</i> L.	0	1	0	0	0	0	0	0
<i>Salvia guaranitica</i> St.Hilaire ex Bentham								
<i>S. uliginosa</i> Benth.	0	1	0	0	0	0	0	0
<i>Teucrium vesicarium</i> Mill.	0	1	0	0	0	0	0	0
<b>Fabaceae</b>								
<i>Vigna luteola</i> (Jacq.) Bentham								
<b>Lentibulariaceae</b>								
<i>Utricularia platensis</i> Speg.	1	0	1	0	0	0	0	0
<b>Limnocharitaceae</b>								
<i>Hydrocleys nymphoides</i> (Willd.) Buchenau	1	0	0	0	0	0	0	0
<b>Loasaceae</b>								
<i>Blumenbachia insignis</i> Schr.	0	0	0	1	0	0	0	0
<b>Loranthaceae</b>								
<i>Tripodanthus acutifolius</i> (Ruiz & Pav.) Tiegh.	0	0	0	0	1	1	0	0
<b>Lythraceae</b>								
<i>Lythrum hyssopifolia</i> L.	0	1	0	0	0	0	0	0
<b>Malvaceae</b>								
<i>Hibiscus striatus</i> Cav.	1	1	0	0	0	0	0	0
<i>Modiola caroliniana</i> (L.) G. Don	0	0	0	1	0	0	0	0
<i>Pavonia distinguenda</i> A. St.-Hil. & Naud.	0	1	0	0	0	0	0	0
<i>P. hastata</i> Cav.	0	0	0	0	0	1	0	0
<b>Marsileaceae</b>								
<i>Marsilea ancylopoda</i> A. Braun								
<b>Myrsinaceae</b>								
<i>Myrsine laetevirens</i> Mez	1	1	0	0	0	0	0	0
<b>Onagraceae</b>								
<i>Ludwigia longifolia</i> (DC.) H. Hara	0	0	0	0	1	1	0	0
<i>L. peploides</i> (H. B. K. ) Raven subsp. montevidensis (Spreng.) Raven	1	1	0	0	0	0	0	0
<i>Oxalis paludosa</i> A. St.-Hil.	0	1	0	1	0	0	0	0
<b>Passifloraceae</b>								
<i>Passiflora caerulea</i> L.	0	0	0	0	0	1	0	0
<b>Plantaginaceae</b>								
<i>Plantago coronopus</i> L.	0	0	0	0	0	0	0	1
<b>Plumbaginaceae</b>								
<i>Limonium brasiliense</i> (Boiss.) Kuntze	0	0	0	0	0	0	0	1
<b>Polygalaceae</b>								

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<i>Polygala australis</i> Benn.	0	0	0	1	0	0	0	0
<b>Polygalaceae</b>								
<i>Muehlenbeckia sagittifolia</i> (Ortega) Meisn.	0	1	0	0	1	1	0	0
<b>Polygonaceae</b>								
<i>Polygonum acuminatum</i> Kunth	1	1	0	0	0	1	0	0
<i>Polygonum brasiliense</i> C. Koch	0	0	0	0	0	0	0	1
<i>P. punctatum</i> Elliott								
<i>Rumex</i>								
<i>Rumex argentinus</i> Rech. f.	1	1	0	1	0	0	0	0
<b>Portulacaceae</b>								
<i>Portulaca cryptopetala</i> Speg.	0	0	0	1	0	0	0	0
<b>Primulaceae</b>								
<i>Anagallis minima</i> (L.) E. H. L. Krause								
<b>Ranunculaceae</b>	1	1	0	0	0	0	0	0
<i>Ranunculus apiifolius</i> Pers.	1	1	0	1	0	0	0	0
<i>R. bonariensis</i> Poir.	1	1	0	1	0	0	0	0
<b>Rhamnaceae</b>								
<i>Scutia buxifolia</i> Reiss.	0	0	0	0	1	1	0	0
<b>Ricciaceae</b>								
<i>Ricciocarpus natans</i> (L.) Corda	1	0	0	0	0	0	0	0
<b>Rubiaceae</b>								
<i>Cephalanthus glabratus</i> (Spreng.) K. Schum.	1	1	0	0	1	1	0	0
<i>Diodia dasycephala</i> Cham. & Schlecht.	0	0	0	0	0	1	0	0
<i>Hedyotis salzmannii</i> (DC.) Steud.	0	1	0	1	0	0	0	0
<i>Spermacoceodes glabrum</i> (Michx.) O. Kuntze	0	1	0	0	0	0	0	0
<i>Relbunium richardianum</i>	0	0	0	1	0	0	0	0
<i>Richardia stellaris</i> (Cham. & Schlecht.) Steud.	0	0	1	0	0	0	0	0
<b>Sapindaceae</b>								
<i>Cardiospermum halicacabum</i> L.	1	1	0	0	0	0	0	0
<b>Scrophulariaceae</b>								
<i>Bacopa monnieri</i> (L.) Pennell	1	1	0	0	0	0	0	0
<i>Gratiola peruviana</i> L.	1	1	0	1	0	0	0	0
<i>Micranthemum umbrosum</i> (J.F. Gmel.) S.F. Blake	1	1	0	0	0	0	0	0
<b>Solanaceae</b>								
<i>Cestrum parqui</i> L'Her.	0	0	0	0	1	1	0	0
<i>Jaborosa integrifolia</i> Lam.	0	0	1	0	0	0	0	0
<i>Nierembergia rivularis</i> Miers	0	1	0	0	0	0	0	0
<i>Salpichroa origanifolia</i> (Lam.) Thellung	0	0	0	0	1	1	0	0
<i>Solanum diflorum</i> Vell.	0	0	0	0	0	1	0	0

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<i>Solanum flagellare</i> Sendtn.	0	1	0	0	0	0	0	0
<i>S. glaucophyllum</i> Desf.	1	1	0	0	0	0	0	0
<i>Solanum mauritianum</i> Scop.	0	0	0	0	1	1	0	0
<i>S. laxum</i> Spreng.	0	0	0	0	1	1	0	0
<i>S. platense</i> Dieckmann	1	1	0	0	0	0	0	0
<b>Tropaeolaceae</b>								
<i>Tropaeolum pentaphyllum</i> Lam. subsp. pentaphyllum								
<b>Urticaceae</b>								
<i>Urtica urens</i> L.	0	0	0	0	0	1	0	0
<b>Verbenaceae</b>								
<i>Phyla canescens</i> (H. B. K.) Greene	0	1	0	0	0	0	0	0
<i>Verbena gracilescens</i> (Cham.) Herter	0	0	0	0	0	0	0	0
<b>WOODY DICOTS</b>								
<b>Anacardiaceae</b>								
<i>Lithraea brasiliensis</i> March	0	0	0	0	1	1	0	0
<i>Schinus longifolius</i> (Lind.) Speg. var. longifolius	0	0	0	0	1	1	0	0
<b>Euphorbiaceae</b>								
<i>Caperonia linearifolia</i> A. St.-Hill	0	1	0	0	0	0	0	0
<i>Chamaesyce rochaensis</i> Croizat	0	0	0	0	0	0	0	1
<i>Phyllanthus sellowianus</i> Müll. Arg.	1	0	0	0	1	0	0	0
<i>Sapium glandulosum</i> (L.) Morong	1	0	0	0	1	1	0	0
<i>Sebastiania brasiliensis</i> Spreng.	1	1	0	0	1	1	0	0
<i>S. commersoniana</i> (Baillon) Lyman B. Smith & B. J. Downs	0	0	0	0	1	1	0	0
<b>Myrtaceae</b>								
<i>Blepharocalyx salicifolius</i> (Kunth) O. Berg	0	0	0	0	1	1	0	0
<i>Eugenia uruguayensis</i> Cambess.	0	0	0	0	1	1	0	0
<i>Myrceugenia glaucescens</i> (Camb.) Legr. & Kaus. var. glaucescens	0	0	0	0	0	1	0	0
<i>Myrcianthes cisplatensis</i> (Cambess.) O. Berg								
<b>Phytolaccaceae</b>								
<i>Phytolacca dioica</i> L.	0	0	0	0	0	1	0	0
<b>Rutaceae</b>								
<i>Fagara hyemalis</i> (A. St.-Hil.) Engl.	0	0	0	0	1	1	0	0
<b>Salicaceae</b>								
<i>Salix humboldtiana</i> Willd.	0	0	0	0	1	1	0	0
<b>Santalaceae</b>								
<i>Jodina rhombifolia</i> Hook. & Arn. ex Reissek	0	0	0	0	0	1	0	0
<b>Sapindaceae</b>								
<i>Allophylus edulis</i> (A. St.-Hill., A. Juss. & Cambess) Radlk.	0	0	0	0	1	1	0	0

<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<b>Violaceae</b>								
<i>Anchietea parvifolia</i> Hallier f.	0	0	0	0	0	1	0	0
<b>Sapotaceae</b>								
<i>Pouteria salicifolia</i> (Sprengel) Radlkofer	0	0	0	0	0	1	0	0
<b>Smilacaceae</b>								
<i>Smilax campestris</i> Griseb.	0	0	0	0	1	1	0	0
<b>Thymelaeaceae</b>								
<i>Daphnopsis racemosa</i> Griseb.	0	0	0	0	1	1	0	0
<b>Ulmaceae</b>								
<i>Celtis iguanea</i> (Jacquin) Sargent	0	0	0	0	0	1	0	0
<i>Celtis tala</i> Gillies ex Planch	0	0	0	0	1	1	0	0
	0	0	0	0	1	1	0	0
<b>NON-GRASS MONOCOTS</b>								
<b>Alismataceae</b>								
<i>Echinodorus grandiflorus</i> (Cham. & Schldl.) Micheli in A. & C. D. C.	1	1	0	0	0	0	0	0
<i>E. longiscapus</i> Arechav.	1	1	0	0	0	0	0	0
<i>Eichhornia azurea</i> (Sw.) Kunth	1	0	0	0	0	0	0	0
<i>Sagittaria montevidensis</i> Cham. & Schldl. subsp. montevidensis								
<b>Areceaceae</b>								
<i>Butia capitata</i> (Mart.) Becc.	0	0	0	0	0	0	1	0
<i>Syagrus romanzoffiana</i> (Cham.) Glassman	0	0	0	0	1	0	0	0
<b>Bromeliaceae</b>								
<i>Tillandsia aeranthos</i> (Loisel.) Lyman B. Smith	0	0	0	0	1	1	0	0
<i>T. usneoides</i> (L.) L.	0	0	0	0	1	1	0	0
<b>Cannaceae</b>								
<i>Canna glauca</i> L.								
<b>Cyperaceae</b>								
<i>Carex bonariensis</i> Desf. ex Poir. var. bonariensis	0	0	1	0	0	0	0	0
<i>C. sellowiana</i> Schltr.	0	0	0	0	1	1	0	0
<i>C. sororia</i> Kunth	0	0	0	0	1	0	0	0
<i>C. vixdentata</i> (Kükenthal) G. A. Wheeler	0	0	0	0	0	0	0	1
<i>Cyperus obtusatus</i> (J.Presl.& C. Presl)Maltf. & Kuk	0	0	0	0	0	0	1	0
<i>C. prolixus</i> Kunth	1	0	0	0	0	0	0	0
<i>C. reflexus</i> Vahl	0	0	0	0	1	0	0	0
<i>C. virens</i> Michx.	1	1	0	0	0	0	1	0
<i>Eleocharis bonariensis</i> Nees	1	1	0	1	0	0	0	0
<i>Fimbristylis autumnalis</i> (L.) Roem. & Schult.	0	0	1	0	0	0	0	0
<i>F. spadicea</i> (L.) Vahl	0	0	1	0	0	0	0	0



<b>Scientific name</b>	<b>Wetland</b>	<b>Wet Prairies</b>	<b>Upland prairie</b>	<b>Rock Outcrops</b>	<b>Riparian Forest</b>	<b>Mound Forest</b>	<b>Palm Forest</b>	<b>Salt marsh</b>
<i>Rhynchospora corymbosa</i> (L.) Britton var. <i>corymbosa</i>	1	0	0	0	0	0	0	0
<i>Schoenoplectus californicus</i> (C.A. Mey.) Soják	1	1	0	0	0	0	0	0
<i>S. tabernaemontani</i> (C.C. Gmel.) Palla	0	0	0	0	0	0	0	1
<i>Scirpus giganteus</i> Kunth								
<b>Iridaceae</b>								
<i>Sisyrinchium iridifolium</i> Kunth ssp. <i>valdivianum</i> (Phil.) Ravenna	0	1	1	1	0	0	0	0
<i>Trifurcia lahue</i> (Molina) Goldblatt subsp. <i>amoena</i> (Griseb.) Goldblatt	0	0	1	1	0	0	0	0
<b>Juncaceae</b>								
<i>Juncus acutus</i> subsp. <i>leopoldii</i> (Parl.) Snogerup	0	0	0	0	0	0	0	1
<i>J. dichotomus</i> Elliott	0	0	1	0	0	0	0	0
<i>J. imbricatus</i> Laharpe	0	0	0	0	0	0	1	0
<i>J. maritimus</i> Lamarck	0	0	0	0	0	0	0	1
<i>J. micranthus</i> Schrad ex E. Mey	1	1	0	0	0	0	0	0
<i>J. microcephalus</i> Kunth	1	1	0	0	0	0	0	0
<i>J. venturianus</i> Castillon	0	0	1	0	0	0	0	0
<b>Juncaginaceae</b>								
<i>Lilaea scilloides</i> (Poir.) Hauman	1	1	0	0	0	0	0	0
<b>Maranthaceae</b>								
<i>Thalia multiflora</i> Horkel								
<b>GRASSES</b>								
<b>Panicoideae</b>								
<i>Axonopus affinis</i> Chase	0	1	0	0	0	0	0	0
<i>Bothriochloa laguroides</i> (DC.) Herter	0	0	1	0	0	0	1	0
<i>Echinochloa helodes</i> (Hackel) L. R. Parodi	1	0	0	0	0	0	0	0
<i>Panicum decipiens</i> Nees ex Trin.	0	1	1	0	0	0	0	0
<i>P. gounii</i> Fourn.	0	0	0	0	0	0	1	0
<i>P. grumosum</i> Nees	1	1	0	0	0	0	0	0
<i>P. repens</i> L.	0	0	0	0	0	0	1	0
<i>P. prionitis</i> Nees	0	1	0	0	0	0	0	0
<i>P. sabulorum</i> Lam.	0	1	0	0	0	0	0	0
<i>Paspalidium paludivagum</i> (Hitch.& Chase) L. R. Parodi	1	0	0	0	0	0	0	0
<i>Paspalum distichum</i> L.	0	1	0	0	0	0	0	0
<i>P. lividum</i> Trin. ex Schlecht.	0	1	0	0	0	0	0	0
<i>P. notatum</i> Fluegge	0	0	1	0	0	0	0	1
<i>P. paspalodes</i> (Michx.) Scribner	0	0	0	0	0	0	0	1
<i>P. vaginatum</i> Sw.	0	0	0	0	0	0	0	0
<i>Setaria geniculata</i> (Lam.) Pal. Beauv.	0	0	1	0	0	0	0	0

Scientific name	Wetland	Wet Prairies	Upland prairie	Rock Outcrops	Riparian Forest	Mound Forest	Palm Forest	Salt marsh
<b>Chloroideae</b>								
<i>Cynodon dactylon</i> L..	0	0	1	0	0	0	0	0
<i>Distichlis scoparia</i> (Kunth) Arechavaleta	0	0	0	0	0	0	0	1
<i>D. spicata</i> (L.) Greene	0	0	0	0	0	0	0	1
<i>Eragrostis hypnoides</i> (Lam.) Briton, Sternn & Poggenb.	0	0	1	0	0	0	0	0
<i>E. retinenens</i> Hackel & Arechav.	0	0	1	0	0	0	0	0
<i>Spartina coarctata</i> Trin.	0	0	0	0	0	0	0	1
<i>S. densiflora</i> Brongn.	0	0	0	0	0	0	0	1
<i>S. longispica</i> Hauman & Parodi ex St.-Yves	0	0	0	0	0	0	0	1
<i>Sporobolus indicus</i> (L.) R. Brown	0	0	1	0	0	0	1	0
<b>Pooideae</b>								
<i>Agrostis hygrometrica</i> Nees	0	1	0	0	0	0	0	0
<i>Briza minor</i> L.	0	0	1	0	0	0	1	0
<i>Bromidium tandilense</i> (Nees) Rúgolo	0	1	0	0	0	0	0	0
<i>Glyceria multiflora</i> Steudel	1	0	0	0	0	0	0	0
<i>Melica argyrea</i> Hackel	0	1	1	0	0	0	0	0
<i>Poa annua</i> L.	0	1	1	0	0	0	1	0
<i>Poidium calotheca</i> (Trin.) Mathei	0	0	0	0	0	0	0	0
<i>Polypogon maritimus</i> Willd.	0	0	0	0	0	0	0	1
<i>P. monspeliensis</i> (L.) Desf.	0	0	0	0	0	0	0	1
<i>Puccinellia glauscescens</i>	0	0	0	0	0	0	0	1
<b>Bambusoideae</b>								
<i>Chusquea ramosissima</i> Lindm.	0	0	0	0	1	0	0	0
<i>Guada angustifolia</i> Kunth	0	0	0	0	1	0	0	0
<i>G. chacoensis</i> (Rojas) Londono & P.M. Peterson	0	0	0	0	1	0	0	0
<i>G. trinii</i> (Nees) Nees ex. Rupr.	0	0	0	0	1	0	0	0
<b>Orizoideae</b>								
<i>Leersia hexandra</i> Sw.	1	1	0	0	0	0	0	0
<i>Luziola peruviana</i> Juss. ex J.F.Gmel.	1	1	0	0	0	0	0	0
<i>Oryza glandiglumis</i> (Doll) Prod.	1	1	0	0	0	0	0	0
<i>O. latifolia</i> Desv.	1	1	0	0	0	0	0	0
<i>Zizaniopsis bonaerensis</i> (Bal. & Poitr.) Speg.	1	1	0	0	0	0	0	0

## **Appendix 2 -- A Combined Pollen and Phytolith Record for the Late Quaternary Vegetational and Climatic Change from the Bañado de India Muerta, Southeastern Uruguay.**

### **Sample Site**

The Bañado de India Muerta is located in the northwestern sector of Rocha Province Uruguay. The studied location (33° 42' S, 53° 57' W) is situated in the locality known as Fondo de los Ajos, which is 0.5 km NE of the Los Ajos archaeological site. The sampled location is an abandoned meander (small oxbow lake) in the middle sector of the Laguan de los Ajos (Figure 4.1), which is covered by water year-round.

### **Methodology**

A 1.70 m core was extracted from the deepest section of the peat using a Wildco hand corer. Pollen samples were extracted every 5 cm and processed following standard methods of analysis (Faegri and Iverson 1992). Additional samples were taken at 62.5 cm, 77.5 cm, 83.5, and 89 cm depth in order to obtain a better resolution for the mid-Holocene period. Claudia Listopad extracted and identified the pollen from the sediment samples. Pollen preparations were examined under magnifications of 1000x. Identifications were based on comparison with the pollen reference collection at the Department of Biological Sciences in the Florida Institute of Technology and with published pollen atlases and keys (Heusser 1971; Markgraf and D'Antoni 1978; Salgado Laboriau 1973). A minimum of 200 grains was counted per slide. The pollen percentage diagram display in Figure 1 consists of 23 samples and present the most abundant (>1%) and ecologically important taxa from 97 pollen types identified. Percentages of all taxa were calculated from the total pollen sum. Arboreal species include *Caesolpinoidea*, *Celtis* sp., *Didymopanax*, *Doliocarpus*, *Forsteronia*, Meastomataceae/Combretaceae (Mel/Comb), Phytolacaceae, Urticaceae/Moraceae (Urt/Mor), and Aracaceae. Herbs consist of Amaranthaceae/Chenopodiaceae (Amar/Chen), *Chamissoa*, Apiaceae, Asteraceae, *Polygonum*, Rubiaceae, and Poaceae. Wetland taxa comprise *Althernanthera*, Cyperaceae, *Ludwigia* sp., *Pontederia* sp., and *Sagittaria*.

Phytolith samples were taken every 10 cm, and at 5 cm intervals in the early and mid-Holocene sections of the core. The extraction and slide preparation of phytoliths followed the standard procedures described by Piperno (1988), and were carried out at the Smithsonian Tropical Research Institute in Panama. Phytolith identifications were made by comparison with our modern plant reference collection (Iriarte and Alonso 2003), the extensive phytolith comparative collection curated at the Smithsonian Tropical Research Institute, and published phytolith atlases and keys (i.e., Piperno, 1988; Bozarth, 1992; Kondo et al., 1994; Kealhofer and Piperno, 1998; Runge, 1999). Slides of the silt fraction were scanned at 400X using an Olympus B2 light microscope. The number of phytoliths counted in the silt fraction of the modern soil samples varied from 203 to 308 per slide, and includes at least 200 short-cells for each sample. Slides from the sand fraction were entirely scanned at 20X in order to search for the presence of diagnostic forms such as Asteraceae perforated opaque platelets and *Cucurbita* spherical scalloped phytoliths that often segregate in this fraction of the soil. Given the dominance of Poaceae morphotypes in most of the samples, and in order to emphasize the variability of short-cell phytoliths, percentages of phytoliths from the Panicoid, Chloridoid, Pooid, and Oryzoid sub-families of grasses were calculated on the sum of the short-cell phytolith types alone. Percentages of non-grass phytoliths were calculated on the basis of the total sum of phytoliths.

## Results

### *Stratigraphy*

The sediments from Los Ajos core can be described as follows:

0-22 cm	black weakly decomposed peat with plant remains, abundant roots and rootlets of grasses.
22- 72 cm	black compact, completely decomposed peat interrupted by a 1 cm clayey gray (10 YR 5/1) band at 48 cm depth, and a very dark brown (7.5 YR 2.5/2), 5 cm wide, compact peat band between 57 and 62 cm depth.
72-83 cm	black compact, completed decomposed peat intercalated with four gray clayey bands (5 Y 6-7/1) at 75 cm (0.5 cm wide), 77.5 cm (0.5 cm wide), 80 cm (0.5 cm wide), and 83.5 cm depth (1.5 cm wide).

84-102 cm black compact, completely decomposed peat.

102-170 cm gray (2.5 YR 6/1) silty clay with olive yellow (5Y 6/6) mottles of sand.

### **Radiocarbon dates**

Four radiocarbon dates provide chronological control for the core, and they indicate a fairly continuous sequence of sedimentation beginning during the Late Pleistocene and extending into the modern era (Table 1, Figures 1 and 2). Radiocarbon ages for each pollen and phytolith zone are based on the four calibrated radiocarbon dates.

Table 1. Radiocarbon dates from Core Los Ajos.

Level	Radiocarbon age	Calibrated age	Material	Laboratory number
62 cm	4,040±40	4510-4445 cal. bp	peat	Beta 180947
71 cm	4680±40	5580-5530 cal. bp	peat	Beta 155022
85 cm	6,620±40	7,580-7,440 cal. bp	peat	Beta 156071
98 cm	8,840±40	10,150-9,730 cal. bp	peat	Beta 155023
158-167 cm	14,810±250	18,580-16,910 cal. bp	phytoliths	Beta 161406

### **Pollen and Phytolith Results**

The diagrams (Figures 1 and 2) are divided in four local zones based on significant changes in the pollen, phytoliths, and sediment characteristics.

**1) Late Pleistocene - (170-102 cm depth) >14,810±250 – ca. 10,000 bp (interpolated age); 158-165 cm depth dated 14,810±250 bp, 98 cm depth dated at 8,840±40 bp.**

The sediment consists of gray silty clay with sand mottles. Due to the poor preservation of pollen grains, only two samples (105 and 115cm depth) from the upper part of Zone I had countable pollen and are incorporated into the pollen diagram. Phytolith representation was good throughout the entire sedimentary sequence.

In comparison with the Early Holocene period, the upper part of the Late\_Pleistocene zone shows markedly greater percentages of the Poaceae (38-41%), Asteraceae (13.3-14.3%), and Amar/Chen (4-.3-10.7%). In contrast, percentages of pollen from wetland species like the Cyperaceae and *Myriophyllum* are lower during the Pleistocene. Arboreal pollen is present in minor amounts, with some taxa like Bignoneaceae, Phytolacaceae, and Aracaceae being better represented during the Late Pleistocene, while others like *Celtis*, *Forsteronia*, and Urticaceae/Moraceae are reduced. Ferns are present only in trace amounts.

The Poaceae phytolith assemblage is dominated by morphotypes that are diagnostic of the sub-family Pooideae, which reach percentages of from 26 to 45%. In contrast, phytoliths diagnostic of the Panicoideae and Chloridoideae sub-families of grasses are represented in minor proportions (from 3 to 9% and 7 to 10%, respectively). The dominance of Poid phytoliths during this period is concordant with the high percentages of rondel phytoliths evidence. These types of silicified cells, while not exclusively diagnostic of the Pooideae, are produced in abundant numbers by Poid grasses and much less commonly in Chloridoid and Panicoid grasses (Brown 1984; Mulholland 1989; Piperno and Pearsall 1998).

Phytoliths diagnostic of the achenes of sedges (Cyperaceae) are less common during the Pleistocene portion of the sequence, corroborating the presence of fewer Cyperaceae pollen grains at this time. In comparison with the early Holocene phytolith record, there are fewer sedge achene phytoliths (corroborated by a decrease of Cyperaceae pollen), and an absence of woody (spherical smooth and other spherical) and herbaceous dicot morphotypes (slightly silicified epidermal cells). Although Asteraceae is well-represented in the pollen record of this zone, no Asteraceae opaque perforated plate phytoliths were recovered for this period.

**2) Early Holocene (102- 85 cm depth) ca. 10,000- ca. 6,620±40 bp (interpolated ages); 85 cm depth dated at 6,620±40 bp.**

At the beginning of this interval, the sediments change from gray, silty clay to black, completely decomposed peat. The sedimentary changes correspond to the beginning of the Holocene dating to ca. 10,000 bp. The pollen and phytolith data indicate that this date marked the onset of significant changes in the local flora. These changes include: 1) an increase in the frequency of grasses, 2) a dramatic shift in the composition of the grass flora, from C3 Poid grasses to C4-dominated Panicoid grass taxa, and declining frequencies of Chloridoid grasses,

which are more tolerant of arid climates than are Panicoid grasses, and 3) an increase in phytoliths derived from woody dicot/arboreal taxa and herbaceous dicots.

**3) Mid-Holocene (85-60 cm depth) 6,620±40 bp – ca. 4,040±40 bp; 85 cm depth dated at 6,620±40 bp, 71 cm depth dated at 4,680±40 bp, and 60 cm depth dated at 4,040±40 bp**

This period is also characterized by dynamic oscillations in some of the plant taxa. One of the most significant patterns is the alternation of peaks of Amar/Chen with synchronous declines in wetland species, in particular, the Cyperaceae and *Myriophyllum*. Amar/Chen fluctuate (0.7-75.8%) with major peaks at 83 cm (58.1%), 80 cm (38%), 75 cm (42%), 62 cm (63.8%), and 60 cm depth (75.8%). Significant declines in Amar/Chen are concomitant with increases in Cyperaceae at 89 cm (53.7%), 85 cm (31.3%), 77.5 cm (31.7%), and 65 cm depth (29.3%), and *Myriophyllum*, in particular, at 100 cm (19.9%) and 70 cm depth (27.2%).

It should be noted that concomitant with the major peaks of Amar/Chen at 83.5 and 60 cm depth, both the percentage and the concentration of wetland taxa also decreases indicating that the decline in Cyperaceae during these periods is not an artifact of the major increase in Amar/Chen percentage.

A massive spike of Amar/Chen occurs at 62.5-65 cm depth dated to ca. 4,040 bp, which reaches 75.8% of the total pollen sum, is paralleled by a major drop both in percentage and concentrations in wetland species and Poaceae. This period is also correlated with a change in the color of the peat from black to very dark brown, which also suggest the presence of dryer conditions.

**4) Late Holocene (60-5 cm depth) ca. 4,040 bp. – Present; 60 cm depth dated at 4,040 bp.**

This period is characterized by a major increase in wetland species, an increase of Poaceae, and a major decline in Amar/Chen. The Cyperaceae attain its strongest representation during this period (24.6-52%). Pollen from the Poaceae also attain their highest percentage in the upper part of this period (45.7 %), and the Asteraceae, Apiaceae, Polygonum, Rubiaceae, and ferns are better represented during this period than throughout the preceding early and mid-Holocene. The total arboreal sum shows a slight increase, in particular in the upper 30 cm of the core.

Panicoid Poaceae phytoliths are continuously predominant (78-89%), while Chloridoid and Poooid morphotypes are rare or absent. In addition, there is an increase in the slightly silicified epidermal cell phytolith category, a finding that is in accordance with the increase in wetland species (Iriarte and Alonso 2003). The slight increase in the woody dicot phytolith morphotypes (corroborated by a slight increase in arboreal pollen) mirrors this trend.

### ***Reconstruction of Paleovegetation and Paleoclimate***

#### **1) Zone 1 - Late Pleistocene (>14,810±250 – ca. 10,000 bp)**

The phytolith and pollen record of the Late Pleistocene is characterized by a dominance of phytoliths from Pooideae grasses and a high percentage of Poaceae pollen. Compared with the post-glacial part of the sequence, there are low percentages of pollen and phytoliths from wetland species (e.g., Cyperaceae, arboreal taxa) that characterize the area today. There is no modern analog for this type of Poooid dominated grassland in the region. Regional paleoenvironmental studies (Iriando and García 1993; Iriando 1999; Prieto 1996; 2000) have characterized the Late Pleistocene climate of the southern Pampas as cool and dry and the resulting vegetation as a dry steppe. The presence of Poooid grasses, adapted to cool climates, indicates that a much cooler Late Pleistocene climate characterized the India de Muerte region. Similar conditions during the Late Pleistocene in the Great Plains of North America have been inferred by Fredlund and Tiezen (1997a, 1997b) from a dominance of C3 grasses. The climate of the India Muerta wetlands was also probably substantially drier before ca. 10,000 bp, as is evidenced by relatively low percentages of the Cyperaceae, *Myriophyllum*, and other wetland taxa. Highest percentages of Chloridoid phytoliths during the Late Pleistocene also points to a climate drier than today's, as this sub-family of grasses can tolerate very dry conditions.

The low percentages of Cyperaceae and arboreal pollen, together with the absence of woody dicot phytolith morphotypes, suggest that during the Late Pleistocene, forests were mainly limited to a narrow belt accompanying the major water courses. Interestingly, trace amounts (0.3-0.7%) of palm pollen were recovered in this zone. No palm spinulose spheres were recovered in this or other segments of the core sequence. Because phytoliths represent a local, decay-in-place deposition of plant fossils, presence of palm pollen probably indicates that palms



were growing in the region, but not in the particular locale of the India Muerta wetlands from which the core was extracted.

In sum, the phytolith and pollen evidence indicates that during the Late Pleistocene (between ca. 14,810 and 10,000 bp), cooler and drier climatic conditions characterized the India de Muerte region. Grasses from the Pooideae sub-family, all of which use the C3 photosynthetic pathway, dominated the vegetation. These conditions prevailed until ca. 10,000 bp with the onset of warmer and more humid conditions.

### **2) Zone II - Early Holocene (ca. 10,000 bp - 6620±40 bp)**

The early Holocene appears to have been substantially warmer and wetter than the preceding five thousand years. At the beginning of this period, dated to ca. 10,000 yr B.P, the replacement of gray, silty clay by black peat indicates that the site was subjected to permanent flooding. This date also marks the installation of wetland vegetation in the area, as phytoliths and pollen from wetland species increase significantly at ca. 10,000 bp. The near loss of phytoliths from cool-adapted Pooideae together with a very significant increase in Panicoid grasses is in accord with the establishment of the wetlands in the area during the Early Holocene. The phytolith record for this zone is very similar to the modern wetland analog. This is indicated by the presence of: (a) very high percentages of Panicoid morphotypes; (b) Oryzoid morphotypes; (c) Cyperaceae achene phytoliths; (d) high percentages of slightly silicified epidermal cells; and (e) absence of Asteraceae opaque platelets (Iriarte and Alonso 2003, in press). Overall, during the early Holocene the region presented a wetland environment and climate very similar to the present conditions.

### **3) Zone III – Mid-Holocene (6620±40 to. 4,040 bp)**

Starting at ca. 6,620 bp and lasting until shortly after ca. 4,040 bp, unstable climates and dynamic fluctuations in the local and regional vegetation appear to have affected the study region. There is no modern counterpart in the area for the very high pollen percentages and inferred abundant presence of the Amar/Chen, as inferred from the four major peaks in this pollen type that occur between ca. 6,620 and 4,040 bp. During this same time period, pollen from *Myriophyllum*, an important taxa of the modern wetland environment, demonstrates marked

increases during intervals when the percentages of Amar/Chen pollen are decreasing or low, a factor which suggests conditions that were wetter and/or less seasonal than today's. The peaks of Amar/Chen pollen probably indicate relatively brief periods during which a precipitation regime that is more strongly seasonal and drier than today's prevailed in the study area, and halophytic vegetational communities expanded. These drier periods appear to have alternated with relatively brier periods of climates wetter than today's, which are marked by sudden rises of *Myriophyllum* pollen.

A possible alternative explanation, that the Amar/Chen peaks are indicative of the presence of a local salt marsh upon regional rises in sea level, is much less compelling. Due to their topographical location at ca 15 masl, the India Muerta wetlands were not directly affected by the marine high stand of the mid-Holocene at ca. 5000 bp, which reached to only 5 masl (see Chapter 3: Geomorphology and soils section). The coring locale is located 30 km west of the marine terrace left by this marine highstand, and ca. 50 km from the Lake Merin border. Furthermore, unlike the wetlands that occur below 5 masl, which are saline and whose extension primarily depends on overflows of Merin Lake overflows, the wetlands of India Muerta are freshwater and their extension depends on rainfall. Finally, the major Amar/Chen peaks are not temporally correlated either with the major Middle Holocene marine highstand at ca. 5000 bp or another that is dated to ca. 3000 bp (Bracco 1992; Bracco et al. 2000; Montana and Bossi 1995).

The phytolith record supports this reconstruction. If the Amar/Chen peaks represented the proliferation of a salt marsh in the area, the Poaceae phytolith assemblage should have been dominated by Poid and Chloroid morphotypes, since the most abundant grasses in salt marshes in the region are *Distichlis spicata*, *D. scoparia*, *Spartina coarctata*, *S. densiflora*, *S. longispica*, *Polypogon maritimus*, *P. monspeliensis*, and *Puccinelia glauscescens*. *Distichlis spicata* produces non-sinuuous, short trapezoids with both straight and mixed ends, as well as plateau and ridge tops (Brown 1984: Table 2, Figure 1). *Polypogon elongatatus* (*Polypogon* genus) produces wavy trapezoids phytoliths (Piperno and Pearsall 1998: 16), and *Puccinelia airoides* (*Puccinelia* genus) produces non-sinuuous short trapezoids with round ends and ridged tops (Brown 1984: 356, Table 3, Figure 1). In this study, the trapezoid category described above is included within the Round/Oblong and Rectangular/Square categories corresponding to the Poid families in our typology (see Chapter 6: Phytolith identification section). *Spartina coarctata* produces saddle-shape (Chloroid) dominated phytolith assemblages (Mulholland

1989:498). However, the Holocene phytolith assemblage is dominated by Panicoid grasses with an near absence of Chloridoid (saddle-shape) and Pooid morphotypes. These findings clearly indicate that the area was a freshwater wetland.

Modern conditions similar to those inferred by the Amar/Chen peaks between ca. 6200 and 4,040 bp are found in the Dry Pampa and the Xerophitic woodland-grassland ecotone of Argentina (Prieto 2000). These regional subdivisions of the Rio de la Plata grasslands, present a drier climate (800-500 mm/yr and >500 mm/yr, respectively) and suffer from a water deficit. Modern pollen data from these Rio de la Plata grasslands subdivisions are characterized higher percentages of Amar/Chen (mean 28-29%; range 0 to >80%) (Prieto 2000).

Significantly, the strongest Amar/Chen pollen spike, ca. 4,040 bp, is broadly contemporaneous with the beginning and establishment of mound-building cultures in the area. The onset of mound-building witnessed major organizational changes in settlement, subsistence and technology exhibited by the early Formative societies that emerge during this period.

The drier conditions of this period reduced precipitation and run-off, which may have caused a decrease in the surface water recharge of the inland wetlands and waterways. Both the pollen and phytolith records and the continued formation of peat, evidenced in the sediment core profile, indicate that during this period, the wetlands of India Muerta did not dry out but were significantly reduced. Therefore, wetlands, though reduced, continued to provide abundant easily accessible aquatic resources and most probably drew birds and terrestrial fauna to them. This period phase probably caused the desiccation of the upland grasslands, deepening the resource gradient between wetlands and uplands prairies and probably resulted in increasing diminishing returns from this latter sector of the landscape. In this regard, during this period of environmental change, though reduced, the upper freshwater wetlands may have become attractive places for the pre-Hispanic populations coping with this period of instability and dryness. Wetlands seemingly provided greater stability reducing risk during periods of environmental change since they provided a stable source of water supply. In fact, the area that is located in the distal part of the India Muerta alluvial fans is the least susceptible to water stress, and probably is the one that remained with the highest water table during dry summers in comparison with the other areas of the region (Juan Montaña, personal communication 2000).

#### **4) Late Holocene (ca 4,040 bp – Present)**

The Late Holocene period is characterized by sharp decrease in Amar/Chen pollen and a major increase in Cyperaceae pollen. The climate appears to have become wetter and less variable, and a flooded system like the one that characterized the earliest Holocene period appears to have been back in place. Two Amar/Chen spikes that are less pronounced than before 4,040 bp and a decrease of the *Myriophyllum* between 40 and 30 cm (you should date this too) may represent less intensive, brief drier periods. Nonetheless, the period from 4,040 bp until the present was marked by more humid and stable climatic conditions than prevailed during the Middle Holocene.

#### **Conclusions**

In summary, the results of the paleoclimatic record indicate that the Late Pleistocene period (between ca. 14,810 and 10,000 bp) was characterized by drier and cooler conditions indicated by the presence of a C3-dominated grassland and minor representation of the Cyperaceae. These conditions prevail until ca. 10,000 bp with the onset of a warmer and more humid climate of the Holocene, which are indicated by the establishment of wetlands as indicated by the formation of black peat, the increase in wetland species, and the replacement of C3 Pooid by C4 Panicoid grasses.

The early Holocene (between ca. 10,000 and ca. 6,620 bp) witnessed an amelioration of the more cooler and drier condition of the Late Pleistocene and presented a wetland environment and climatic conditions typical of today. The mid-Holocene was a period of climatic instability. Around 6500 bp begin a period of environmental change characterized by drier climatic conditions, which resulted in the expansion of halophytic communities in the flat, low-lying areas of the wetlands of India Muerta. About 4200 bp a massive spike of Amar/Chen coupled with a radical drop in wetland species indicates another major and more severe period of dryness. After 4,040 bp, a decrease of halophytic species appears to represent an amelioration of the mid-Holocene drier climatic conditions and the onset of more humid and stable climatic conditions.

The correlation of paleoenvironmental and archaeological data for the mid-Holocene indicates that around 4040 bp, generally contemporaneous with the rise of early Formative cultures, the region experienced the major drying trend. The archaeological data from the region and the study site, Los Ajos, suggests that during this period, local populations did not disperse

(e.g., disaggregate into smaller groups and increased mobility) or out-migrate to other regions, but opted for orienting their settlement towards the upper freshwater wetlands where they established more permanent communities in strategic locations such as Los Ajos. It is the contention of this study, that the these “unfavorable” climatic conditions served to provide the impetus for a more intense human occupation and an increase in their level of permanence at these strategic locations, which ultimately triggered the process of early village formation at Los Ajos around 4,190 bp. These aspects are expanded in Chapter 3 and 9.

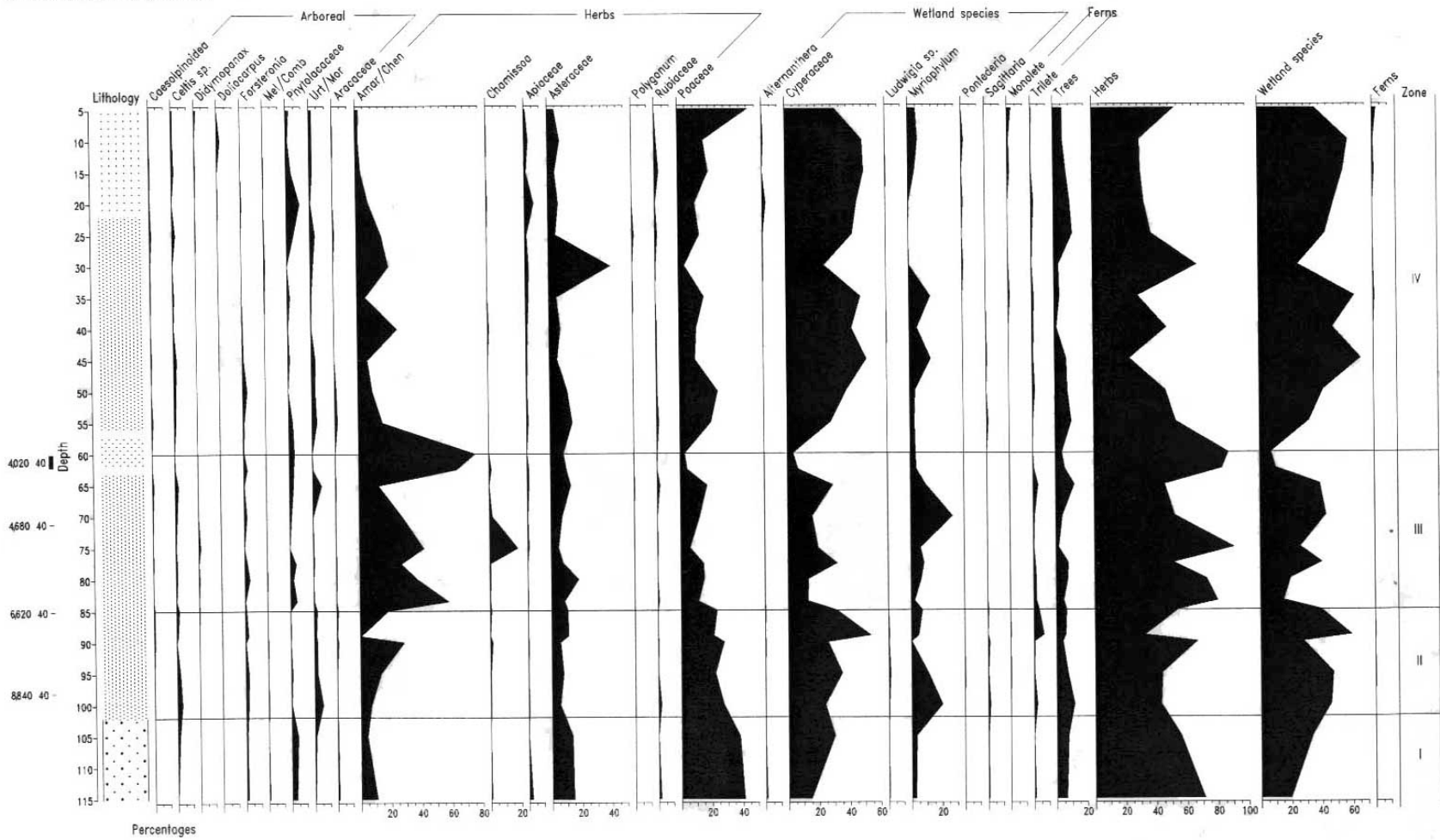


Figure 1. Pollen Percentage Diagram from the Los Ajos Core.

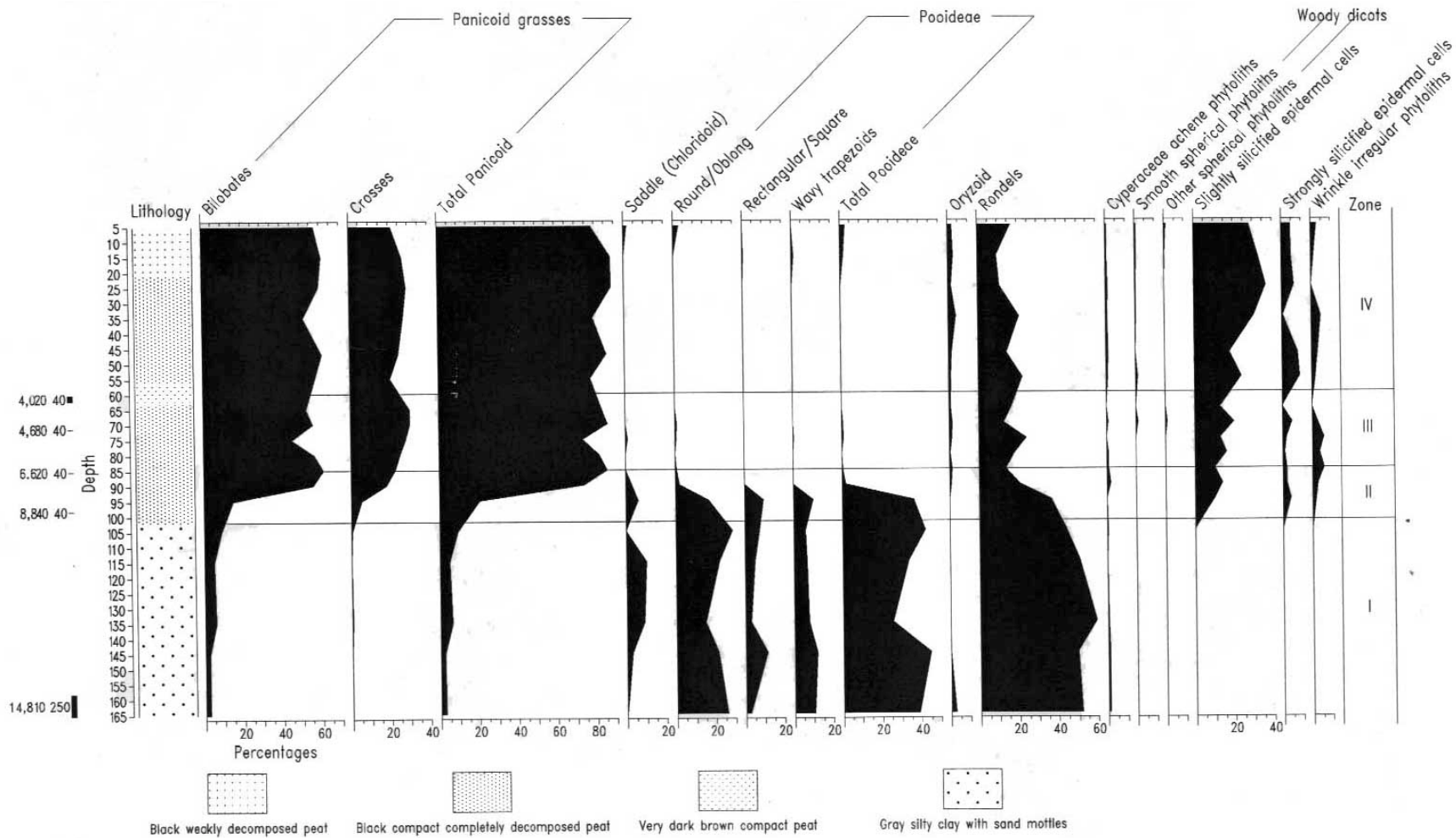


Figure 2. Phytolith Percentage Diagram from the Los Ajos Core.

## Appendix 3 --Lithic Data Coding Form

### Record for debitage:

Provenience: Excavation, Unit, Level and Sector provenience information.

### Debitage type:

1. cortical flake: unipolarly struck flakes bearing cortical striking platform and 100% cortical dorsal surface
2. primary flake: unipolarly struck flakes bearing single facet striking platform and between some cortex (0-99%).
3. secondary flake: unipolarly struck flakes bearing one or more facets striking platforms and 0 % of cortex in the dorsal surface
4. bipolar flake: usually defined by the presence of two positive bulbs of percussion on the same or different surfaces, or the existence of one positive bulb of percussion at one end of the artifact and a negative scar originating from the opposite end of the same or different surface. Crushing at opposite ends is often present (see quartz bipolar percussion section for more details)
5. bifacial thinning flake: long, thin curved flake with many dorsal scars, ventral lipping, multifaceted platform, and no cortex.
6. working edge rejuvenation flake
7. Artificial fragment: debitage upon which no ventral surface can be defined but which exhibits unquestionable negative scars characteristic of percussion technique.
8. Indeterminate

### Raw material:

- 1- Translucid quartz
- 2- Hyaline (transparent) quartz
- 3- Milky quartz (opaque)
- 4- Grainy rhyolite
- 5- Fine-grained rhyolitite
- 6- Quartzite
- 7- Opal
- 8- Chalcedony
- 9- Phyllite
- 10- Black metamorphic stone
- 11- Other fine-grained raw materials

### Metric attributes:

*Length*: maximum dimension (for flakes, maximum length of axis perpendicular to striking platform) measured to the nearest millimeter.



Width: largest dimension perpendicular to the length measurement, measured to the nearest millimeter

Thickness: maximum thickness measured to the nearest millimeter.

Weight: measured to the nearest 0,1gram.

Completeness: estimated completeness of artifacts.

Platform type:

1- cortical (cortex present on platform)

2- single facet

3- multiple facet

4- ridged

6. pointed

7. crushed

8. indeterminate.

Note: The category indeterminate was applied in the cases when the platform was gone or the original piece was other than a flake.

Dorsal face characteristics of flakes:

Cortical covering:

1. 100% (total)

2. over 50%

3. less than 50%

4. 0% (absence of cortex/natural surface)

5. indeterminate

In the case of tools, how the percentage of cortex remaining was measured depended on the kind of original piece used. If the tool was a flake or blade, the percentage was computed on the basis of the amount of dorsal surface with cortex. If the tool was not a flake or a blade, the percentage was computed on the basis of the entire surface of the tool.

Dorsal Scar count: 0-9, with more than 9 coded as 9.

### **Record for Cores:**

Raw material and Metric attributes same as in debitage coding form

Core morphology:

1. amorphous

2. globulose

3. prismatic

4. pyramidal

5. discoidal

Platform type:

1. natural/cortical
2. Single platform core: a core with flakes removed from only one platform plane
3. Multiple platform core: a core with flakes removed from more than one platform
4. Bipolar core: a core with platform remnants on opposing ends and with opposing negative scars and/or bulbs of percussion resulting from core rebounding from two direction (see Bipolar quartz percussion section for a detailed description).

Core platform count: 0-5, with more than 5 coded as 5.

Core scar count: 0-10 with more than 10 coded as 10.

Scar length: measurement of the largest and smallest scars to the nearest millimeter.

Scar width: measurement of largest and smallest scars to the nearest millimeter.

Mass potential:

1. still have potential
2. exhausted

### **Record for tools:**

Raw material type and metric attributes same as debitage.

Completeness/Breakage:

1. whole
2. tip
3. base
4. midsection
5. broken indeterminate fragment

Blank:

1. cortical flake
2. primary flake
3. secondary flake
4. bipolar flake
5. bifacial thinning flake
6. core
7. indeterminate

Modification:

1. utilization (systematic, patterned scarring along one or more tool edges)
2. unifacial retouch
3. bifacial retouch
4. Biface: any artifact that has flake scars extending over both the ventral and dorsal sides. Bifaces undergo changes in morphology from a bifacial core stage through the perform stage to a finished tool.

Location of the modification:

1. lateral
2. distal
3. lateral/distal
4. proximal
5. entire surface
6. indeterminate

Location of the modification on the faces of the artifact:

1. Dorsal face
2. Ventral face
3. Dorsal and ventral face

Edge shape:

1. point
2. notch
3. point within notches
4. denticulate
5. concave
6. convex
7. straight
8. irregular
9. indeterminate

Note: The division between these attributes is subjective with a very slight curvature allowed for the straight category. The concave edges were distinct from notches by having a general broader arc. In turn, a notch was defined a marked concavity in the edge profile.

Edge angle: angular measure of the cross-section of the edge.

Tool angle: angular measure of the cross-section of the edge after retouch or intense utilization.

## **Appendix 4 -- Preliminary Microscopic Use-Wear Analysis on a Small Sample of Stone Artifacts from the Los Ajos Site, Uruguay**

**Tom D. Dillehay**  
**University of Kentucky**

### **Introduction**

This brief report concerns a preliminary study of a small sample of stone tools from different contexts in the Los Ajos site. The aims of this paper are (1) to describe use-wear (and any residues) on stone tools from the site, and (2) to assess whether discrete stone tool activities are archaeologically visible at this site. Only a small sample of stone tools was studied just to determine the general patterns in use wear. Eventually the use-wear analysis on stone tools should be integrated with similar studies on bone tools and other contextual data from the site. Furthermore, extensive tool-use experiments on a wide variety of local stone raw material and on different worked materials (e.g., skin, meat, plant, bone, wood) and more exact techniques of use wear and residue analysis analyses need to be applied to more fully determine the function of either fine- and coarse-grained stone artifacts from the excavated stone assemblage not studied here. Four types of raw material were identified among the stone artifacts from Ajos: grainy rhyolite, fine-grained rhyolite, quartz, and fine-grained quartzite.

José Iriarte divided the stone tools from the site into lithic debitage, utilized flakes, and tools with unifacial retouch which were described on the basis of gross morphology and edge-shape. The handling and storage of the stone artifacts were appropriate for residue and use-wear studies. Excavated tools were stored for use wear study in the field. None of the tools were subjected to chemical or sonic cleaning in order to preserve any residue studies for the future. After an initial inspection for residues on edges under 100X to 500X magnification, some edge areas were subjected to spot cleaning to examine polish and scarring.

The twenty samples studied showed no or minimal degrees of retouch. The simple technology and the use of pieces with little apparent evidence of edge flaking indicate an expedient exploitation of stone. Other than bifaces, there were few identifiable production of specific stone tools, or identifiable stages of resharpening or recycling to indicate anything other than:

expedient local production, limited use and discard within the site area. I estimate that the flake tools and perhaps other tools were used on the spot and thrown away.

### **Use-wear and Residue Analysis**

All selected stones were examined under a stereomicroscope (with oblique light) and a metallographic (with vertical incident light, with brightfield, darkfield and polarizing filter attachments). The stereomicroscope with external light permitted magnifications up to about X100. The metallographic microscope permitted magnifications at X50, X100, X220, and X500 magnifications. A data sheet for each stone included a sketch with records of the main forms of use-wear (e.g., scarring, rounding, striations, polish or smoothing and beveling); residues (including the presence of any plant and animal tissue, and direct structures such as starch granules and fibers). Tool function was interpreted in terms of modes of use (scraping, cutting, adzing, etc.) and also in terms of likely materials used (e.g., plant, wood, tissue, skin, bone carcass, the latter indicating butchering). If the edge or a tool had no use-wear or if it was unknown, I termed it indeterminate. Approximately one hour of microscopic examination was given to each tool, with a few tools reinspected to determine their possible function and use material use. In total approximately 30 hours of microscopic work was performed on the collection. Once again, in the absence of a larger sample size for analysis, a comparative experimental collection, a site-wide interassemblage contextual study (*sensu* Dillehay 1997; Dillehay and Rossen 2000) and a blind test to predetermine the accuracy of the investigator, any interpretations must be taken as possibilities only (see Keeley 1980). It should be noted that while some stones had use wear consistent with a specific task, the actual use-wear may not have been diagnostic of that task, in which case interpretations had a low level of confidence.

I have documented more than 200 previous experiments on chert, silex, obsidian, basalt, andesite, quartz, quartzite and many other raw material types to develop a key for interpreting use-wear on a variety of prehistoric stone tools used for many tasks. The methods employed, the results of blind tests, and experimental studies are reported in detail elsewhere (Dillehay 1989; Dillehay and Rossen 2000). These publications should be consulted for more precise methodological procedures and cautions in approaching this type of study.

## **Use wear Results**

Use wear and residue analysis indicates that out of the 20 pieces of stone examined from surface layers, 57 edges and surfaces on the tools had been employed in working plant, wood, skin, bone and possibly animal carcasses. Retouch is used in few instances to shape the edge. Nevertheless, particular unretouched edge shapes seem to have functional significance. Results of the use wear study are described briefly for each tool. Three categories are described: bifaces, tools with unifacial retouch, and utilized flakes. Figures 1 and 2 illustrate the stones analyzed showing the specific aspects examined for microscopic use-wear.

### **Bifaces: 8 specimens**

Specimen Plaza Test Unit 2, 5-10 cm deep (Figure 1a):

Aspect 1 reveals a slight dull polish and diagonal to subparallel tiny striations at the base of the stem that suggest hafting polish. Aspect 2 is located along a sharp edge near the broken distal tip. It shows parallel striations and semi-bright polish and tiny (200X magnification) step fractures, all of which are indicative either of penetration upon impact into a target or slicing/cutting motion on fresh hide or meat. Aspect 3 shows semi-bright polish and tiny subparallel and diagonal striations and step fractures indicative of slicing and scraping (Figure 3a). This point may have broken on impact and then reutilized as a scraper and/or cutting tool for processing hide and possibly meat. Aspect 4 shows slight polish. Action on this aspect is indeterminate.

Specimen Mound Gamma, 220-225 cm deep, 1/E (Figure 1b):

This is an intact projectile point. The tip shows no determinable impact damage. Aspect 1 reveals slight dull polish suggestive of haft polish. Aspects 2 and 3 along the sides show highly localized minute dots of dull to semi-bright polish and a few minor nicks and scratches. All of this evidence could suggest one use episode on a target or no use with the damage due to trampling or other taphonomic variables.

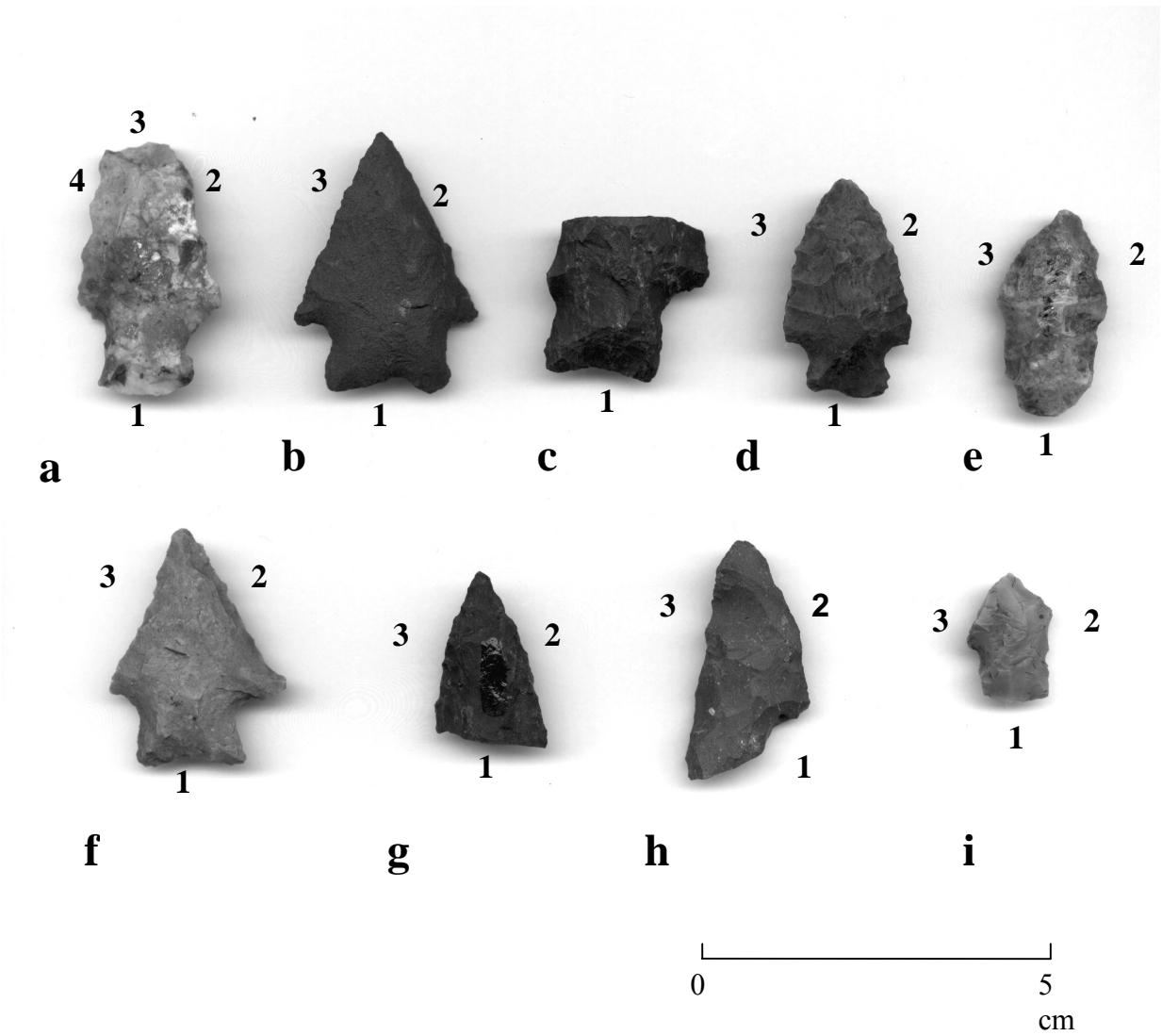


Figure 1. Hafted Bifaces Illustrating Specific Aspects Analyzed for Microscopic Use-Wear.

Specimen TBN Trench, 165-170 cm deep, -9 (Figure 1c):

This is a broken point with slight dull polish along the basal stem area indicative of hafting polish. A few nicks and polish spots could be seen along the edges at 100-200X magnification, but they are so minor they could be attributed to any cultural or natural cause.

Specimen Grid Test Unit N100-E200, 5-10 cm deep (Figure 1d):

This complete point also shows dull haft polish and minor scratches along the basal stem edge indicative of hafting. Both aspects 2 and 3 reveal discontinuous but extensive semi-bright to bright polish and subparallel nicks and striations along the edges, especially along aspect 3. These suggest use as a cutting/slicing tool perhaps more than a projectile function. Use may have been related to cutting soft fresh hide and plant material. The distal tip exhibits no convincing evidence of use as a projectile or penetrating tool. A slight natural sheen on the edges and the body of the point suggests exposure to water or wind at some point. There also are several scratches, nicks and polish spots that are indeterminate in function.

Specimen Mound Gamma 1.65-1.70 cm deep, 3/E (Figure 1e):

This complete point reveals haft polish similar to the other points at the tip of the proximal stem. Aspects 2 and 3 show slight damage in the form of polish and nicking at 100 and 250 X magnification, but there is no convincing evidence of use other than possibly being employed as a projectile point.

Specimen Mound Gamma Trench, 250-260 cm deep, -4/C (Figure 1f):

Aspect 1 shows parallel streaks and dull polish also suggesting hafting marks. Both aspects 2 and 3 exhibit a few parallel and subparallel striae associated with semi-bright and bright polish streaks, all suggestive of exposure to a slicing action, perhaps as the point entered a target. The use wear patterns support employment as a projectile point. Curiously, the tip is intact and shows no impact damage.

Specimen Mound Gamma Trench, 240-250 cm deep, -3/C (Figure 1g):

This is the broken distal tip of a projectile point. The broken "base" shows breakage only and thus nothing conclusive. The edges of aspects 2 and 3 contain slight nicking, scarring and polish



but nothing determinate. The specimen was probably broken in use as a projectile, and the use patterns observed probably relate to penetration of the point into a target.

Specimen Mound Gamma, 260-265 cm deep, 1/C (Figure 1h):

This is the medial and distal end of a broken projectile point or bifacial tool. Aspect 1 is the damaged area and reveals no use wear. Aspect 2 shows heavy discontinuous polish in some areas and minor stepped fractures and parallel striae along the edge indicative of cutting/slicing fresh hide and hard plants. Aspect 3 has a few nicks, scars and polish streaks but nothing determinate. This may not have been a projectile point but a bifacial tool designed for cutting and slicing.

Specimen Plaza Test Unit 6, 10-15cm deep (Figure 1i):

This is a small bifacial point with light polish smear along the stem base (aspect 1), which is possibly due to hafting, and small localities of streaked polish along aspects 2 and 3. The use of this tool is indeterminate.

#### **Tools with unifacial retouch: 2 specimens**

Specimen Mound Gamma, 205-210 cm, 6/D (Figure 2a):

This tool has a long convex edge (aspect 2) that is well worked and slightly retouched and a short convex edge that is much steeper (70-80 degrees). There is a weakly developed polish, edge scarring and slight rounding at 100X magnification along the interior spurred tips of aspect 3. Aspect 2 shows more localized polish on the interior edge that is semi-bright to bright and associated with minor perpendicular striae that are not well developed. Similar features are also seen on the exterior or outer tipped edges of both aspects suggesting the tool was used as an adze. A small deposit of a brown residue on Aspect 2 was on the tool; this was interpreted as resulting from soil deposit. On the basis of the weakly developed polish and edge scarring the tool is tentatively interpreted as an implement, which was probably used for working a hard siliceous plant, possibly wood. One locality on Aspect 2 showed a dull polish with tiny striae

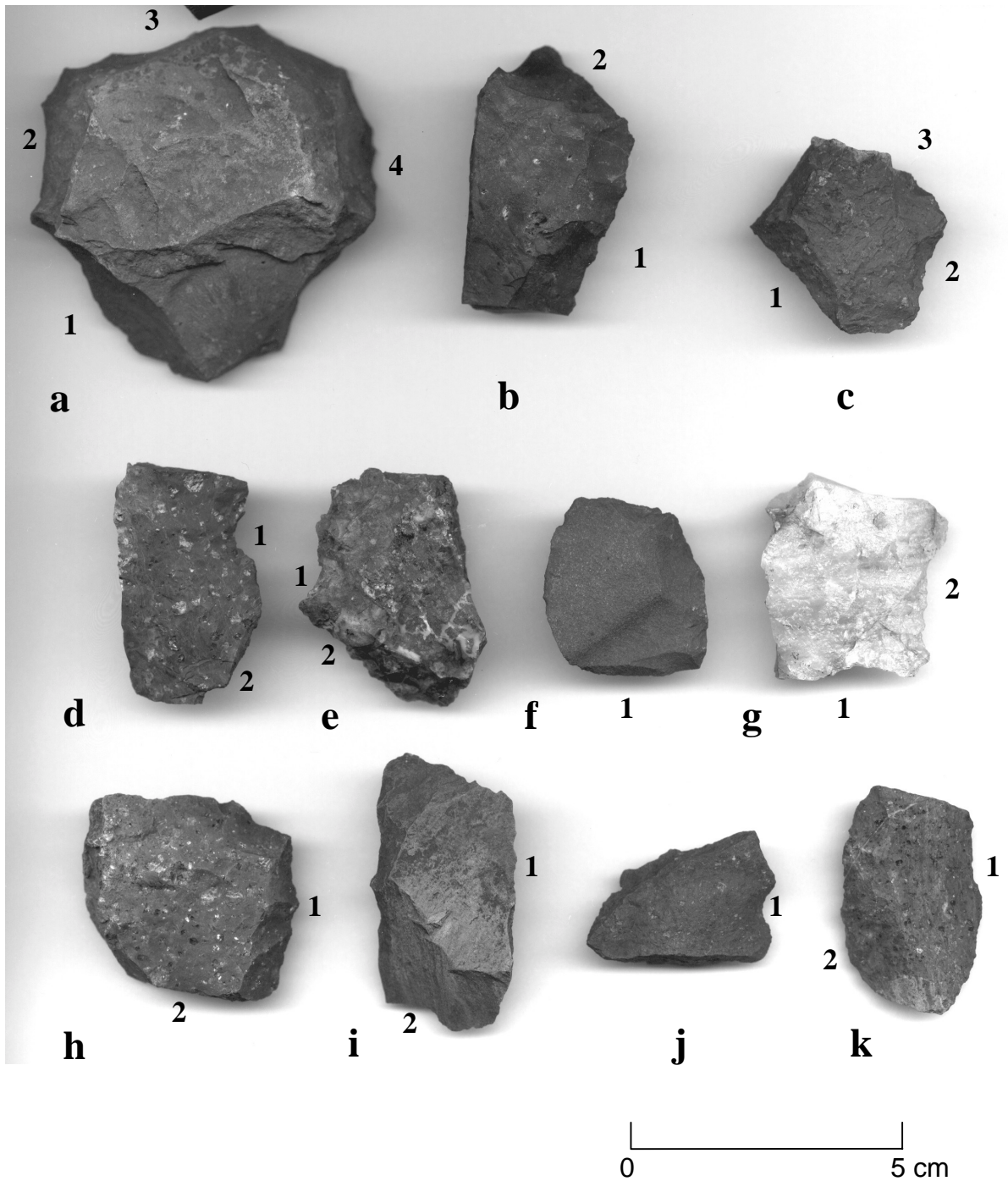


Figure 1. Unifaces Illustrating Specific Aspects Analyzed for Microscopic Use-Wear.

(200 X) possibly associated with scraping fresh hide. This tool seems to have used for scraping and possibly adzing.

Specimen Mound Delta Test Unit, 195-205 cm deep (Figure 2a):

This is a large tool that has several semi-notched or concave flake scars forming three long worked aspects (2-4). The longest surface (Aspect 3) opposite the hafted end (?) had white flaky residues of low incidence under polarized light. These are unidentifiable substances. The edge itself forms an 80 angle, was moderately rounded and displayed microscopic edge scarring and moderate polish on the inner and outer edges. Aspect 2 reveals similar but much less scarring and polish. Aspect 4 also reveals moderate to heavy polish and scarring and diagonal striae. Aspect 1 has extensive rounding that may be due to use, hafting, or natural cause. Aspects 2-3 were probably related to processing some animal material, most likely fresh bone and hide, but the nature of this material was not clearly indicated by the use-wear, and the function was recorded as scraping to indeterminate.

**Utilized Flakes:** 9 specimens

Specimen Mound Gamma, 155-160 cm deep, 4/E (Figure 2c):

This tool is a flake with several aspects. All edges show semi-bright to dull polish, extensive edge rounding, and a few subparallel striae. Extensive edge rounding also occurs. This tool was interpreted to be primarily used to slice/cut hide or meat.

Specimen Mound Gamma, 195-200 cm deep, 1/A (Figure 2d):

This is an elongated flake with a notch near the proximal end and a long convex working edge extending from the notch to the distal tip. The notch (Aspect 1) reveals perpendicular and diagonal striae, both long and short, and semi-bright domed polish on the interior edge reminiscent of working wood or hard plants (Figure 3b). The long convex edge shows intermittent polish streaks and edge rounding on the high or prominent points along the edge suggesting some scraping but mostly cutting action.

Specimen Mound Gamma, 190-195 cm deep, 1/C (Figure 2e):

This tool also has a slight notch on the distal edge (Aspect 1) and an adjacent sharp edge with small flakes struck from the surface edge to form a semi-serrated straight edge (Aspect 2). The raw material refracts light strongly making it difficult to determine cultural polish. There was no clear edge scarring or use polish in the notch (Aspect 1). However, there was some polish and edge damage in the form of rounding and nicking along the serrated edge (Aspect 2) suggesting a slicing motion. The type of material worked is indeterminate.

Specimen Mound Gamma, 235-240, 1/C (Figure 2f):

This is a well-formed flake with a sharp distal edge (Aspect 1). This aspect has a few specks of residues that may be plant (or soft tissue?), with striations running parallel to the edge. Subparallel streaks of polish and a few striae as well as slight edge rounding are also observed on this edge. The tool was interpreted as a cutting/slicing edge for working soft, low silica plant material.

Specimen Mound Gamma, 210-215 cm deep, 7/A (Figure 2g):

This tool is a quartz fragment with no apparent use polish or scarring mainly due to the hardness of the material and due to the refraction of light from its surface, although the probable utilized edge (Aspect 1) has distinctive smears of light reflection along the edge and very slight edge rounding suggestive of a possible slicing motion. The worked material is indeterminate. Aspect 2 is slightly notched, but no clear use wear was observed.

Specimen Mound Gamma, 130-135 cm deep, 1/A (Figure 2h):

This tool has two possible aspects. Aspect 1 is a straight beveled edge with slightly polish and a few short striae running perpendicular to the edge. Slight edge rounding also appears, which is similar to patterns associated with working or adzing/scraping hard wood or plant material. Several small flake scars to produce several tiny spurs along a lower angle edge form aspect 2. This edge has both subparallel and subperpendicular striae and dull polish on high points to suggest scraping or slicing dry hide or possibly bone.

Specimen Mound Gamma, 135-140 cm deep, 1/B (Figure 2i):

This is an elongated core flake with a small notch (Aspect 1) that exhibits slight to moderate polish, perpendicular striations and edge rounding suggesting woodworking (Figure 3c). Aspect 2 is a long rugged edge with large stepped fractures produced when manufactured. Edge rounding and a few polish points are present, but the action is indeterminate.

Specimen Mound Gamma 160-165 cm deep, 1/A (Figure 2j):

This tool has a small notch on one edge (Aspect 1), which shows semi-bright polish on a few high points and slight edge rounding. This notch seems to have been used to work fresh wood.

Specimen Mound Gamma, 235-240 cm deep, 7/C (Figure 2j):

This tool has obvious edge scarring on both aspects. Both aspects are long continuous edges with pronounced edge rounding and extensive polish streaks roughly running parallel to the edges. This tool is interpreted as a general-purpose cutting/slicing tool.

### **Materials Worked and Tool-use Activities**

Plant and/or woodworking was evident on most edges and surfaces. Use polish was rarely well developed and extensive edge scarring was not common. Exceptions were tools with semi-bright to bright polish streaks. However, plant tissue and fibers were not common residues distinctive of material worked. Any plant residues may be fortuitous adherences. At least two kinds vegetal working activity may have taken place at Ajos. One activity identified was the cutting, slicing and scraping of soft to moderately hard plant materials. Some of these tools may have been used to work soft and hard woods; the low amount of edge scarring and poor use polish development meant that more precise determinations were not possible. Other activities may have involved the scraping of fresh hide and bone and the cutting/slicing of meat. Several tools had moderately to heavily utilized edges, which were interpreted as used for woodworking or for working bone. Feather and step scarring was common around the edges and the degree of edge damage probably indicated a hard material. This evidence suggests that wood was probably the material worked the most.

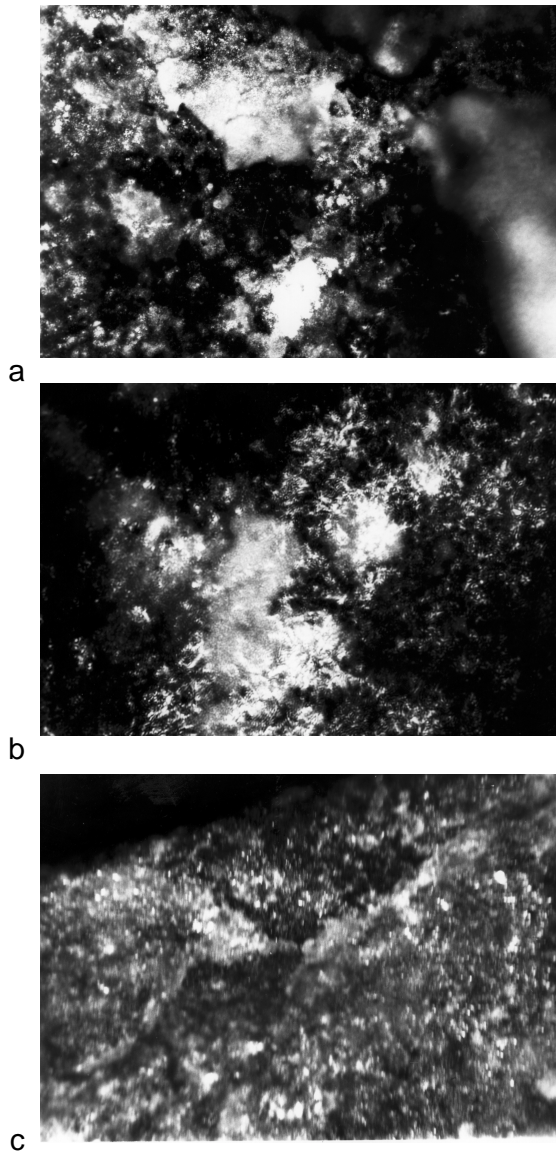


Figure 3. a: Semi-bright polish and tiny subparallel and diagonal striae along slightly stepped edge of a biface (200x magnification)(Mound Gamma, 195-200 cm deep, 1/A); b: Semi-bright to bright polish with tiny striae on domed areas near an edge (200 x magnification) (Mound Gamma, 195-200 cm deep, 1/A) ; c: Edge of tool (Mound Gamma 135-140 cm deep, 1/B) showing extensive edge rounding, slight to moderate polish on high points, stepped fractures, and several perpendicular striations probably related to working hard wood (100 x magnification).

A few tools had multiple edges used for several tasks, such as plant working and hide manufacture. Unfortunately the relationship between these different kinds of task cannot be determined. Several tools also may have been recycled or the tasks may be related to a single complex activity. Several worked edges had clear evidence of use but the material worked could not be determined with any degree of confidence.

A few utilized edges were interpreted as having been used exclusively for butchering task. Butchering tools were indicated mainly by heavy edge damage and dull polish. Quartz and grainy rhyolite would have been most efficient for these tasks. However, the quartz and grainy rhyolite artifacts rarely showed any distinct form of edge scarring or distributions of polishes, which could be used as indicators on fine-grained flint and chert tools. Bone working was interpreted as the primary function of two tools. .

On the basis of design and use-wear pattern, I assume that round scrapers were probably used as planes, chisels and whittling tools for working wood. Steep edge scrapers (high and low angles) had similar wear patterns. I interpret the probable function of these tools as planes for working fresh wood used, for example, in the manufacture of wooden implements and for scraping hide and bone. Flat, straight edge scrapers were interpreted as tools used to cut vegetable fiber, thin bark, skin, sinew and/or flesh. Concave and nosed scrapers had wear patterns suggesting woodworking. Utilized flakes had wear patterns indicating probable use on softer materials.

## **Discussion and Conclusion**

The small sample size of this study prevents any interpretation of activity areas across the site and through time. Many tools seemed to be used expediently. Several tools suggest multiple tasks. The use of single implements for multiple tasks could arise from recycling discarded tools. Alternatively, particular tasks may have involved manipulation of several materials. For example, several edges may have been used to scrape or cut plant material, the user preferring a new pristine edge to the bother of resharpening the already used edge.

Based on this preliminary study, it is speculative to infer the importance of any one activity over another, because of the large proportion of tools whose function could not be determined to material worked. However the minimal evidence for stone tool working and the small number of tasks indicated by the use wear suggest intensive use of the site.

The use wear study enabled 32 discrete tool-use events to be identified. Pieces of stone with minimal flaking and with sharp edges were used as tools but less frequently than clearly flaked stones. There were only three tools with retouch and few obvious attempts to shape flakes.

Several tasks were identified by the use wear study. These were skin scraping and bone working. The actual tasks identified probably represent the range of simple domestic activities rather than a single complete task, such as the production of points. The activities identified include plant processing, probably to extract starch, and simple butchering. The wood, skin and bone working activities probably relate to maintenance of organic equipment such as spears, clothing and animal gutting tools respectively.



## Appendix 5 -- Plant-Grinding Tools Starch Grain Residue Analysis

Dolores Piperno and Irene Holst  
Smithsonian Tropical Research Institute

### Methods for isolating starch granules

Six unwashed grinding stones were shaken in an ultrasound for five to ten minutes to dislodge adhering sediment and starch. Starch was then isolated using a heavy liquid at a specific gravity of 1.8 made from a solution of Cesium Chloride (CsCl). The residue was mounted in water on a slide and examined with polarized and unpolarized light at a power of 400X. Artifacts numbered 3 and 6 were also examined under a stereoscopic microscope at a power of 100X. The point of a fine needle was inserted into the cracks and crevices to loosen and remove any residue. It was mounted and observed as described above.

### Results

#### Tool 1. Mound Gamma, 175-180 cm deep, sector 4/C

Four starch granules were recovered.

Starch 1	10x12 $\mu$ m	not identified
Starch 2	18x16 $\mu$ m	Poaceae, <i>Zea mays</i>
Starch 3	16x14 $\mu$ m	not identified
Starch 4	14x12 $\mu$ m	Poaceae, <i>Zea mays</i>
	$\bar{x}$ = 16x14 $\mu$ m	(for Poaceae)

#### Tool 2. TBN, 180-185 cm deep, sector 10

We found one starch granule.

Starch 1	8x10 $\mu$ m	not identified.
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#### Tool 3. Mound Gamma, 210-215 cm deep, sector 6/D

We found two starch granules.

Starch 1	20x18 $\mu$ m	Poaceae, <i>Zea mays</i>
Starch 2	14x12 $\mu$ m	Poaceae, <i>Zea mays</i>
	$\bar{x}$ = 17x15 $\mu$ m	(for Poaceae grains)

## Tool 6. Gamma 150-155 3/E 21

We found eleven starch granules.

Starch 1	22x20 $\mu$ m	Poaceae, <i>Zea mays</i>
Starch 2	16x14 $\mu$ m	Fabaceae
Starch 3	8x8 $\mu$ m	not identified
Starch 4	10x14 $\mu$ m	Cannaceae
Starch 5	10x12 $\mu$ m	not identified
Starch 6	12x12 $\mu$ m	not identified
Starch 7	18x16 $\mu$ m	Poaceae, <i>Zea mays</i> .
Starch 8	12x12 $\mu$ m	Poaceae
Starch 9	14x14 $\mu$ m	Poaceae, <i>Zea mays</i> .
Starch 10	18x18 $\mu$ m	Poaceae, <i>Zea mays</i>
Starch 11	14x14 $\mu$ m	Poaceae
	$\bar{x}$ = 16x16 $\mu$ m	(for Poaceae)

### Results of Starch Granule identification

The modern reference collection of the Paleoecological and Archaeological Center at the Smithsonian Tropical Research Institute (STRI) was used for comparison and identification of the starch granules. For this study we added twelve species of Poaceae and four species of *Canna* native to Uruguay to STRI's collection of over 300 species from more than 36 families of plants. As described in detail elsewhere (Piperno and Holst, 1998; Piperno et al., 2000; see also Perry 2000) the starch granules identified as maize combine size and morphological criteria found only in maize. A sample of maize starch grains are illustrated in Figure 6.13.

## Appendix 6 -- Ceramic Data Coding Form

**Provenience:** Excavation unit, sector, and level information

**Temper:**

1. fine-sand
2. medium-sand
3. coarse-sand

**Firing:**

1. reducing incomplete
2. reducing complete (black)
3. oxidizing incomplete (black core)
4. oxidizing complete (red)

**Paste texture:**

1. homogeneous
2. heterogeneous
3. lamellar

**Surface treatment:**

1. No surface treatment
2. Smoothed
3. Slipped

**Thickness:** Maximum thickness measured to the nearest millimeter.

**Rim profile:**

1. direct
2. expanded
3. vertical
4. externally inclined

**Lip shape:**

1. flat
2. rounded
3. pointed
4. beveled

## Appendix 7-- Soil Chemistry Analyses from the TBN Crescent-Shaped Sediments

### Introduction

The study of archaeological soils provides important information to understand site formation processes in archaeological sites (e.g., Limbrey 1979; Stein 1987; Norman and Garrison 1998). In particular, chemical analyses of soils are becoming an important aspect to determine the anthropic nature of soils<sup>20</sup> (e.g., Eidt 1984; Woods 1982; Heckenberger 1996). In Uruguay, as reviewed in Chapter 4, previous studies carried out in archaeological sediments from Mound CH2D01 have served to clearly establish the anthropic nature of mounds in the region (Durán 1989; Bracco and Nadal 1991). The studies of percentage of organic matter, phosphorous, and potassium revealed a marked chemical enrichment in these mound site sediments, reaching levels 10 to 100 times higher than the background natural soils of the area (Durán 1989). Similarly, in the Atlantic coast sites, López (1995) compared the amount of phosphorous against artifact frequencies in buried paleosoils, finding a strong positive correlation between these two. This evidence led him to suggest that these paleosoils are anthropic soils whose genesis is related to an intense and redundant occupation of selected locations along the Atlantic coast. Last but not least, phosphate analysis was successfully employed to identify evidence of human activity (e.g., midden-refuse areas and architectural features) at a Guarani historic site in the Durazno Province, Uruguay (Mañosa 1996; Mañosa and Baeza 1996).

In this study, I tested several soil chemistry properties, notably pH, percentage of organic matter, and five basic chemical constituents (phosphorous, calcium, magnesium, potassium, and zinc) in order to gain a better understanding of the site formation processes as well as to identify stratigraphic zones in the TBN crescent-shaped rise.

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<sup>20</sup> Eidt (1984) differentiated between unintentionally accumulated “anthropic soils” and those formed with the purpose of improving the quality of soils. The latter, he called “anthropogenic soils”. However, to avoid misunderstandings, in this study the author will refer to “anthropic” or “antropogenically-altered” soils as human-produced soils to indicate human intervention without specifying its nature.

This appendix provides a detailed description of the soil chemistry analyses carried out at Los Ajos. The discussion and interpretation of these results are presented in more depth in the section on “Distribution Of Anthropogenically-Altered Soils At The Los Ajos Site” in Chapter 8. It is important to point out that the analyses described in this section greatly benefited from several courses I took with Dr. Karathanasis (Soil Science Agriculture Department of the University of Kentucky) as well as from analysis and conversations in the field with Engineer Juan Montaña (Facultad de Agronomía, Universidad de la República, Montevideo, Uruguay). This appendix is however written from the perspective of a general archaeologist attempting to relate soil texture, color, and chemistry to analyze artifact assemblages rather than from the perspective of a soil scientist.

### **Field and Laboratory Procedures**

The soil samples analyzed were extracted from a profile wall in sector 7 in the central part of the TBN (Figure 4.20). In order to avoid modern soil contamination, the first sample was taken 10 cm below the ground surface. The samples were analyzed at the College of Agriculture Soil Testing Laboratory of the University of Kentucky. The chemical analyses were carried out using the Mehlich- 3 extraction process. Soil samples were analyzed for pH, extractable phosphorous (P), calcium (Ca), magnesium (Mg), potassium (K), zinc (Zn), and organic matter percentage. The results are presented in parts per million (ppm). The background information from “natural” areas is provided by a background control sample collected in a non-culturally modified knoll in the Sierra de los Ajos. The wetlands of India Muerta have been intensively occupied by human populations since pre-Hispanic times thus, it is difficult to find soils unaffected by the activities of humans. The locality where the control sample was taken has only been used for cattle grazing and is one of the few localities in the region, that does not have a modern history of vegetation disturbances by agricultural practices (Gustavo Uriarte, personal communication 1999). Moreover, as will be apparent from the color, texture, and soil chemistry analyses of the archaeological samples obtained from the TBN, the differences between the TBN and the control sample is so extreme that the impact of humans on these soils is not significant.

## Results

A close inspection of Table 1 indicates two main patterns. First, a comparison between the chemical elements of the soils from the TBN crescent-shaped rise and the control samples clearly evidence enrichment in most of the chemical elements from the TBN crescent-shaped rise. All the TBN samples exhibit higher contents of these chemical elements and higher percentages of organic matter whereas the background control samples present lesser amounts of chemical elements. Second, all these chemical elements increase vertically in their contents from the base to the top of the profile. I will turn now to the description of each particular soil property analyzed.

**Color.** Several authors (e.g., Woods 1982; Mora et al. 1991) have noted that anthropic soils are darker as a result of organic enrichment and humus accumulation. These soils are usually called in Amazonia as “Terra Preta” (black earth). The soils of the TBN are markedly darker than the light brown to light grey soils in the background surrounding the TBN. Together with the TBN soil chemical alteration, this further corroborates the anthropic nature of the TBN sediments. The distribution of these darker anthropogenically-altered soils is described and considered in detail in Chapter 8.

**Soil pH.** The determination of soil pH is generally regarded as one of the most important chemical measurements made on soils. Soil pH has been used by archaeologists in different ways, for example, to define site boundaries and differentiate stratigraphic zones in complex midden deposits (Woods 1982: 1392). A high pH in midden soils has been generally interpreted as the result of additions originating from wood ash (Woods 1982:1394).

In the TBN crescent-shaped rise, the pH is the only type of soil chemistry measure that decreases over time from the base of the profile towards the ground surface. The 10 samples analyzed ranged from 5.3 to 6.1, varying from slightly to strongly acid (Soil Survey Staff 1951). In comparison with the control sample, which is strongly acid, the TBN sediments show a slight tendency towards alkalinity. The relatively higher pH of the basal level could be explained by the fact that the lowermost part of the TBN has a high proportion of gravel as a result of the weathering processes of the basic rhyolitic substrate. The more basic nature of the basal part of the TBN appears to be the result of contact of the weathered rhyolite with the archaeological

sediments. The acid nature of the TBN sediments may explain the poor preservation of bone in this sector of the site (Biek 1963; Gordon and Buikstra 1981; Woods 1982).

**Phosphorus.** Two main characteristics make phosphorus an attractive measure to determine the intensity of human occupation at archaeological sites: (a) it provides a direct measure of the decay of organic debris and (b) is stable both in its chemistry and its location in soils. As summarized by Woods (1982: 1396), soil phosphorus mainly derives from urine, plant and animal tissues, and bones. When we look at the amount of phosphorus in the TBN soil profile, even in its basal levels, the amount of phosphorus sharply contrasts with the values obtained from the control samples. From the bottom to the top of the TBN sequence, phosphorus increases from 173 to 480 ppm, which indicates a gradual but steady increase in the accumulation of refuse in this sector of the site.

**Organic matter.** The percentage of organic matter is usually perceived as the result of incomplete combustion of plant materials, humified plant tissues and animal remains, as well as intermediate decomposition products (Woods 1982: 1392). As Table 1 shows, the TBN samples have significant higher organic matter percentages from level 195 cm deep towards the ground surface. The low percentage of organic matter and low value of all the chemical constituents lend support to the fact that the relatively high pH of the basal levels is the result of their contact with the basic rhyolite substrate.

**Ca, K, Mg, and Zn.** All the chemical elements tested showed a vertical increase in ppm: calcium raises from 2484 to 6423; potassium increases from 168 to 765; magnesium raises from 306 to 555; and zinc increases from 2.5 to 17.3.

## **Summary**

The soil chemistry data presented above is crucial to obtain a better understanding of the nature and formation processes of the TBN crescent-shaped rise. As it is described in detail in Chapter 8, upon closer examination of the TBN soil chemistry, the artifact properties, the stratigraphy-chronology, and its comparison with other sectors of the site, reveals several specific trends. In comparison with the natural soils of the area, the central TBN profile shows

chemical enrichment associated with human-produced soil accumulations. In addition, there is a clear vertical increase in the chemical enrichment of the soil in all of the chemical elements. The soil chemistry analyses at Los Ajos show great potential, however, we need to know more about the properties of the soils in the area in order to arrive at more conclusive interpretations.

The chemical enrichment of the soil is interpreted as the result of the accumulation of occupational refuse, which is mainly constituted by organic materials such as plant and animal tissues, urine, and excrements. The chemical enrichment of the soil is interpreted as the result of the accumulation of occupational refuse, which is mainly constituted by organic materials such as plant and animal tissues, urine, and excrements. Overall, the depth, extension, and chemical alteration of human-accumulated soils is fairly typical of more permanent occupations, but unlikely to happen with short-term occupations (Eidt 1984; Woods 1982; Heckenberger 1996). The interpretation of the TBN as an occupational area, which grew accretionally over time, also is supported by other lines of evidence, for example, the place that exhibits the highest densities of debris of the site, the gradual upward vertical increase in artifact density, and its homogenous stratigraphy (see Chapter 4).



Table 1. Soil chemistry analysis. All Values Except pH are in Parts Per Million (ppm).

	pH	% Mat organic	P	K	Ca	Mg	Zn	
<b>TBN profile</b>								
160	5.3		9.25	480	765	2816	555	17.3
1.65	5.3		7.43	422	631	2428	382	7.9
1.7	5.4		7.13	384	532	2634	306	8
1.75	5.6		7.09	371	483	3554	341	6.4
1.8	5.8		6.57	381	411	4489	369	5.2
1.85	5.9		5.81	394	270	4898	352	4.4
1.9	6		5.25	373	189	5749	383	4
1.95	6.1		4.54	368	168	5955	358	3.1
200	6.1		4	338	173	5746	339	2.5
2.05	6.1		3.6	261	204	6423	386	3.1
<b>Control sample</b>								
<b>Sierra de los Ajos Litosol</b>								
	5.4		3.39	23	194	1369	496	0.8

## APPENDIX 8 -- Tables of Lithic Debitage, Ceramic, and Bone Density in the Different Excavations Units at Los Ajos.

Table 8.1. Off-Mound test units debitage count and densities

Test Units	Levels (cm)											Component													
			5-10		10-15		15-20		20-25		25-30		30-35		35-40		40-45		45		Average				
	N	E	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	Ceramic Mound	Preceramic Mound	Preceramic Archaic		
50	0		2	17.8						2	17.8										17.8		17.8		
50	50				3	26.7				1	8.9										17.8				
50	100				6	53.3				5	44.4	1	8.9	5	44.4						35.5		44.4		
50	150		5	44.4	4	35.6	2	17.8	9	80.0	7	62.2	13	115.6	12	106.7					44.5		62.2	111.2	
50	200				14	124.4	29	257.8	6	53.3													124.4	155.6	
50	250	1	9.1		24	213.3	9	80.0													100.8				
50	300	1	9.1	6	53.3			5	44.4														31.2	44.4	
50	350			5	44.4	11	97.8	33	293.3	27	240.0											145.2		240.0	
50	400	1	9.1		4	35.6	9	80.0	5	44.4													42.3		
50	450				2	17.8	12	106.7	7	62.2											62.3			62.2	
100	0	10	90.9		3	26.7	4	35.6	5	44.4													49.4		
100	50				8	71.1	14	124.4															97.5		
100	100	2	18.2	8	71.1	12	106.7	11	97.8	17	151.1	29	257.8	4	35.6							117.1		35.6	
100	150			4	35.6	29	257.8	25	222.2														171.9		
100	200			27	240.0	19	168.9	4	35.6														148.2		
100	250			4	35.6	1	8.9	1	8.9	9	80.0	3	26.7										33.4	26.7	
100	300			1	8.9	1	8.9	8	71.1	1	8.9												24.5		
100	350			4	35.6	4	35.6	4	35.6															35.6	
100	400	1	9.1	26	231.1	36	320.0	21	186.7	7	62.2												186.7	124.5	
100	450			23	204.4	17	151.1	14	124.4	21	186.7	34	302.2	81	720.0	15	133.3	1	8.9				166.7	291.1	
150	0			1	8.9	8	71.1	14	124.4	14	124.4											68.1		124.4	
150	50			3	26.7	14	124.4	25	222.2	51	453.3	34	302.2									206.7		302.2	
150	100							2	17.8	15	133.3	40	355.6									168.9			
150	150																		1	8.9				8.9	
150	200							2	17.8															17.8	
150	250	1	9.1	97	862.2	7	62.2	8	71.1	58	515.6			32	284.4							304.0		284.4	
150	300					2	17.8	14	124.4	19	168.9	8	71.1										95.6		
150	350							5	44.4															44.4	
150	400	1	9.1	19	168.9	18	160.0	25	222.2			26	231.1	52	462.2	39	346.7	2	17.8			140.1	346.7	182.3	
150	450			5	44.4	5	44.4	9	80.0	12	106.7											56.3		106.7	
200	0			73	648.9	43	382.2			25	222.2											515.6		222.2	
250	0					12	106.7	6	53.3	9	80.0	1	8.9											62.2	
250	50			5	44.4	16	142.2	28	248.9	51	453.3	12	106.7	22	195.6	14	124.4						187.9		
250	100			23	204.4	20	177.8	16	142.2	21	186.7	16	142.2											177.8	142.2
250	200			3	26.7	23	204.4																	115.6	
250	250					19	168.9	13	115.6	8	71.1												142.3	71.1	
250	300			1	8.9					8	71.1	8	71.1										50.4		
250	350							3	26.7															26.7	
300	0					2	17.8	4	35.6															26.7	
300	200			2	17.8	7	62.2	7	62.2															47.4	

Preceramic Archaic Component  
 Preceramic Mound Component  
 Ceramic Mound Component

Table 8.2. Off-Mound Test Units Ceramic count and density

Test Units		Levels (cm)										Mean		
N	E	5-10		10-15		15-20		20-25		25-30			30-35	
		N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>		N	/m <sup>3</sup>
0	0									1	8.9			8.9
0	100	5	44.4	2	17.8	1	8.9							23.7
4		5	44.4	1	8.9	2	17.8	1	8.9					20
5						1	8.9							8.9
6				1	8.9									8.9
7						1	8.9							8.9
8				1	8.9	3	26.7							17.8
10		1	8.9	1	8.9									8.9
50	0			1	8.9									8.9
50	50			7	62.2			2	17.8					40
50	100			2	17.8	3	26.7	1	8.9	1	8.9			15.6
50	150	1	8.9			5	44.4	3	26.7					26.7
50	250			3	26.7	2	17.8	1	8.9					17.8
50	450					1	8.9							8.9
100	50			5	44.4					4	35.6	4	35.6	38.5
100	100			1	8.9	12	106.7	8	71.1	3	26.7			53.3
100	150			12	106.7	6	53.3			1	8.9			56.3
100	200			4	35.6	1	8.9	9	80.0	3	26.7			37.8
150	0			7	62.2	6	53.3							57.8
150	50					6	53.3	3	26.7					40
150	100									6	53.3			53.3
150	250							4	35.6					35.6
150	400			2	17.8	3	26.7							22.3
150	450			1	8.9	2	17.8							13.4
200	0					4	35.6							35.6
		12		51		59		32		19		4		177

Table 8.3. Plaza area test units lithic debitage and ceramic count and density

Test Units	Lithic Debitage								Component Averages		
	Levels (cm)								Ceramic Mound	Preceramic Mound	Preceramic Archaic
	5_10		10_15		15-20		20-25				
N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>				
1	2	13.3	22	146.7	16	106.7				13.3	126.7
2	56	373.3	55	366.7	21	140.0				373.3	253.4
3	63	420.0	5	33.3	44	293.3	8	53.3		420	126.6
4	11	73.3	31	206.7	52	346.7	5	33.3	165		
5	58	386.7	50	333.3	97	646.7			455.56		
6			104	693.3	40	266.7	9	60.0	480		60
7	3	20.0	36	240.0					130		
8	4	26.7	18	120.0	8	53.3			66.7		
9	11	73.3	9	60.0							66.7
10	9	60.0	23	153.3							106.7

Plaza area ceramic count and density

Test Units	Levels (cm)								Average
	5_10		10_15		15-20		20-25		
N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>	N	/m <sup>3</sup>		
4	5	45.5	1	9.1	2	18.2	2	9.1	20.5
5									9.1
6			1	9.1					9.1
7					1	9.1			9.1
8			1	9.1	3	27.3			18.2
10	1	9.1	1	9.1					9.1




 Preceramic Archaic Component  
 Preceramic Mound Component  
 Ceramic Mound Component

Table 8.4. Transect N 50 E 0-300 lithic debitage and ceramic density

N 50 E 0-250 Ceramic Density

Test Units		Levels (cm)					Mean
N	E	5 10	10 15	15 20	20 25	25 30	
50	0		9.1				9.1
50	50		63.9		18.2		41.05
50	100		18.2	27.3	9.1	9.1	18.2
50	150	9.1		45.5	27.3		27.3
50	200		45.5	63.9	9.1		39.5
50	250		27.3	18.2	9.1		18.2

N 50 E 0-300 Lithic Debitage Density

Test Units		Levels (cm)								Mean
N	E	5 10	10 15	15 20	20 25	25 30	30 35	35 40	40 45	
50	0		18.2			18.2				18.2
50	50			27.3		9.1				18.2
50	100			54.5		45.5	9.1	45.5		38.7
50	150		45.5	36.4	18.2	81.8	63.6	118.2	109.1	67.5
50	200			127.3	263.6	54.5				148.5
50	250	9.1		218.2	81.8					103.0
50	300	9.1	54.5		45.5					36.4

Table 8.5. Mound Gamma Debitage and Ceramic count and density

Component Ceramic	Levels (cm)	Lithic Debitage			Ceramic			Bone		
		N	/ m3	Component Average	N	/ m3	Component Average	N	/ m3	Component Average
Mound	105-120				6	3.4				
	120-125				2	1.1				
	125-130	674	385.1		9	5.1		3.0	1.7	
	130-135	680	388.6		7	4.0		0.0	0	
	135-140	706	403.4		4	2.3		7.0	4	
	140-145	969	553.7		1	0.6		3.0	1.7	
	145-150	132	75.4					1.1	0.6	
	150-155	460	262.9		2	1.1		1.1	0.6	
	155-160	414	236.6		3	1.7		1.9	1.1	
	160-165	69	39.4		1			3.0	1.7	
	165-170	443	253.1		1	0.6		5.1	2.9	
	170-175	373	213.1		1	0.6		42.0	24	
	175-180	337	192.6		1	0.6		31.5	18	
	180-185	651	372.0					8.9	5.1	
	185-190	400	228.6	277.3	2	1.1	1.8	27.0	15.4	5.9
		6308			32		134.4			
Preceramic Mound	190-195	312	178.3					50.1	28.6	
	195-200	243	138.9					61.1	34.9	
	200-205	294	168.0					57.1	32.6	
	205-210	286	163.4					45.0	25.7	
	210-215	407	232.6					70.0	40	
	215-220	141	80.6					28.0	16	
	220-225	179	102.3					85.9	49.1	
	225-230	84	48.0					91.0	52	
	230-235	147	84.0					85.1	48.6	
	235-240	112	64.0					76.0	43.4	
	240-245	100	57.1					4.0	2.3	
	245-250	105	60.0					4.0	2.3	
	250-255	127	72.6					1.9	1.1	29.0
255-260	144	82.3	109.4							
Archaic Preceramic	260-265	17	9.7							
	265-270	14	8.0							
	270-275	28	16.0	11.2						

Table 8.6. Mound Delta debitage count and density

Components Ceramic	Levels (cm)	Lithic Debitage		Component Average
		N	/ m <sup>3</sup>	
Mound	135-145	120	300.0	
	145-155	122	305.0	
	155-165	74	185.0	
	165-175	95	237.5	
	175-185	34	85.0	
	185-195	33	82.5	
	195-205	31	77.5	181.8
Preceramic	205-215	55	137.5	
Mound	215-225	48	120.0	
	225-235	36	90.0	115.8

Table 8.7. Central sector of TBN crescent-shapedd rise lithic debitage and ceramic count and density

Components	Levels (cm)	Lithic debitage			Ceramics		
		N	/ m <sup>3</sup>	Component Average	N	/ m <sup>3</sup>	Component Average
Ceramic	145-150	20	38.5				
Mound	150-155	106	203.8				
	155-160	136	261.5		12	38.5	
	160-165	142	273.1		60	130.8	
	165-170	139	267.3		34	80.8	
	170-175	221	425.0		36	84.6	
	175-180	133	255.8		18	50.0	
	180-185	63	121.2		12	38.5	70.5
	185-190	37	71.2	213.0			
	Preceramic	190-195	93	178.8			
Mound	195-200	38	73.1	126.0			
Preceramic	200-205	25	48.1				
Archaic	205-210	35	67.3	57.7			



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1983 La Etnoarqueología de una Vivienda Achuar y sus Implicaciones Arqueológicas. *Miscellanea Antropologica Ecuatoriana*, 3:155-193, Guayaquil, Ecuador.

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1998 Distinguishing Rice (*Oryza sativa* Poaceae) from Wild *Oryza* Species Through Phytolith Analysis II: Finalized Method. *Economic Botany* 52: 134-145.

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2000 Fitólitos de Poaceae de Argentina. III. Fitólitos Foliáres de Especies del Género *Paspalum* (Paniceae) en la Provincia de Entre Ríos. *Darwiniana* 38: 11-32.

1999 Fitólitos de las Poaceae Argentinas: IV. Asociación Fitólítica de *Cortadeira selloana* (Danthonieae:Poaceae), de la Provincia de Entre Ríos (Argentina). *Natura Neotropicales* 30: 25-33.

1998 Microfitólitos de las Poaceae Argentinas: II. Microfitólitos Foliáres de Algunas Especies del Género *Panicum* (Poaceae, Paniceae) de la Provincia de Entre Ríos. *Darwiniana* 36: 29-50. Buenos Aires. Argentina.

1996 Microfitólitos de las Poaceae Argentinas: I. Microfitólitos Foliáres de Algunas Especies de *Stipa* (Stipae: Arundinoideae), de la Provincia de Entre Ríos. *Darwiniana* 34:151-172. Buenos Aires. Argentina.

## VITA

**1. Date and Place of Birth:** 24<sup>th</sup> September 1969, Montevideo, Uruguay.

### 2. Education

1995            Licenciatura Degree in Anthropological Sciences with a focus on Archaeology. Departamento de Antropología, Facultad de Humanidades y Ciencias, Universidad de la República, Uruguay. Dr. José López, Advisor. Monograph Title: *Size, Shape, and Rejuvenation of Projectile Points of Uruguay*.

### 3. Professional Experience

#### Participation in Archaeological Projects

2002-2003    Survey and Excavation Crew Chief. Project *Preliminary Studies About the Origin of Maize in the Balsas Region Project*. Smithsonian Tropical Research Institute- Mellon Foundation, Dr. Dolores Piperno, Principal Investigator.

2000-2001    Project Director, Survey and Excavation Crew Chief, Laboratory Instructor-Supervisor. Dissertation Title: *Mid-Holocene Emergent Complexity and Landscape Transformation: The Social Construction of Early Formative Communities in Uruguay, La Plata Basin*. Funded by National Science Foundation (U.S.A.), Wenner-Gren Foundation for Anthropological Research, University of Kentucky, and the collaboration of the Smithsonian Tropical Research Institute, Panama and the Ministerio de Educacion y Cultura, Uruguay (7 months).

1998            Project Director, Excavation Crew Chief, Laboratory Instructor-Supervisor. Exploratory Dissertation Project. Title: *Proyecto Arqueológico Estancia Mal Abrigo, Uruguay* (Estancia Mal Abrigo Archaeological Project). Funded by the Graduate School of the University of Kentucky and the collaboration of the Ministerio de Educación y Cultura, Uruguay (2 months).

- 1997 Survey Crew Chief, Research Assistant (Part-time) for Dr. Tom Dillehay. *Human-Environment Interactions in the Lower Jequetepeque Valley*, Perú. Dr. Tom Dillehay (University of Kentucky) and Dr. A. Kolata (University of Chicago), Project Directors (3 months).
- 1996 Co-Principal Investigator with J. Femenias, M. Farias, and A. Florines. Excavation Crew Chief, Laboratory Instructor-Supervisor. *Arqueología del Delta del Río Negro* (Archaeology of the Rio Negro Delta). Excavación La Blanqueada. Funded by the Museo Nacional de Antropología, Ministerio de Cultura, Uruguay. (2 months).
- 1996 Co-Principal Investigator with Lic. Leonel Cabrera. Excavation Crew Chief, Laboratory Instructor-Supervisor. *Rescate Arqueológico de la Costanera Norte de Salto* (Salvage Archaeology of Northern Coast of Salto Project). Funded by Patrimonio Cultural de la Nación, Ministerio de Educacion y Cultural, Uruguay.
- 1992-1995 Excavation Crew Chief, Research Assistant (20hrs/week). *Estudio de la Prehistoria y Protohistoria de la Costa Atlántica-Platense* (Prehistory and Protohistory of the Atlantic-River Plate Coast). Funded by the Instituto de Cooperación Ibero-Americana (Spanish Embassy in Uruguay) and the Universidad de la República, Uruguay. Dr. José López, Project Director.
- 1989-1994 While pursuing my Licenciatura Degree in Uruguay, I participated in various archaeological projects as Research Assistant, Field Crew, Lithic and Ceramic Analyst, Power Point Map Drawing, Designer of Computer Coding Scheme and Data Input for IBM P.C. in the following projects: 1990-1995- *Estudio de la Prehistoria y Protohistoria de la Costa Atlántica-Platense* (Prehistory and Protohistory of the Atlantic-River Plate Coast), Dr. J. López Mazz, Project Director; 1989-1993- *Proyecto de Rescate Arqueologico de la Cuenca de la Laguna Merin* (Salvage Archaeology of the Merin Lagoon Basin), Dr. J. López, Lic. L. Cabrera, and Lic. R. Bracco, Project Directors; 1993-1994- *Estudio del Desarrollo de Estrategias Adaptativas en el Río Uruguay Medio* (Adaptive Strategies

in the Middle Uruguay River), Lic. Leonel Cabrera, Project Director; 1992- *Relevamiento Sur-Oeste de la Costa del Departamento de Montevideo* (Archaeological Survey of the Southwest Coast of Montevideo Province), Dr. José López, Project Director; 1990-*Proyecto Arqueológico del Río Cuareim* (Archaeology of the Rio Cuareim), Dr. A. Austral, Project Director.

### **Phytolith and Starch Grain Analyses**

- 2001-present Phytolith analyst of core sediments from Ixtlayola and Tuxpan lakes, Guerrero, Mexico in the context of *Preliminary Studies About the Origin of Maize in the Balsas Region Project*. Smithsonian Tropical Research Institute- Mellon Foundation, Dr. Dolores Piperno, Principal Investigator.
- 2001 Build a modern reference collection of 150 plant specimens of southeastern Uruguay from voucher specimens collected at the National Museum of Natural History, Washington D.C., the Missouri Botanical Garden, Facultad de Agronomía, Universidad de la República, Uruguay and collected and identified in the field by Lic. Eduardo Alonso.
- 2001 Phytolith morphotypes of Mesoamerican neotropical flora from the modern reference collection housed at the Smithsonian Tropical Research Institute in Panama under the supervision of Dr. Dolores Piperno in the context of *Preliminary Studies About the Origin of Maize in the Balsas Region Project*. Smithsonian Tropical Research Institute- Mellon Foundation, Dr. Dolores Piperno, Principal Investigator.
- 2001 Phytolith analysis of archaeological and paleoenvironment (wetland cores) samples from Uruguay as part of my dissertation research (5 months).

1999 Full-time internship at the Smithsonian Tropical Research Institute, Panama, where the applicant learned phytolith analysis and processed samples of soils to extract phytolith and starch grains from archaeological sites in Uruguay under the technical guidance of Dr. Dolores Piperno. Project Title: *The Role of Wild and Domesticated Plant Resources in the Economy of the Mound-Building Cultures of Southeastern Uruguay* (3 months).

### **Other Research Experience**

- 1998-1999 Full-time research assistant for Dr. Tom Dillehay. Department of Anthropology, University of Kentucky.
- 1996-1998 Part-time research assistant for Dr. Tom Dillehay. Department of Anthropology, University of Kentucky.
- 1993-1995 Research assistant *Proyecto de Prehistoria del Litoral Atlántico* (Prehistory of the Atlantic Coast) (20hrs/week). Department of Anthropology, Universidad de la República, Uruguay. Dr. José López, Project Director.
- 1992 Research assistant *Proyecto de Prehistoria y Protohistoria del Litoral Atlántico* (Prehistory and Protohistory of the Atlantic Coast) (20hrs/week). Department of Anthropology, Universidad de la República, Uruguay, Dr. José López, Project Director.

## Teaching Experience

- 2002 Instructor. Course Title: *Origins of Old World Civilizations*. Department of Anthropology, University of Kentucky.
- 2000 Develop and carry out activities about Uruguay's heritage spanning grades 4<sup>th</sup>-6<sup>th</sup> at primary Schools in Rocha Province, Uruguay as part of the Kentucky-Uruguay Cultural Heritage Project, Dr. Gwynn A. Henderson, Cecilia Manosa, Alicia Burbaquis-Vinson, and Judy Sizemore, Co-Directors.
- 2000 Instructor. Course Title: *Lithic Analysis: Macroscopic Studies*. Lectured at the Comisión Nacional de Arqueología. Ministerio de Educación y Cultura, Uruguay (2 weeks).
- 2000 Supervise 4<sup>th</sup> grade students on archaeological excavations. Jouette House Archaeology Education Project, Kentucky Archaeological Survey, Dr. Kim McBride, Principal Investigator.
- 2000 Teaching Assistant. Course Title: *Cultural Diversity*. Lectured by Dr. Monica Upvardy. Department of Anthropology, University of Kentucky (20hrs/week).
- 1999 Teaching Assistant. Course Title: *Native American Peoples of North America*. Lectured by Dr. Richard Jefferies. Department of Anthropology, University of Kentucky (20hrs/week).
- 1997 Instructor. Course Title: *Lithic Analysis*. Lectured for the personnel of the Museum of Archaeology of Salto, Uruguay (2 weeks).
- 1990-1994 Teaching Assistant. (Honorary). Course Title: *Prehistoria General e Introducción a la Arqueología* (Introduction to Prehistory and Archaeology). Lectured by Dr. José López. Department of Anthropology, F.H.C.E. Universidad de la República, Uruguay.



## Preparation of Educational Materials

- 2000 Co-producer – Project Archaeologist of educational video titled *The Prehistoric Mounds of Uruguay: Linking the Past and the Future*, KET, Kentucky Educational Television, U.S. ([www.archaeologychannel.org](http://www.archaeologychannel.org)), as part of the Kentucky-Uruguay Cultural Heritage Project, Dr. Gwynn A. Henderson, Cecilia Mañosa, Alicia Burbaquis-Vinson, and Judy Sizemore, Co-Directors.
- 2000 Assist in the design and content of the Kentucky-Uruguay Cultural Heritage Education Project's web page ([www.dinacy.gub.uy/proykent](http://www.dinacy.gub.uy/proykent)) hosted by CONICYT (Uruguay's National Science Foundation), Dr. Gwynn A. Henderson, Cecilia Mañosa, Alicia Burbaquis-Vinson, and Judy Sizemore, Co-Directors.

## 5. Grants, Fellowships, and Awards

- Present Smithsonian Tropical Research Institute-Mellon Foundation Fellowship Post- Doctoral Position. Panama.
- 2003 Dissertation Visiting Distinguished Faculty Award. The Graduate School, University of Kentucky.
- 2002 Margaret Lantis Award For Excellence in Original Research by a Graduate Student by the Department of Anthropology, University Kentucky.
- 2000 National Science Foundation Doctoral Dissertation Award: *Community Organization and the Emergence of Cultural Complexity in the Early Formative Cultures of Southeastern Uruguay*. Dr. Tom Dillehay, Principal Investigator.
- 2000 Wenner-Gren Foundation for Anthropological Research Pre-doctoral Grant: *Human Environment Interactions and the Emergence of Cultural Complexity During the Mid-Holocene in Southeastern Uruguay*. Dr. Tom Dillehay, Principal Investigator.

- 2000 University of Kentucky, Graduate School, Dissertation Year Award: *Human-Environment Interactions and the Emergence of Cultural Complexity During the Mid-Holocene in Southeastern Uruguay*. Dr. Tom Dillehay, Principal Investigator.
- 1999 Commonwealth Research Award. Graduate School Fellowship Office to cover the expenses to present the results of research conducted at the Smithsonian Tropical Research Institute at the Wetland World Conference held in Gainesville, Florida. December 1-5.
- 1999 Kentucky Research Challenge Fellowship-Graduate School, University of Kentucky to cover travel expenses to collect voucher specimens at the Missouri Botanical Garden, Missouri.
- 1998 Graduate Student Support-Graduate School Fellowship Office, University of Kentucky to cover air ticket expenses to carry out fieldwork in Uruguay.
- 1996 Fulbright-IIE Grant to seek graduate education in Archaeology in the U.S.A.

## 6. Publications

- 2003 Iriarte, José  
Assessing the feasibility of identifying maize through the analysis of cross-shape size and three-dimensional morphology in the grasslands of Southeastern South America. *Journal of Archaeological Science* 30 (2003): 1085-1094.
- 2001 Iriarte, José, Irene Holst, José López, and Leonel Cabrera  
Subtropical Wetland Adaptations in Southeastern Uruguay: An Archaeobotanical Perspective. In *Enduring Records: The Cultural Heritage of Wetlands*, edited by Barbara Purdy, pp. 61-87. Oxbow Books, England.

- 2001 Iriarte, José, Jorge Femenías, Andrés Florines and Mariela Farías.  
Arqueología del Delta del Río Negro: Excavación del Sitio La  
Blanqueada. In *Arqueología hacia el Fin del Milenio*, edited by Nelsys  
Fusco, pp. 68-85. Fundación Fontana-Minelli. Montevideo, Uruguay.
- 2001 Iriarte, José  
Arqueología del Río Uruguay Medio: Retrospectiva y Futuras  
Direcciones. In *Arqueología Hacia el Fin del Milenio*, edited by Nelsys  
Fusco, pp. 56-67. Fundación Fontana-Minelli. Montevideo, Uruguay.
- 2000 Iriarte, José  
Organización de la Tecnología Lítica en la Costa Atlántica de los  
Humedales de Rocha. In *Arqueología de las Tierras Bajas de Sudamérica*,  
edited by A. Durán and R. Bracco, pp. 142-160. Ministerio de Educación  
y Cultura, Montevideo, Uruguay.
- 2000 Iriarte, José and Jorge Femenías  
Puntas de Proyectoil del Río Negro Medio: Primer Paso en la Construcción  
de una Cronología Cultural. In *Arqueología de las Tierras Bajas de  
Sudamérica*, edited by A. Durán and R. Bracco, pp. 45-67. Ministerio de  
Educación y Cultura, Montevideo, Uruguay.
- 2000 López, José and José Iriarte  
Relaciones entre el Litoral Atlántico y las Tierras Bajas. In *Arqueología de  
las Tierras Bajas de Sudamérica*, edited by A. Durán and R. Bracco, pp.  
89-101. Ministerio de Educación y Cultura, Montevideo, Uruguay.
- 1996 López, José and José Iriarte  
Archaeology of the Atlantic Coast of Uruguay. *Ultramarine Newsletter*.  
Nro.3. Edited by Ortiz-Troncoso. Amsterdam, The Netherlands.
- 1995 Iriarte, José  
Afinando la Puntería: Tamaño, Forma y Mantenimiento en las Puntas  
Pedunculadas de Uruguay. In *Arqueología en el Uruguay: 120 Años  
Después.*, edited by M. Consens, C. Curbelo y J. López, pp. 142-151.  
Editorial Surcos, Montevideo, Uruguay.

- 1995 Iriarte, José  
Análisis de los Desechos de Talla del Sitio S 5-42. In *Arqueología en el Uruguay: 120 Años Después.*, edited by M.Consens, C. Curbelo y J. López, pp.:162-171. Editorial Surcos, Montevideo, Uruguay.
- 1989 Iriarte, José, Alejandro Segovia, and Alfredo Di Giorgi  
Aportes del Diario de Operaciones del Capitán Jorge Pacheco al Conocimiento de los Indígenas de Uruguay." . In *Anales de VII Encuentro Nacional y V Regional de Historia.*, pp. 145-163. Editorial Linardi-Risso, Montevideo, Uruguay.