Palo Errado Patterned Wetland Mapping Project, Veracruz, México

Research Year: 2005
Culture: epi-Olmec
Chronology: Late Pre-Classic to Early Classic
Location: Southern Gulf Lowlands, Veracruz, México
Site: Palo Errado

Table of Contents

Abstract
Resumen
Introduction
Background
Methods
    Aerial Reconnaissance
Results of Aerial Reconnaissance
Mounded Pre-hispanic Sites
Surface Reconnaissance
Mounded Site Inspections
    La Cartera "A"
    El Zapotal
Summary and Conclusions
Acknowledgements
List of Figures
Sources Cited

Abstract

The possible remains of pre-hispanic patterned wetlands were detected on a 1:50,000 vertical aerial photograph of the Late Formative to Early Classic period site of Palo Errado, Veracruz, México in 2004. In order to better define these patterns, as well as potentially identify additional patterns, a series of low-altitude, oblique aerial photographs were taken of a 7,200 ± hectare area surrounding Palo Errado in February 2005.

The subsequent analysis of the low-altitude, oblique aerial photographs indicated that the original patterns observed in the 1:50,000 vertical aerial photograph either did not exist, or had been obliterated due to recent agricultural activities. Nonetheless, three previously unidentified zones of possible wetland patterning were identified, as well as several large mounded sites. A surface reconnaissance was carried out to explore and map the zones of possible wetland patterning and the mounded sites. Once mapped, the patterns observed during the aerial reconnaissance were determined to date to the recent historic period, due to their systematic spacing and alignment. These modern patterns likely functioned as flood mitigation strategies. Finally, several large mounded sites that were identified were visited and mapped.

Resumen

En el año 2004 se detectaron posibles restos de campos inundables en el sitio de Palo Errado, Veracruz (México), el cual data del Formativo Tardío al Clásico Temprano, por medio de una fotografía aérea vertical a escala 1:50.000. En Febrero del año 2005 se tomó una serie de fotos aéreas oblicuas a baja altitud en un terreno de aproximadamente 7200 hectáreas alrededor del sitio con el fin de entender mejor la extensión de estos posibles campos, y de detectar otros que posiblemente existieran.

El análisis de estas últimas fotos indica que los campos que parecían visibles en las fotos verticales no existen o han sido destruidos como resultado de actividades agrícolas recientes. Sin embargo, se identificaron tres zonas de posibles campos inundables que no habían sido detectadas con anterioridad, al igual que varios sitios grandes con montículos. Una vez digitalizados, los campos que se observaron durante el reconocimiento aéreo parecen estar sistemáticamente distribuidos y alineados, lo cual sugiere que posiblemente datan del período histórico reciente. Estos campos inundables modernos probablemente sirven la función de mitigar las inundaciones. Adicionalmente se visitaron varios de los sitios con montículos identificados, cuyo plan se dibujó.

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Introduction

Palo Errado is a small mounded site, located 10 km southwest of the epi-Olmec site of Tres Zapotes, municipality of Santiago Tuxtla, in the southern Gulf Lowlands of Veracruz, México. A principal characteristic of the southern Gulf Lowlands which encompasses portions of the modern states of Veracruz and Tabasco, is its fluvial environment (Figure 1, shown below). The southern Gulf Lowlands are located within the drainage basin of the Sierra Madre Oriental and the Chiapan Mountains, and as a result are bisected by the major rivers and their tributaries that drain these upland areas. The southern Gulf Lowlands lie, on average, less than 10 m above sea level (asl). The major topographic exception to the low-lying, fluvial environment of the southern Gulf Lowlands is the Sierra de los Tuxtlas, a relatively small volcanic upland zone in the northeastern corner of the region. Nonetheless, much of the southern Gulf Lowlands are seasonally inundated, which has had the effect of concentrating both modern and pre-hispanic populations onto elevated areas, such as stable levee lands and salt domes. One result of the observed concentration of archaeological populations on these elevated landforms, has been the centrality of their role in the development and maintenance of sociopolitical and economic complexity during the Formative and Classic periods in the southern Gulf Lowlands.

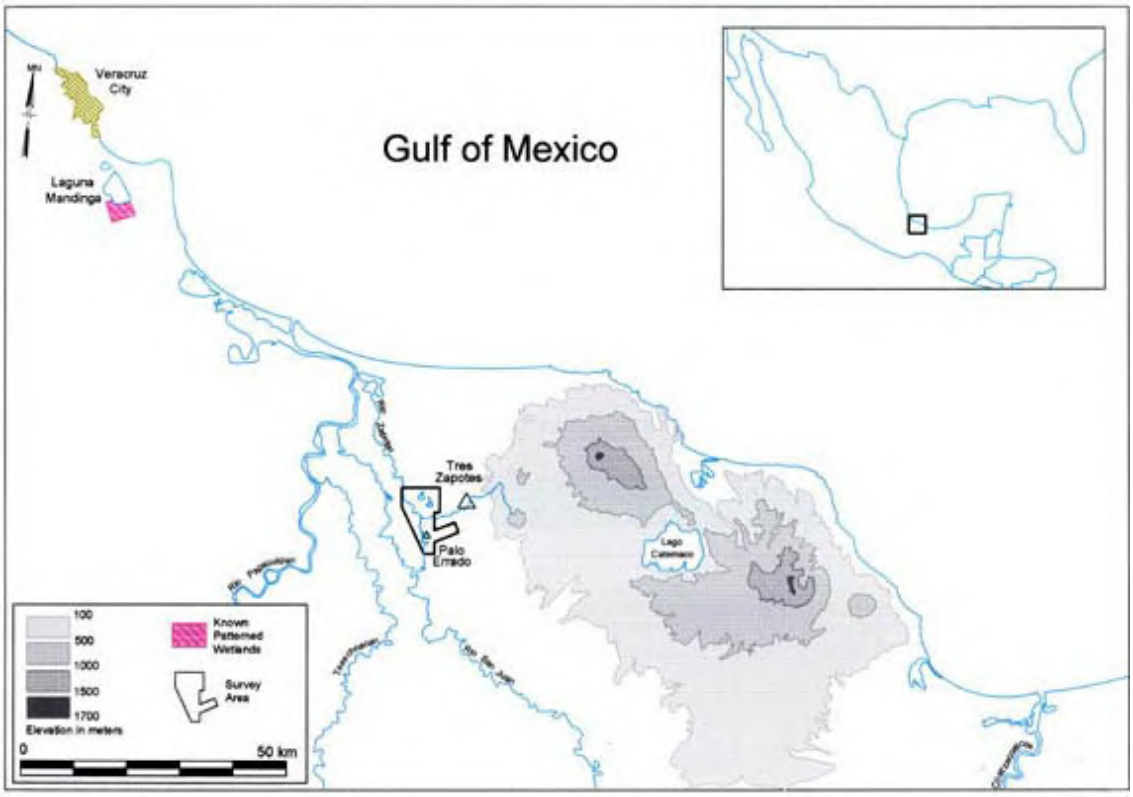

Figure 1. Map showing the location of the Palo Errado Wetland Mapping Project Area in southern Gulf Lowlands of Veracruz and Tabasco, México.

Stemming from ethnohistoric accounts of post-conquest agricultural practices in the region (Siemens 1998; Sluyter 1995) and on ethnographic observations of modern land use activities (Coe and Diehl 1980), a model developed of pre-hispanic agriculture in the southern Gulf Lowlands which emphasized the exploitation of seasonally inundated levee lands (Coe 1981; Coe and Diehl 1980). The control over access to these annually nutrient enriched lands was given as the mechanism for the development and maintenance of the socio-politically complex Olmec, who inhabited this area during the Formative period (Coe 1981; Coe and Diehl 1980). While at first this agricultural model focused only on the cultivation of maize on these soil-rich landforms, it then incorporated the exploitation of the readily available, and abundant, riverine and marine resources (Rust and Leyden 1994; Rust and Sharer 1988).

The centrality of this model in the southern Gulf Lowlands during the Formative period has recently been de-emphasized, especially for large population centers that occur in environments that are not characterized by extensive levee lands. Stark (1977, 1978) has identified adaptations to the delta plains and mangrove swamps of coastal areas where a wealth of aquatic and terrestrial resources were exploited. Elsewhere in the southern Gulf Lowlands, Borstein (2001) has argued for a subsistence strategy emphasizing aquatic resources, rather than maize, as the key ingredient in the rise of sociopolitical economies in the Early Formative period prior to ca. 1000 B.C. In the Sierra de los Tuxtlas, Arnold (2000) has identified an emphasis on nonagrarian strategies during the Early Formative period. By the Late Formative period, however,

subsistence strategies in the Sierra de los Tuxtlas had shifted to maize agriculture (Vanderwarker 2006). Our increased recognition of the wide variety of subsistence strategies employed by pre-hispanic populations in the southern Gulf Lowlands has led Stark (2000:38-9) to suggest that access to the fertile levee lands in the area may not have been as important in the development of socio-political hierarchies during the Formative period as previously thought. At the same time, field canalization and/or platforming, constituting "patterned wetlands", also may have been developed to mitigate the cycle of flooding and drought, thus providing another subsistence strategy in this riverine environment.

While this discussion has focused on the development of socioeconomic complexity during the Formative period, a need for mitigating seasonal flooding would have been as relevant in the subsequent Classic and Post-Classic periods as well, when regional populations increased throughout much of the southern Gulf Lowlands (Stark and Arnold 1997). Although Palo Errado appears to have had a small occupation during the Late to Terminal Formative, its primary occupation was during the Early, and possibly Late Classic periods (Knight 1999). At the nearby, regional center of Tres Zapotes a pattern of settlement contraction appears to have occurred during the Early Classic period. Nonetheless, a substantial population remained at the site during this time (Pool and Ohnersorgen 2003).

Recently, remnant patterned wetlands have been identified in Central Veracruz at Buenavista near Boca del Río (Daneels 2002:122-125), along the southeast edge of Lago Mandinga (Heimo et al., 2004), at the mouth of the Papaloapan River and along the lower reaches of the Río Blanco in the Mixtequilla (Stark and Arnold 1997:13), in the San Juan River basin (Siemens 1983a, 1998; Siemens et al. 1988; Sluyter and Siemens 1992), in Northern Veracruz in the Nautla River Basin (Siemens 1983b), and near the Totonac capital of Zempoala (Wilkerson 1983). These patterns match the description of drained fields and associated canals used for intensive agriculture identified in the southern Maya lowlands (Siemens and Puleston 1972; Turner and Harrison 1983). The wetland patterns identified in the San Juan and Nautla River basins, as well as those near Zempoala, are believed to have been constructed and used during the Early Classic and Post-Classic periods (Siemens 1983b, 1998; Wilkerson 1983).

Considering the similar topography and hydrological regime of the neighboring southern Gulf Lowlands, it is curious why similar wetland patterns have not been identified there. In fact, Siemens (1998:34) has stated that: "There is no reason to believe that the prehistoric inhabitants of the Southern Gulf Lowlands were not aware of techniques developed to the east and west of them for the modification and more intensive use of swampy terrain."

I carried out a combination of aerial reconnaissance and ground survey in the spring of 2005 to determine the nature of possibly wetland patterning identified in the immediate vicinity of the Late Formative to Early Classic period site of Palo Errado in the southern Gulf Lowlands of Veracruz, México.

Background

Palo Errado is located 10 km southwest of the epi-Olmec site of Tres Zapotes, in the municipality of Santiago Tuxtla, Veracruz, México (Figure 2, shown below). This mounded archaeological site sits on the eastern levee of the Río Zapotal, which is the eastern-most branch of the Río San Juan. The Río San Juan that passes near Palo Errado should not be confused with the river of the same name located in Central Veracruz, northwest of Veracruz City, which has been the focus of several intensive studies on wetland patterning (Siemens 1983a, 1998; Siemens et al. 1988; Sluyter 1995; Sluyter and Siemens 1992). This southern Río San Juan drains the northern slopes of the Sierra de Juárez of Oaxaca, south of the Sierra de los Tuxtlas before it meanders northwest to eventually join the Río Papaloapan drainage system at the city of Tlacotalpan.

Palo Errado lies at the boundary of the Papaloapan River drainage system to the west, and the foothills of the Sierra de los Tuxtlas to the east (see Figure 2, below). As such, it avoids the worst of the seasonal volatility of the Papaloapan River and its major tributaries, which otherwise would have hampered the production and maintenance of pre-hispanic wetland agricultural systems (Siemens 1998: 33-4). The lower velocity and load bearing drainages in the vicinity of Palo Errado provide suitable "micro-environments" conducive to wetland agriculture. Siemens (1989:9) has characterized these "micro-environments" as occurring at environmental ecotones that "provided a store of moisture that could be tapped in the dry season and [where] the flooding across them in the wet season was usually benign." Other examples of patterned wetlands have been identified in similar "micro-environments" along the lower reaches of the Río Blanco, a tributary of the Papaloapan River in the Mixtequilla (Stark and Arnold 1997:13-4), and in the San Juan River basin of Central Veracruz (Siemens 1983a, 1998; Siemens et al. 1988; Sluyter and Siemens 1992).

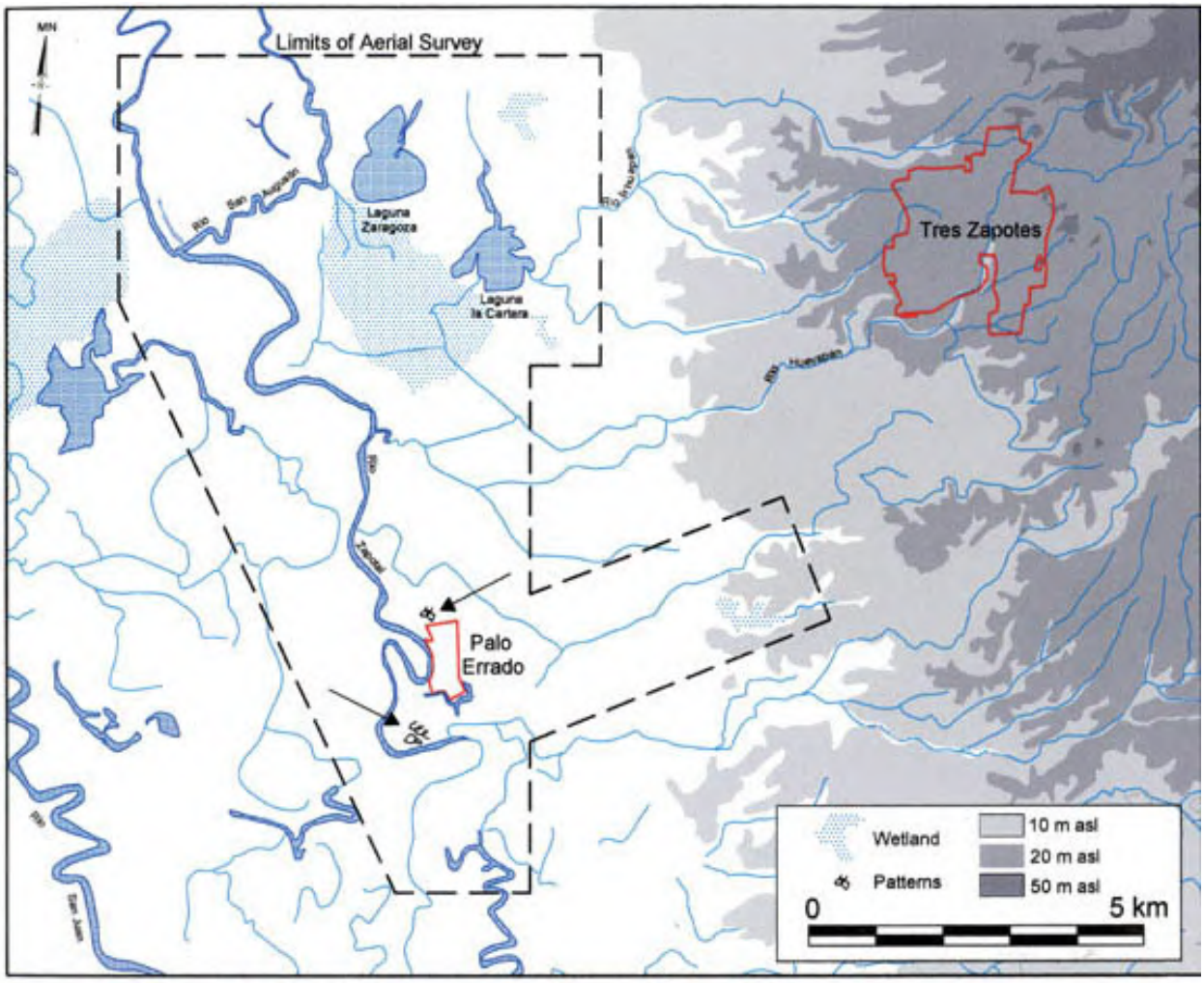

Figure 2. Map showing the location of the Palo Errado Wetland Mapping Project, Veracruz, México, and possible patterns identified on INEGI aerial photograph.

Two zones of geometric topographic patterning were observed on the 1:50,000 vertical aerial photograph from the Instituto Nacional de Estadística Geografía e Informática (INEGI), in the 30 x 30 km block that includes Palo Errado (see Figure 2). One zone was located just north of the limits of a surface survey I conducted in 1997 (Knight 1999), in a low-lying area off the levee top; an area that is now planted in sugar cane. The second zone was located to the southwest of the survey limits in a grassland swamp.

In order to determine the nature of these topographic patterns, and investigate the possibility of additional patterning in the greater Palo Errado area, a project combining aerial and surface reconnaissance was proposed. A program of low altitude, oblique photodocumentation would comprise the aerial reconnaissance. If the aerial reconnaissance confirmed the presence of patterned wetlands, or identified additional wetland patterning, then would be systematically field checked to differentiate cultural from natural patterns. All cultural features would be mapped and measured on the

ground. In addition, all mound groups and surface artifact scatters in the vicinity of the patterned wetlands and Palo Errado would be mapped to better understand the association of settlements to the patterned wetlands, and the association between settlements.

Methods

Aerial Reconnaissance

The aerial reconnaissance of the Palo Errado area was carried out during the first week of February 2005. The methods used in the aerial reconnaissance benefited greatly from suggestions and advice given to me by Alfred Siemens (personal communication 2004).

A Cessna 182 was chartered from *Fly Over México* in México City. The Cessna 182 series has a raised wing providing an unobstructed view of the landscape. In addition, the passenger window can be open in-flight, thus avoiding possible impediments such as window glare and/or dirt that might affect the interpretation of the aerial photographs. Where possible, Siemens (1998 and personal communication) has championed the style of light aircraft that allow the door to be open while flying. While this technique facilitates the taking of larger, unobstructed panoramic photographs, it also drastically raises the utter terror per photograph ratio.

Three return flights, originating from the Veracruz City airport, were made to the Palo Errado study area over the course of one day. Each flight followed a 200 km return route from Veracruz City that crossed the Laguna Mandinga, the Cotaxtla River basin, and the extensive lowlands of the Papaloapan drainage basin including the Mixtequilla cultural zone. Once the Palo Errado study area was reached, the plane would circle around the greater site area covering approximately 7,200 ± hectares (ha), which also included several tributaries of the Río San Juan and two shallow lakes, located 5 km northeast of Palo Errado (see Figure 2). Oblique aerial photographs were taken from within this area. Flights were carried out mid-morning, early afternoon and late afternoon in order to capture the changing effects of light and shade on the landscape. The study area was reconnoitered at an altitude of 300 m (1,000 ft) for topographic detail, and at 1,200-1,500 m (4,000-5,000 ft) for topographic context. In total, slightly more than 400 oblique aerial photographs were taken of this 7,200 ± ha area.

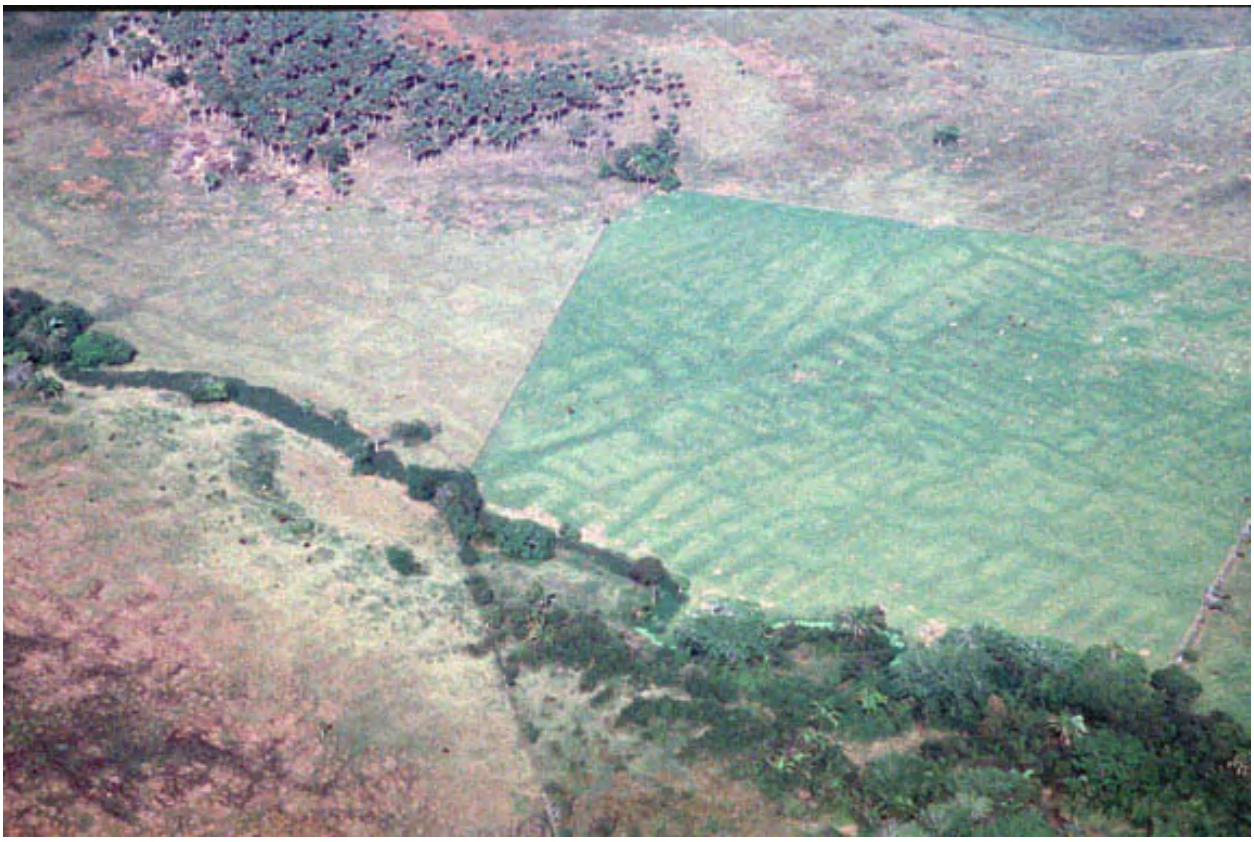

Figure 3. Patterned Wetlands bordering the Laguna Mandinga in central/south Veracruz, México. Northeast is at the top.

Predetermined Latitude/Longitude coordinates were critical in locating the study zone from the air, utilizing the Cessna's on-board Global Positioning System (GPS). Oblique aerial photographs were taken in color, using 400 ISO Fujichrome Provia slide film. In addition, the entire flight path was digitally video recorded with a mini-DV video camera mounted on a tripod on the back seat of the plane. The video of the flight path became a key element in orienting the oblique aerial photographs in space after they were developed.

While crossing the Laguna Mandinga during the second and third flights, the vast system of patterned wetlands associated with its eastern, southeastern, and southern margins were clearly visible (Figure 3, shown above). These extensive wetland patterns were originally recognized from the air by A. Siemens in the mid to late 1970s (Heimo *et al.* 2004; Siemens 1998:8), and have since been studied archaeologically in some detail (Heimo *et al.* 2004). The benefit for the current study of identifying these from 1,500 m (5,000 ft) in the air is that it confirmed that we could, in fact, detect such patterns and provided a template for what to look for in the Palo Errado study area.

Results of Aerial Reconnaissance

A detailed analysis of the oblique imagery, and the digital video indicated that the original patterns observed in the 1:50,000 vertical aerial photograph had either been obliterated due to recent agricultural activities, or never existed. In addition, no extensive rectilinear network of wetland patterns, as had been seen around Laguna Mandinga, or linear canal features were identified anywhere within the 7,200 ± ha area under study. Nonetheless, three relatively small, previously unidentified zones of possible wetland patterning were identified.

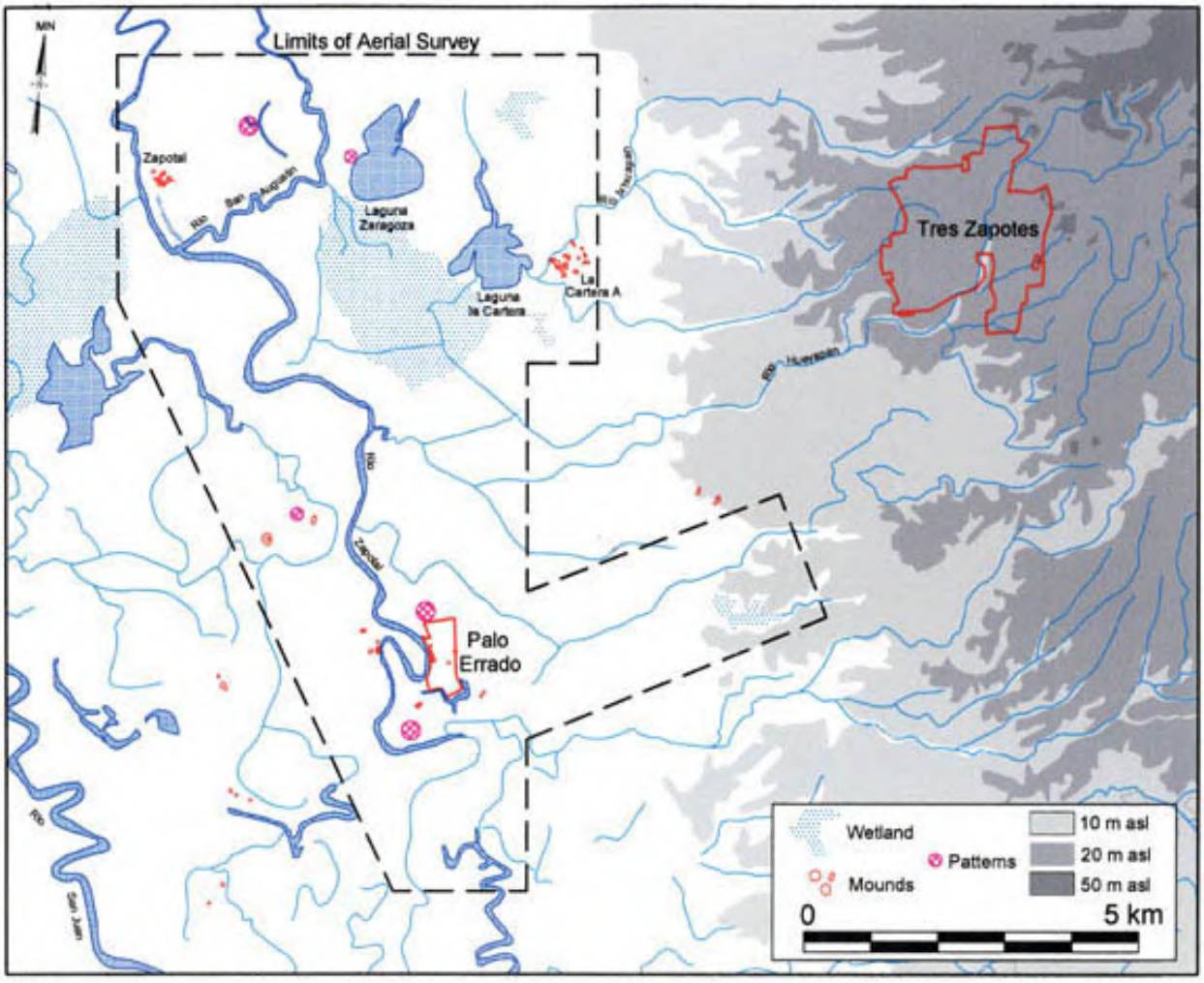

Figure 4. Map showing the location of patterns and mound groups in relation to Palo Errado and Tres Zapotes.

These three zones of patterning were not located in the immediate vicinity of Palo Errado, but rather were located 2.5–8 km north of the site (Figure 4, shown above). The smallest pattern was identified along the north margin of the Laguna Zaragoza, the northern-most of two shallow lakes located 5 km northeast of Palo Errado (Figure 5, shown below). This small pattern conformed to the typical rectilinear, or figure-8, shape

of other pattern wetlands in Veracruz, but did not appear to be connected to a larger network of such patterns.

Figure 5. Oblique aerial photograph of low lying pattern between a wetland and the edge of the Laguna Zaragoza in the center of this photograph. Northeast is at the top.

Another small zone of patterning was identified next to a tributary of the Río La Cocina, which drains into the Laguna Mata de Chile to the west (Figure 6, shown below). This pattern was comprised of three or four crisscrossing lines.

Figure 6. Oblique aerial photograph of linear pattern along the edge of a small drainage in the left bottom corner of this photograph. View is looking northeast.

Finally, the largest zone of patterning was located along the west edge of a former branch of the Río San Augustín (Figure 7, shown below). Patterns were well defined, but did not conform to the expected rectilinear shape, as seen along the margins of Laguna Mandinga, and as identified in Central Veracruz (Sluyter and Siemens 1992; Siemens 1998). They resembled, somewhat, the linear lines radiating away from modern river channels that Siemens (1998:18) has suggested represent pre-hispanic fisheries. However, the systematic grid layout of the ones observed is more suggestive of a recent, historic manufacture. Although it appeared from the air that these might have represented the remains of modern, deeply plowed furrows, a comparison with obvious plow furrows in the adjoining parcel to the south indicated that this was not the case. The observed linear patterns were spaced approximately five furrow's width apart, when compared to adjoining fields (see Figure 7). Images from the video of this flight indicated that similar linear patterns also covered several parcels to the southeast associated with a large wetland.

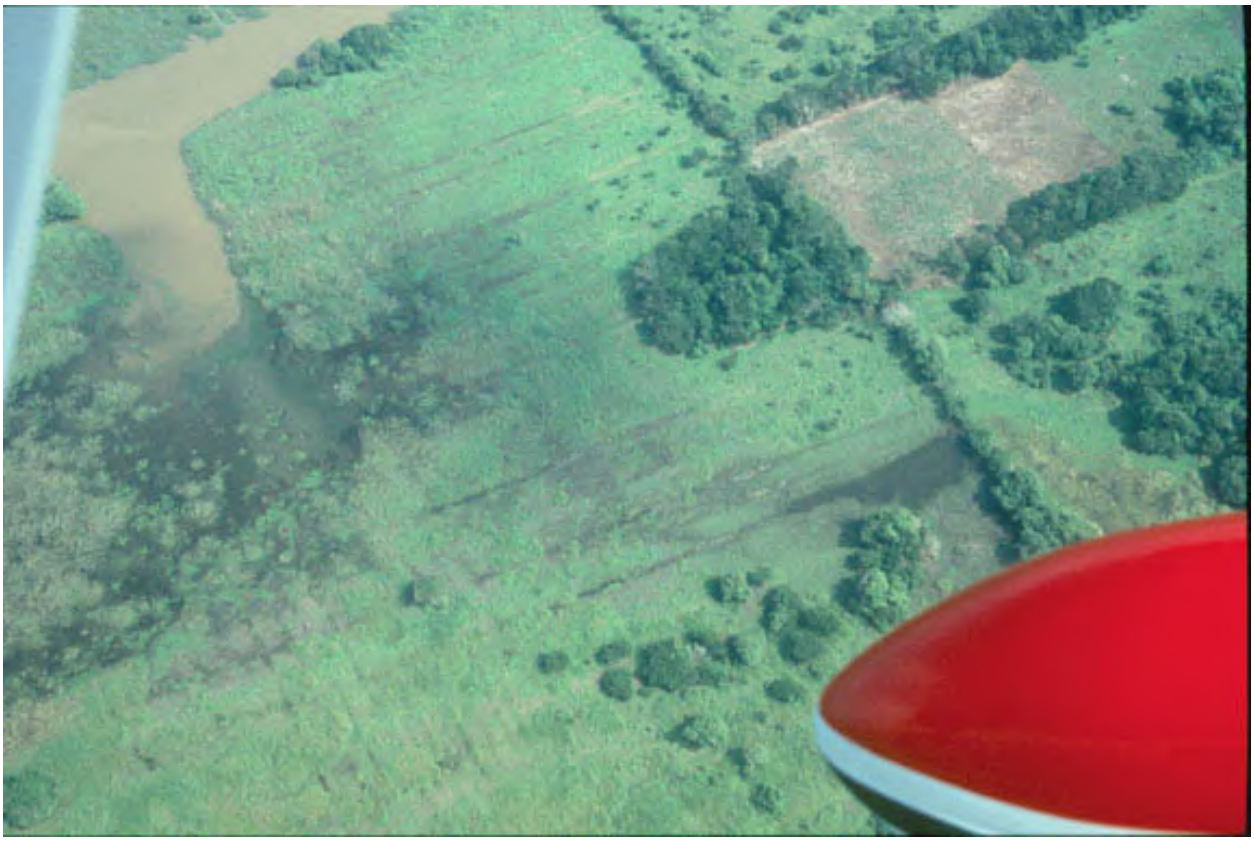

Figure 7. Oblique aerial photograph of linear patterns near a former channel of the Río San Augustín, in the center of this photograph. South is at top of photograph.

Mounded Pre-hispanic Sites

An unexpected, but not surprising, result of the aerial reconnaissance was the identification of two, large mounded pre-hispanic sites, and several isolated platform mounds within the study area (see Figure 4). Named after the near-by lake, La Cartera was the largest of the mounded sites identified. It is located along the southeast banks of the shallow Laguna la Cartera, at the confluence of the Río Ixhuapán and an unnamed stream that drains the northern portion of the site of Tres Zapotes, 5 km to the east (see Figure 4). This site had previously been identified during the Proyecto de Salvamiento Arqueológico "Jimba 3D", an extensive surface survey of the area conducted by INAH in the mid to late 1990s ahead of boring by Petróleos Mexicanos (PEMEX) (León Pérez 2002). During the Jimba 3D project, three sites in the general area of Laguna la Cartera were identified and labeled La Cartera A, B, and C. The mounded site core identified from the air corresponds to the Jimba 3D site of La Cartera "A".

Figure 8. Oblique aerial photograph showing the mounded site center of La Cartera "A" and modified harbor area. View is looking east.

At the time of the flight, seasonal flooding had defined a culturally modified harbor along the southwestern edge of the site, closest to the largest earthen platforms (Figure 8, shown above). This would have made water borne access to both the Laguna la Cartera and Laguna Zaragoza, and all points north and west through various connected streams, relatively easy during the rainy season.

The site of El Zapotal was identified to the northwest of the Laguna Zaragoza, on a levee associated with the Río Zapotal, immediately north of where it branches off to form the Río San Augustín (see Figure 4). Several other isolated mound groups were identified in the vicinity of Palo Errado, along the Río Largo southeast of Palo Errado, as well as near the Lagunas Zaragoza and La Cartera.

Surface Reconnaissance

The wetland patterning and mound groups observed from the air were field inspected, mapped and measured in March and April 2005. As it has been observed by others (Sluyter and Siemens 1992:151; Stark and Arnold 1997:13), the difficulty of locating low-relief topographic features on the ground, initially observed from the air cannot be overstated, and often are difficult to identify from standard, vertical aerial photographs (Siemens 1983a:92, 1998:4). In this regard, fence-lines, cattle paths and any other

modern cultural modification provided invaluable reference points for the surface inspection of these wetland patterns.

The opportunity to test the nature of the identified surface patterns through subsurface excavation was repeatedly hampered due to the inability to obtain landowner permission. As was often the case, landowners were not local residents, their identities known only by the few individuals who were either renting rights to graze the land, or looking after the landowner's cattle. In the rare event that a landowner's name was obtained, tracking them down in either Tres Zapotes, or in one of the larger towns in the nearby Sierra de los Tuxtlas proved impossible. As a result, interpretations of the nature of the patterns and their history relied on surface inspections, background research, and discussions with other researchers.

Upon surface inspection of the figure-8 shaped area located along the northwestern margins of Laguna Zaragoza, the lack of any topographic relief, and evidence of a water channelization between the Laguna Zaragoza and the large, shallow wetland to the west, strongly suggest a natural origin for this pattern.

The smaller pattern associated with a tributary of the Río La Cocina, was covered in seed cane at the time of surface inspection. Since the cane was in existence during the aerial reconnaissance, it is likely that the patterns observed were the result of the planted cane, rather than topographic variations.

Figure 9. A view of one of the patterned depressions or channels, and adjoining elevated areas. View is looking north towards the swamp and Oxbow Lake.

Finally, the largest area of potential patterning, along the west edge of an ancient branch of the Río San Augustín was surface inspected and mapped. A series of linear depressions, ranging from 0.5–2 m in width were interspersed by raised areas 10-20 m in width (see Figure 7). The difference in elevation between the depressions and raised areas was 30-50 cm (Figure 9, shown above). These depression/raised earth complexes were oriented between 357°–359° E of magnetic north, trending north-south (Figure 10, shown below). These were crisscrossed by similar canals and raised areas in the west of the parcel, which were oriented 85° E of magnetic north. The regular orientation of the canals parallel to modern parcel boundaries suggests they are not pre-hispanic. Siemens (1998:97, and personal communication 2005) suggested they are the products of mechanical dry season cropping activities, or *tonalmil*, as he has observed similar patterning elsewhere. However, they do not appear to be remnant agricultural furrows, since their width is much larger than modern examples observed in a neighboring parcel. Perhaps the wide, linear canals observed in this parcel functioned as a form of wet season drainage, permitting cropping on the wide "raised areas" in between. This would be in-line with what Siemens (1998:97, and personal communication 2005) has noticed in terms of modern strategies of flood-recessional agriculture paralleling those of the pre-hispanic past. Discussions with local cattle ranchers did not shed light onto the history or purpose for these patterns, and landowner permission could not be obtained to investigate their nature with subsurface excavation pits.

Figure 10. Schematic map of the orientation and location of the linear patterns observed near the Río San Augustín, Municipio of Santiago Tuxtla, Veracruz, México.

Mounded Site Inspections

La Cartera "A"

La Cartera "A" is the largest mounded site identified from the air, is located along the southeastern banks of the Laguna la Cartera, at the confluence of the Río Ixhuapán and an unnamed stream (see Figure 4). The limits of La Cartera "A" cross the modern boundaries of at least four properties. Since modern land-use activities between these four properties differ, the amount of vegetation on each parcel varied. As a result, some low-lying mounds may not have been identified during my mapping of the site.

In total, I mapped 25 earthen mounds, ranging in height from 1–10 m, covering an area approximately 25 ha in size (see Figure 4). The Jimba 3D project identified 28 mounded structures (León Pérez 2002). At least three plazas were identified within the site core, associated with two seasonally inundated bajos. The limits of the site are defined by larger wetlands to the south, west and north. The Río Ixhuapán appears to define the eastern limits of the site core; however the area to the east of the Río Ixhuapán was not surveyed due to the density of vegetation.

Figure 11. Earthen mound at La Cartera "A" bisected by modern trench cut. View is looking west.

One mound located within the largest plaza along the western margin of the site bore the remains of a 2 m wide trench cut through its center at some point in the recent past

(Figure 11, shown above). The trench scar was readily visible from the air (see Figure 9). A caretaker from a neighboring parcel informed me that crews from PEMEX had been excavating in the general vicinity at some point in the recent past, and therefore this trench cut may have been a result of those PEMEX activities.

Only half a dozen ceramic sherds were identified from the surface of La Cartera "A," most associated with the trench cut. All sherds recovered were Fine Orange ware, a local diagnostic of the Early Classic period, although they are not uncommon in Late Formative and Late Classic period contexts. An Early Classic period occupation corresponds to the initial observations made by León Pérez during the Jimba 3D survey (2002). No other temporally diagnostic artifacts were recovered from the surface of the site.

Figure 12. Largest of the earthen mounds at the site of Zapotal, Veracruz, México. View is looking east towards the Sierra de los Tuxtlas.

El Zapotal

The site of El Zapotal, named after the near-by village, is located on the levee of an ancient arm of the Río El Zapotal, which defines the eastern limits of the site. These levees comprise the only elevated, and therefore permanently dry, landforms in the general area. Beyond this levee, a large, seasonally inundated wetland extends in all directions.

Figure 13. Looking east at the eroding profile of the site of Zapotal, near the confluence of the Ríos Zapotal and San Augustín, Municipio of Santiago Tuxtla, Veracruz, México. View is looking south.

In total, nine mounds ranging in height from 1–5 m were identified (Figure 12, shown above). A seasonally inundated bajo is located at its center. A portion of the site, and the levee platform it sits upon, has been excavated away in the recent past, likely as part of the construction of an adjacent causeway. As a result, a large profile of the site was exposed (Figure 13, shown above). Two living surfaces consisting of ceramic sherds, obsidian prismatic blades, *chapapote* (bitumen), and *barro quemado* (burnt clay) were identified in the exposure (Figure 14, shown below). The oldest living surface was located approximately 1 m below the surface, while the younger living surface was located approximately 1.5 below the surface. Ceramics identified in both living surfaces included fine orange and fine grey wares, some with decoration (Figure 15, shown below). The prismatic blade fragments that were identified were all of black obsidian, likely representing the Zaragoza-Oyemelas obsidian source material. No blade production debitage was identified. Based on the ceramic and obsidian types identified eroding out of the exposure, it appears that both living surfaces date to the Early to Late Classic periods. No diagnostic Formative period sherds were recognized.

Figure 14. Two occupation strata eroding out of cut in Zapotal site.

Figure 15. Decorated fine orange ceramic sherd diagnostic of the Classic period, which eroded out of an exposed profile of the Zapotal site.

Summary and Conclusions

An aerial and surface reconnaissance was carried out across an approximately 7,200 hectare area surrounding the Late Formative to Early Classic period site of Palo Errado in southern Veracruz, México, in order to investigate the surficial wetland patterning identified on a vertical INEGI 1:50,000 aerial photograph of the area. Larger systems of similar patterning have been observed and investigated elsewhere in Veracruz and determined to have functioned as either water retention systems in the dry season or water dispersal systems in the wet season, or a combination of the two; all related to pre-hispanic agricultural systems.

The patterning visible on the vertical INEGI 1:50,000 aerial photograph of the Palo Errado area was not visible during the aerial reconnaissance carried out as part of this project. The original patterns have either been destroyed through modern land use practices, since the INEGI aerials were taken in the 1960s, or, more likely, the patterns originally observed did not represent wetland patterning related to pre-hispanic agriculture, but rather natural channel scarring and infilling.

Although no patterning typical of pre-hispanic wetland agricultural systems known elsewhere in Veracruz were identified within the study zone, three small and discrete zones of patterning were identified associated with existing wetlands. These three zones of patterning were investigated in greater detail through surface reconnaissance and determined not to be pre-hispanic, but rather, are the result of modern land use practices, such as dry season cropping. Although the largest cluster of linear patterning is unlikely to be pre-hispanic in age, the width of canals and "raised areas" in between suggest something more than just the remnant markings of modern plow scarring. It is possible that these observed patterns reflect a modern attempt at field drainage to create serviceable cropping surfaces during the wet season.

One corollary of the aerial and surface reconnaissance surveys was the identification and mapping of several mounded pre-hispanic period sites, several of which date at least to the Early and Late Classic periods. These ranged in size from sites represented by a single raised earthen platform, to the large site of La Cartera "A," which contained over 30 large earthen mounds and platforms surrounding plazas and bajos. The identification of these sites is an important first step in reconstructing the settlement system located between the slopes of the Sierra de los Tuxtlas and the Papaloapan drainage in the vicinity of the epi-Olmec site of Tres Zapotes.

In sum, it appears that a strategy of raised or drained wetland agriculture was not practiced in the southern Gulf lowlands near the site of Palo Errado, between the eastern edge of the Río San Juan basin and the foothills of the Sierra de los Tuxtlas. While the nature and organizational mechanisms of the subsistence strategies in this area are not yet clear, it does appear, at least, that the annual cycle of flooding and subsequent desiccation did not disrupt the subsistence strategies enough to necessitate a means of mitigating their effects.

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List of Figures

Figure 1. Map showing the location of the Palo Errado Wetland Mapping Project Area in southern Gulf Lowlands of Veracruz and Tabasco, México.
Figure 2. Map showing the location of the Palo Errado Wetland Mapping Project, Veracruz, México, and possible patterns identified on INEGI aerial photograph.
Figure 3. Patterned Wetlands bordering the Laguna Mandinga in central/south Veracruz, México. Northeast is at the top.
Figure 4. Map showing the location of patterns and mound groups in relation to Palo Errado and Tres Zapotes.
Figure 5. Oblique aerial photograph of low lying pattern between a wetland and the edge of the Laguna Zaragoza in the center of this photograph. Northeast is at the top.
Figure 6. Oblique aerial photograph of linear pattern along the edge of a small drainage in the left bottom corner of this photograph. View is looking northeast.
Figure 7. Oblique aerial photograph of linear patterns near a former channel of the Río San Augustín, in the center of this photograph. South is at top of photograph.
Figure 8. Oblique aerial photograph showing the mounded site center of La Cartera "A" and modified harbor area. View is looking east.
Figure 9. A view of one of the patterned depressions or channels, and adjoining elevated areas. View is looking north towards the swamp and Oxbow Lake.
Figure 10. Schematic map of the orientation and location of the linear patterns observed near the Río San Augustín, Municipio of Santiago Tuxtla, Veracruz, México.
Figure 11. Earthen mound at La Cartera "A" bisected by modern trench cut. View is looking west.

Figure 12. Largest of the earthen mounds at the site of Zapotal, Veracruz, México. View is looking east towards the Sierra de los Tuxtlas.
Figure 13. Looking east at the eroding profile of the site of Zapotal, near the confluence of the Ríos Zapotal and San Augustín, Municipio of Santiago Tuxtla, Veracruz, México. View is looking south.
Figure 14. Two occupation strata eroding out of cut in Zapotal site.
Figure 15. Decorated fine orange ceramic sherd diagnostic of the Classic period, which eroded out of an exposed profile of the Zapotal site.

Sources Cited

Arnold, Philip J. III
2000 "Sociopolitical Complexity and the Gulf Olmecs: A View from the Tuxtla Mountains, Veracruz, México." In *Olmec Art and Archaeology in Mesoamerica*. John E. Clark and Mary E. Pye (editors), pp. 117-136 National Gallery of Art, Washington.

Borstein, Joshua A.
2001 *Tripping over Colossal Heads: Settlement Patterns and Population Development in the Upland Olmec Heartland*. Ph.D. dissertation, Department of Anthropology, Pennsylvania State University. Ann Arbor, University Microfilms.

Coe, Michael D.
1981 "Gift of the River: Ecology of the San Lorenzo Olmec." In *The Olmec and Their Neighbors: Essays in Memory of Matthew W. Stirling*, edited by Elizabeth P. Benson. Dumbarton Oaks Research Library and Collections. Washington D.C.

Coe, Michael D., and Richard A. Diehl
1980 *The People of the River. Vol. 2 of In the Land of the Olmec*. University of Texas Press, Austin.

Daneels, Annick
2002 *El patrón de asentamiento del periodo Clásico en la cuenca baja del río Cotaxtla, centro de Veracruz*. Tesis de doctorado, Facultad de Filosofía y Letras, Universidad Nacional Autónoma de México.

Heimo, Maija, Alfred. H. Siemens, and Richard Hebda
2004 "Prehispanic Changes in Wetland Topography and their Implications to Past and Future Wetland Agriculture at Laguna Mandinga, Veracruz, México." In *Agriculture and Human Values* 21:313-327.

Knight, Charles L.F.
1999 *The Late Formative to Classic period obsidian economy at Palo Errado, Veracruz, México*. Ph.D. dissertation, Department of Anthropology, University of Pittsburgh. Ann Arbor, University Microfilms.

León Pérez, Ignacio
2002 *Jimba 3D. Primera y Segunda Fase: Rescate Arqueológico realizado en Estudios Sismológicos*. Archivo Técnico INAH. México.

Pool, Christopher A., and Michael A. Ohnersorgen
2003 "Archaeological Survey and Settlement at Tres Zapotes." In *Settlement Archaeology and Political Economy at Tres Zapotes, Veracruz, México,* edited by Christopher A. Pool. pp. 7-31. UCLA Institute of Archaeology Occasional Papers. Monograph 50.

Rust, William F. III, and Robert J. Sharer
1988 "Olmec Settlement Data from La Venta, Tabasco, México." In *Science* 242:102-104.

Rust, William F. III, and Barbara Leyden
1994 "Evidence of Maize Use at Early and Middle Preclassic La Venta Olmec Sites." In *Corn and Culture in the Prehistoric New World*, ed. Sissel Johannessen and Christine Hastorf, pp. 181-201. Boulder.

Siemens, Alfred H.
1983a "Oriented Raised Fields in Central Veracruz." In *American Antiquity* 48:85-102.
1983b "Modelling Prehispanic Hydroagriculture on Levee Backslopes in Northern Veracruz, México." In *Drained Field Agriculture in Central and South America*, edited by J.P. Darch, pp. 27-54. BAR International Series 189, Oxford.
1998 *A Favored Place. San Juan River Wetlands, Central Veracruz, A.D. 500 to the Present*. University of Texas Press, Austin.

Siemens, Alfred H., and Dennis. E. Puleston
1972 "Ridged Fields and Associated Features in Southern Campeche: New Perspectives on the Lowland Maya." In *American Antiquity* 37(2):228-239.

Siemens, Alfred H., Richard J. Hebda, Mario Navarrete Hernández, Dolores R. Piperno, Julie K. Stein, and Manuel G. Zola Baez
1988 "Evidence for a Cultivar and a Chronology from Patterned Wetlands in Central Veracruz, México." In *Science* 242:105-107.

Sluyter, Andrew
1995 *Changes in the Landscape: Natives, Spaniards, and the Ecological Reconstruction of Central Veracruz, México during the Sixteenth Century*. Ph.D. Dissertation, University of Texas at Austin. Ann Arbor, University Microfilms.

Sluyter, Andrew, and Alfred H. Siemens
1992 "Vestiges of Prehispanic, Sloping-field Terraces on the Piedmont of Central Veracruz, México." In *Latin American Antiquity* 5(4):312-332.

Stark, Barbara L.
1977 "Prehistoric Ecology at Patarata 52, Veracruz, México: Adaptations to the Mangrove Swamp." In *Vanderbilt University Publications in Anthropology 18*. Vanderbilt University, Nashville.
1978 "An Ethnohistoric Model for Native Economy and Settlement Patterns in Southern Veracruz, México." In *Prehistoric Coastal Adaptations: The Economy and Ecology of Maritime Middle America*, edited by B.L. Stark and B. Voorhies, pp. 211-238. Academic Press, New York.
2000 "Framing the Gulf Olmecs." In *Olmec Art and Archaeology in Mesoamerica*. John E. Clark and Mary E. Pye (editors), pp. 31-53. National Gallery of Art, Washington.

Stark, B.L., and Philip J. Arnold III
1997 "Introduction to the archaeology of the Gulf lowlands." In *Olmec to Aztec: Settlement Patterns in the Ancient Gulf Lowlands*, B.L. Stark and P.J. Arnold III (eds.), The University of Arizona Press, Tucson, Arizona, pp. 3-32.

Turner II, B.L. and Peter D. Harrison (eds)
1983 *Pulltrouser Swamp. Ancient Maya Habitat, Agriculture, and Settlement in Northern Belize*. University of Texas Press, Austin.

Vanderwarker, Amber M.
2006 *Farming, Hunting, and Fishing in the Olmec World*. University of Texas Press, Austin.

Wilkerson, S. Jeffrey K.
1983 "So Green and Like a Garden: Intensive Agriculture in Ancient Veracruz," In *Drained Field Agriculture in Central and South America*, edited by J.P. Darch, pp. 55-90. BAR International Series 189, Oxford.