Anais da Academia Brasileira de Ciências (2013) 85(1): 415-429
(Annals of the Brazilian Academy of Sciences)
Printed version ISSN 0001-3765 / Online version ISSN 1678-2690
www.scielo.br/aabc

Fishing strategies among prehistoric populations at Saquarema Lagoonal Complex, Rio de Janeiro, Brazil

MÁRCIA B. GUIMARÃES

Programa de Pós-Graduação em Arqueologia, Departamento de Arqueologia, Universidade Federal de Sergipe, Campus de Laranjeiras, Rua Samuel de Oliveira, s/n, Centro, 49170-000 Laranjeiras, SE, Brasil

Manuscript received on October 26, 2011; accepted for publication on July 17, 2012

ABSTRACT

Two distinct fishing technologies were identified among the shellmound builders of the Saquarema Lagoonal Complex, in the Brazilian state of Rio de Janeiro: bone point technology and worked fish spines. These technologies were related to the acquisition of specific fish resources; Worked fish spines were used in the capture of *Micropogonias furnieri* (Desmarest), and bone points used for fishing specimens of the Ariidae family. Worked spines technology was predominant between 6,726 cal. years BP and 3,699 cal. years BP, while the bone point technology was dominant after 3,699 cal. years BP. It is believed these different strategies for obtaining fishing resources before 3,699 years cal. BP was related to environmental. Notably the gradual regression of relative sea level occurred during the mid- and late Holocene.

Key words: subsistence resources, fishing strategies, shellmound, Holocene.

INTRODUCTION

Archaeology has always been associated with environmental studies since the 19th century (see Trigger 1992). However, it is only since the latter half of the 20th century that archaeologists have explicitly designed projects and field methods (e.g., flotation, pollen and phytolith analysis, zoo-archaeology, etc.) to study these relationships (Jochim 1990:75). Following the methodological refinement, theoretical perspectives have rapidly increased in sophistication, in the forms of historical ecology (e.g., Baleé 1998, Crumley 1994), landscape archaeology (e.g., Crumley and Marquardt 1990, Ingold 1993, Tilley 1994), and resilience theory (RT) (e.g., Delcourt and Delcourt 2004, Nelson et al. 2006, Redman 2005, Redman and Kinzig 2003).

Until very recently, most archaeologists have been extremely reluctant to invoke climate changes as an explanation for any of the major changes they have observed in the Holocene archaeological record.

The relationship between cyclical or structural socio-cultural changes and environmental changes has been seen as deterministic heritage from the Cultural Evolutionism in understanding the process of transformation of prehistoric societies. On the other hand, the recent global climate change agenda has influenced a number of archaeologists on paleo-climate studies and their influence on past societies, viewed under the current environmental possibilities of understanding the

E-mail: marcia.segal@terra.com.br

processes of socio-cultural changes, especially in regard to climatic oscillations, geological and geomorphological processes and their effects during the Holocene (Shennan 2005).

Thus, it is possible to observe the expansion of archaeological studies on adaptative strategies and / or technological fronts to paleo-environmental changes in the Holocene, although it should be noted that this issue has always been present in studies of prehistoric hunter-gatherer groups. In fact, the evolutionary paradigms, such as behavioral ecology, evolutionary ecology or selectionism, have dominated the discourse on variability and the change on studies of hunter-gatherers in the last three decades (Bettinger 1991, Binford 2001, Kelly 1995).

In the case of holocenic fishermen-gatherer groups, the studies have incorporated the hunter-gatherer model, derived from the ethnographic assumptions contained in the "Man, the Hunter" model (Barbosa 2003, De Masi 2001).

In the 80s, some critics of this view such as Pálsson (1988), Perlman (1980), Renouf (1988) and Yesner (1980), sought to understand the coastal adaptations from vectors related both to the marine productivity and the environmental stability after the Climatic Optimum that would have given conditions to increase exploration, considering the abundance and the predictability of the marine resources (Yesner 1980).

In relation to environmental changes during the Holocene, it is known that the fluctuations in the relative sea level, associated with climatic factors, have consistently contributed to the availability and frequency of the coastal aquatic resources (De Masi 2001, Erlandson 2001, Thomson and Turck 2009, Thomas 2008). However, I agree with Thomson and Turck (2009), when they observe that coastal populations returned to the structural pattern, similar to the one expressed before the environmental changes. This capacity is due to the high visibility of past behaviours, registered in the landscape in the form of shellmounds.

The idea of shellmounds as a room for social and ancestral memory has been developed in Brazil since the 90s (Gaspar and De Blasis 1992, Gaspar 2004). One of its perspectives directly involves the question of the permanence of traits common to groups of fishermen-gatherers, traits that have remained over time, allowing the construction of an identity for these groups, viewed as belonging to a socio-cultural system (Gaspar 1995, 1998). Thus, the habit of building shellmounds would evidence a characteristic that seems to have been fundamental to structure the social identity of shellmounds builders, i.e., a purpose of building a space where "the residents, the dead and the food and industrial waste, are in close association" (Gaspar 1995, p.230).

Given the changes, considering the dynamics of the shellmounds builder's socio-cultural system and the Holocene coastal environment, identity features have survived over time. Here these traits are considered as permanence (structures), elemental traits of mentalities that operate in the field of behavior and that are perpetuated in the long term (Vouvelle 1993). These identity structures resist the changes, but do not prevent them from occurring, only delay them, printing them a so slowly rhythm that they often seem like immovable structures. In this sense, Dias and Carvalho (1995) also emphasize this feature, when addressing the apparent immobility of Itaipu tradition, proposed for the coast of Rio de Janeiro, considering it as a reflection of the traditional aspects of the groups related to it. Being them traditional, they are more visible as opposed to innovative elements.

In the specific case of the shellmound population of Rio de Janeiro coast, both the continuities and the changes have been addressed separately in previous studies, which contributed to an apparent vision of social immobility, translated into emphasis of the traditional aspects of a society and, on the other hand, into a socio-cultural weakness, influenced by the generalizing characteristics of the concept of nomadic bands applied to those groups (see

Barbosa 2003). Furthermore, the study of cultural changes, although focused by the neo-evolutionist school, was devoted to build a single-factor model (the environmental factor).

Fishing Strategies at Holocene

Considering the fishing strategies and the environmental variations caused by the fluctuations of the relative sea level, the studies on fisheries have focused more on the recent Holocene, especially on the coast of California (Bowser 1993a, b, Colten and Arnold 1998, Davenport et aI. 1993, Glassow 1980, Kennett and Kennett 2000, Raab et al. 1995), but less on the middle and early Holocene (Rick and Erlandson 2008).

The capabilities for intensive marine fishing practices were present by at least the Early Holocene, however, the elaboration of fishing technology and the increasing dietary significance of fish over time is the product of several millennia of fishing and technological refinement (Rick and Erlandson 2000, Bowdler 1974).

Some researchers have argued that fishing requires relatively sophisticated knowledge and high technological investments. Experimental work by Limp and Reidhead (1979) suggested, however, that under the right circumstances, riverine fishing could be extremely productive even without complex technologies. Even when more sophisticated technologies are required to capture fish, these do not need to be especially elaborated or expensive to be produced. Dip nets or small tidal weirs, for instance, can greatly facilitate the mass harvest of small fish in truly impressive yields.

A number of cultural ecological studies have modeled the productivity of various fishing activities relative to alternative terrestrial subsistence pursuits (e.g., Osborn 1977, Perlman 1980, Lindstrom 1996).

In Brazil, studies on fishing strategies have been rare and more focused on technological aspects (Beck 1978, Beck et al. 1970, T.C. Franco, unpublished data, Gaspar 2004, Rohr 1977, T.A. Lima, unpublished data) and zoo-archaeological aspects (Figuti 1998, Figuti and Klökler 1996). Evidence shows the existence of hooks in coastal sites, of about 1,400 years ago, on the “Enseada I” site, on the coast of Santa Catarina (Beck 1974) and in Rio de Janeiro (Lima and Silva 1984), and the presence of bone points and worked fish spines has been abundant in some shellmounds since 5,000 years BP (Beck 1978, Beck et al. 1970, Gaspar 2004, Kneip 2001, Lima and Silva 1984, Tenório et al. 2009, Uchôa 2007).

Considering the presence of bone artifacts, notably worked bone points and fish spines, in a set of ten archaeological sites in the Saquarema Lagoonal Complex, in the state of Rio de Janeiro, I sought the relationship between the frequency of these artifacts and fishing debris and the environmental changes, possibly related to the effects of the sea level variation, also supported by the availability of different shellfish resources. Thus, the variation in the frequency of these artifacts was considered as part of technological strategies for obtaining constant and abundant fish, represented by specimens of the Ariidae and Scianidae families, which contributed significantly to the economic stability and the permanent settlement of shellmounds builders in the Saquarema Lagoonal Complex.

Thus, a change in the circumstances relating to the adoption of adaptative strategies occurred during the middle Holocene and did not compromise, alone, the shellmounds builder’s socio-cultural system.

MATERIALS AND METHODS

The Saquarema Lagoonal Complex, this study’s area, is located in the Saquarema County, within the Região dos Lagos, in the State of Rio de Janeiro, Brazil. This region has twenty-three identified archaeological sites, related to fishermen and gatherers and the Tupinambá ceramic ancestral groups (Figure 1).

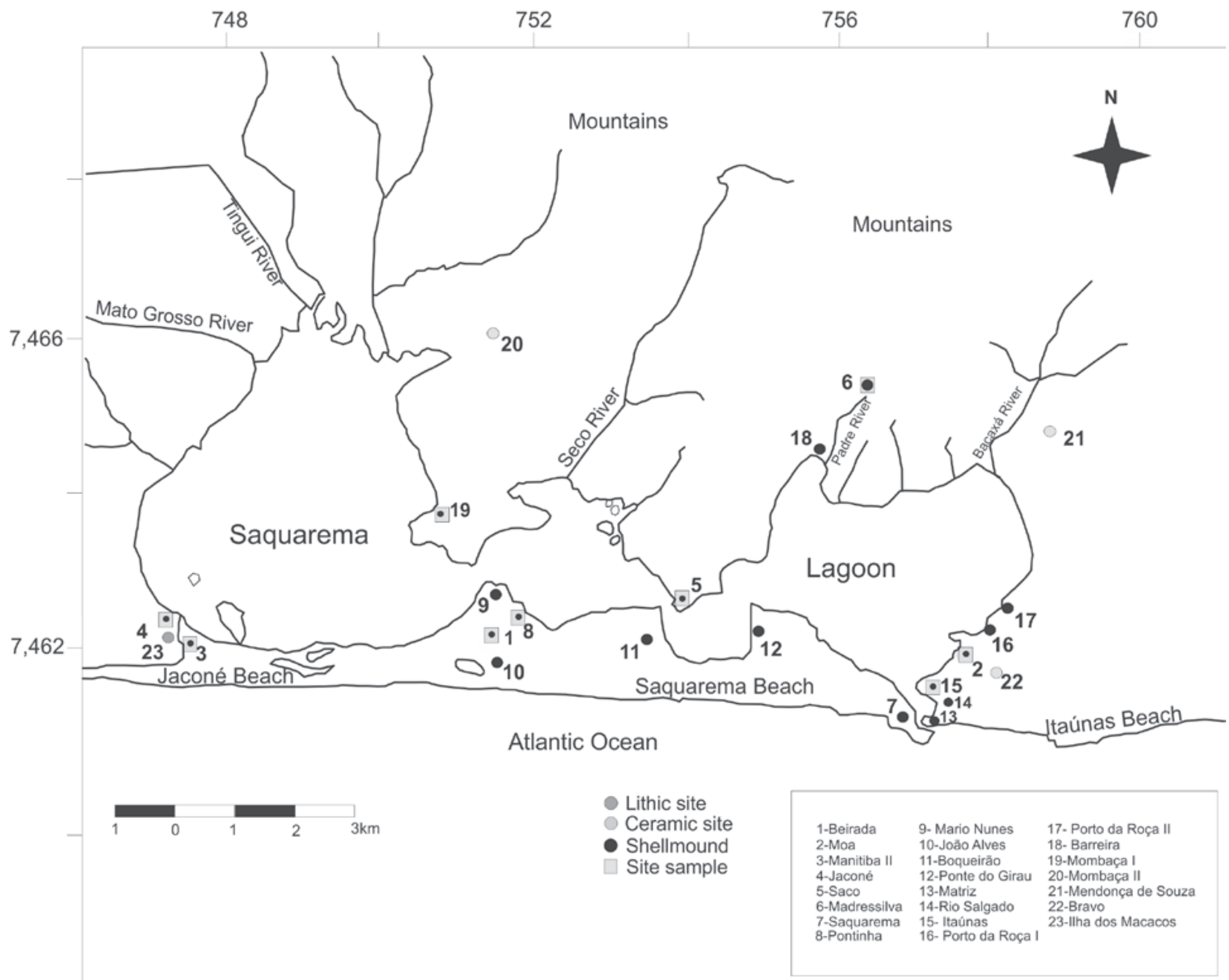

Figure 1 - Map showing the distribution of archaeological sites in the Saquarema Lagoonal Complex. Source: Pages IBGE 23-Z-B-VI-3 and SF-2-B-V-4. Scale 1:50,000.

In the Saquarema Lagoonal Complex, unsystematic archeological researches were conducted in the 60s and 70s (Beltrão and Kneip 1969). However, systematic researches occurred in Beirada shellmound in 1976 (Kneip 1976, 1978); and, thereafter, from 1987, before the unfolding of this study (see Kneip 2001).

A systematic analysis of the available archaeological literature for the study area indicated the presence of twenty-three archaeological sites, distributed in the Saquarema Lagoonal Complex. The results indicated two distinct sets of information: First, some data had a generic character, being the result of unsystematic research done in the area during the 40s and 60s; the other data were obtained by systematic researches developed during the 80s.

Thus, from the late 80s, the archaeological literature involved archaeological research in seven shellmounds in the region, namely: Moa, Pontinha, Beirada, Saco, Madressilva, Saquarema and Manitiba I. The first three were also the subject of a study on burial rituals (Kneip and Machado 1992, 1993).

Faced with these results, in which some fundamental attributes to the development of the research were both quantitatively and qualitatively unsatisfactory, this study opted to undertake field research and revisit some sites described in the literature, with the aim of complementing the existing gaps and evaluating sites likely to be subjected to testing, thus improving this study's sample. This investigation also used information available in the catalogue of archaeological sites, organized by the Institute of the Historical and Artistic National Heritage (Instituto de Patrimônio Histórico e Artístico Nacional – IPHAN). This information revealed a gap in archaeological surveys: only three sites had been recorded after the research done at the end of the 60's. This study revisited eighteen of the twenty-three sites recorded within the region, of which only fifteen were recorded at IPHAN. During the 2003 field season, seven sites could not be located and four new sites were identified (Ilha dos Macacos, Itaúnas, Mombaça I, and Ponta dos Anjos).

Therefore, the multivariate analysis associated secondary data (from the literature) and primary data (analysis of archaeological material recovered from the investigated sites).

The secondary data refer to studies published between 1980 and 2001 and are sometimes characterized by general descriptions (Kneip 1994, 1998, 1999, 2001, Kneip et al. 1997), and sometimes by more detailed descriptions, as in the case of Beirada shellmound (Kneip 1978, Kneip and Crancio 1988, Kneip and Francisco 1988, Kneip et al. 1989, Kneip and Pallestrini 1990), addressing different topics, such as: material culture (Crancio 1995, Crancio and Kneip 1992, 2001, Kneip et al. 1997); chronology and spatial analysis (Kneip et al. 1991, Kneip 1992); economy, food diet and bio-anthropology (Kneip 1994, Kneip et al. 1995, Machado and Kneip 1994, Machado 2001, Magalhães et al. 2001, Rodrigues-Carvalho et al. 2001, Rodrigues-Carvalho and Souza 2005); as weel as stratigraphy (Kneip 1995, Mello 2001). They also involved studies of experts from different disciplines such as Zoology (Mello 1988, 1999, Vogel and Magalhães 1989a, b) and Archaeobotany (Scheel-Ybert 2000, 2001).

Considering all the limits and possibilities of a sample selection, ten were chosen from a total of twenty-three archaeological sites identified in the literature and surveys: Saquarema, Pontinha, Beirada, Moa, Jaconé, Manitiba I, Itaúnas, Mombaça I, Saco and Madressilva.

Hierarchical cluster analyses (Ward's Method, Euclidean distance) of six attributes and thirty-four variables allowed systematization of information for the twenty-eight layers identified in this study's sample of ten sites (figure 2). The data were systematized considering the absolute frequency. Multivariate analyses resulted in identification of two sets (figure 3).

ATTRIBUTES	VARIABLES
1) Matrix	1-Mineral-organic 2-Shell 3-Mineral-organic with shell lenses and/ or pockets 4-Indeterminate
2) Fish components	1- Ariidae 2-Scianidae 3- Ariidae/ Scianidae 4-Absent 5-Indeterminate
3) Lithic assemblage	1- Flaked 2 -Worked Cobbles 3 - Flaked and cobbles 4-Indeterminate 5-Absent
4) Worked bone assemblage	1- Points 2-Worked fish spines 3- Points and spines 4-Indeterminate 5-Absent
5) Dominant burials	1-Primary/Secondary Cremations 2-Non cremated Primary/Secundary 3-Secondary with bone manipulation 4-Secondary within crematory hearths 5- Absent 6-Indeterminate
6) Chronology	1-Primary/Secondary Cremations 2-Non cremated Primary/Secundary 3-Secondary with bone manipulation 4-Secondary within crematory hearths 5- Absent 6-Indeterminate

Figure 2 - Investigated variables and attributes.

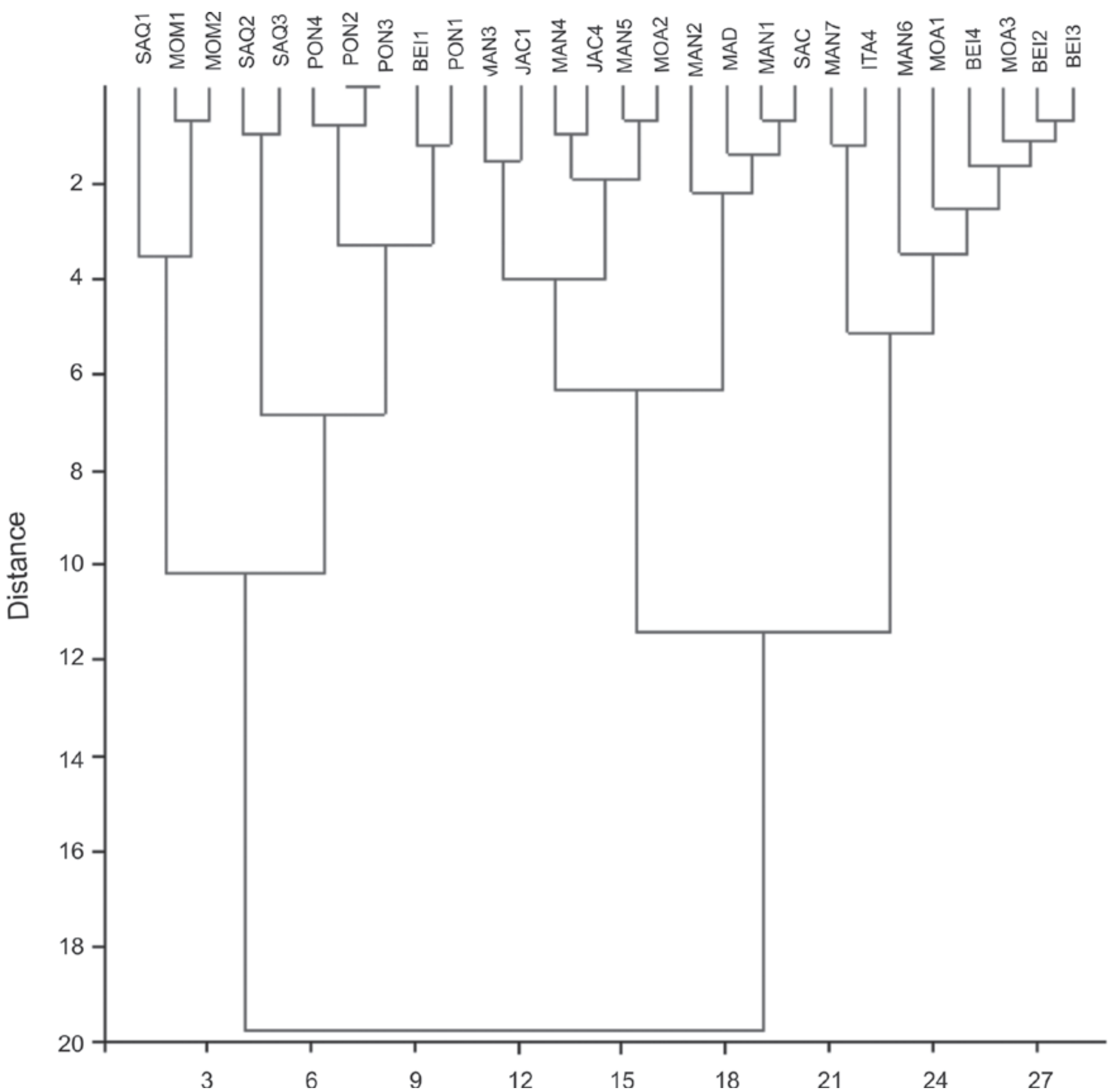

Figure 3 - *Dendrogram*: *SAQ1 – Layer I from Saquarema shellmound; SAQ2 – Layer II from Saquarema shellmound; SAQ3 – Layer III from Saquarema shellmound; PONT1- Layer I from Pontinha shellmound; PONT2- Layer II from Pontinha shellmound; PONT3- Layer III from Pontinha shellmound; PONT4- Layer IV from Pontinha shellmound; MOA1- Layer I from Moa shellmound; MOA2- Layer II from Moa shellmound; MOA3- Layer III from Moa shellmound; SAC- Saco shellmound; MOM1 - Layer I from Mombaça shellmounds; MOM2 - Layer II from Mombaça shellmound; BEI1- Layer I from Beirada shellmound; BEI2- Layer II from Beirada shellmound; BEI3- Layer III from Beirada shellmound; BEI4- Layer IV from Beirada shellmound; MAD – Madressilva shellmound; ITA4– Layer IV from Itaúnas shellmound; JAC1- Layer I from Jaconé shellmound; JAC4- Layer IV from Jaconé shellmound; MAN_1- Layer I from Manitiba shellmound; MAN2- Layer II from Manitiba shellmound; MAN3- Layer III from Manitiba shellmound; MAN4- Layer IV from Manitiba shellmound; MAN5- Layer V from Manitiba shellmound; MAN6- Layer VI from Manitiba shellmound; MAN7- Layer VII from Manitiba shellmound.*

For the variables regarding fish, I determined the quantitative attributes referring to their species and / or families identified in the samples.

Technological variation in the mounting of bone artifacts was related to the presence of two types of artifacts: modified fish spines and bone points (figure 4). The worked fish spines are from dorsal and anal fin spines of fish not yet identified. The use of grinding (an abrasive technique), in the posterior and anterior ends of the spine and rays, smoothed the bones' natural curvature and enlarged their narrow channel, resulting in a beveled shape, identified as "needles" in the archaeological literature, because the resulting shape is similar to a needle (Beck et al. 1970, T.C. Franco, unpublished data, Rohr 1977, Gaspar 2004).

Most of the bone points were from long bones of mammals and birds. Although this type of artifact can be characterized by the presence of either one or two sharp edges, no distinction was made between these objects in the sample, being both considered, based on the definition of the proposed purpose in the available literature (Kneip 2001). Bone points were manufactured by cutting a bone to extract the epiphyses, followed by grinding, to achieve the desired final shape (Rohr 1977).

The present study used the PAST (Paleontological Statistics) software package for education, version 2.02, for multivariate analyses (Hammer et al. 2001). Also, it calibrated radiocarbon dates available in the literature with the Calib – Radiocarbon Calibration Program, version 6.2 (Stuiver and Reimer 1993), providing better resolution for the chronological data. In the case of shell samples, this study used the Marine 04 curve (Hughen et al. 2004), considering the value of the reservoir effect (R) of 220 ± 20 years, as proposed by Eastoe et al. (2002).

RESULTS

The cluster analysis showed the existence of two large groups: group A is older and is formed by the

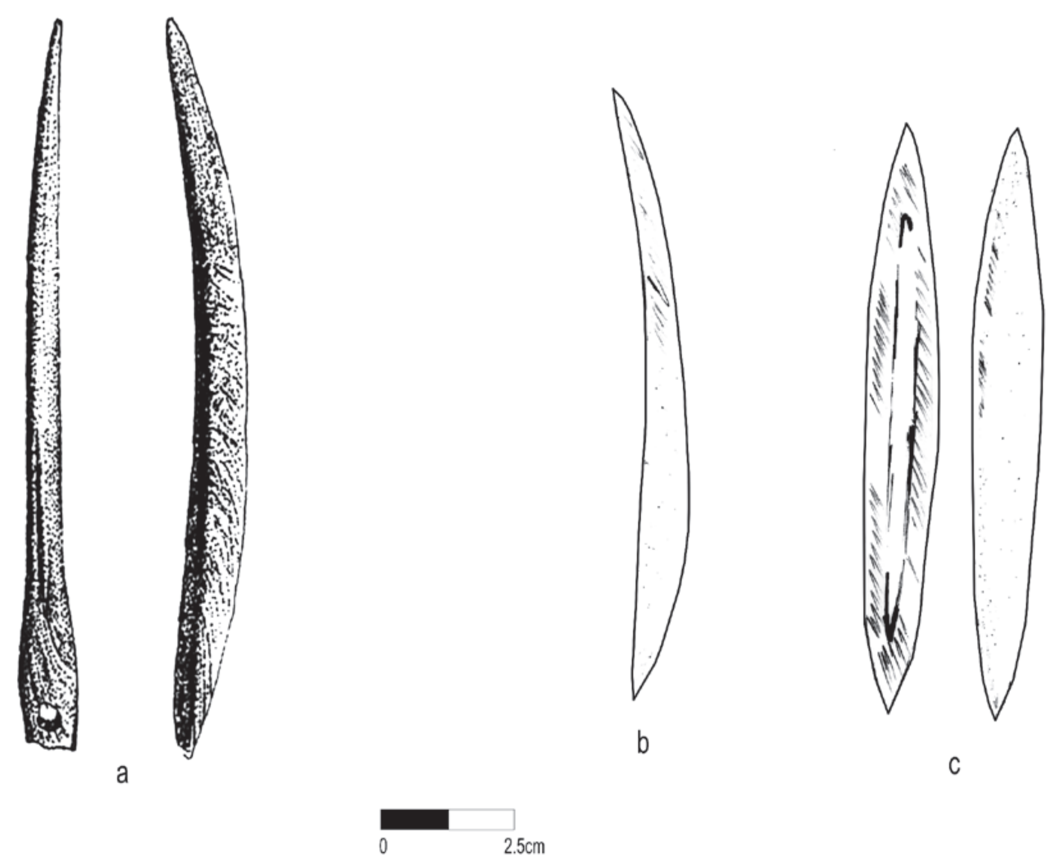

Figure 4 - Bones artifacts from Saquarema sites: **(a)** worked fish spine (side and frontal view); **(b)** bone point (side view); **(c)** bone point (frontal and back view).

Itaúnas, Manitiba, Beirada (layers II, III and IV), Jaconé, Madressilva and Moa (layers II and III) shellmounds. This first group was interpreted as representing the original or generating units, in other words, shellmounds builders. Group B is more recent and is composed of Pontinha, Saquarema, Saco sites and layer I of Beirada and layer I of Moa. These sites are seen as new socio-cultural units, holding traits related to their original groups - the economy of fishermen and gatherers and the mounds construction.

The inhabitants of the sites included in group A were found with fish specimens from the Scianidae family. The *Micropogonias furnieri* species (Desmarest) was their main fishing resource. The fishing technique for this species seems to be associated with the manufacture of worked fish spines, and the results point to a direct relationship between the prevalence of *M. furnieri* specimens and the commonness of this technology in all archaeological layers in sites of this group. This fishing technology was predominant between 6,726/6,356 and 3,699/3,600 cal. years BP among the shellmounds builders of the Saquarema Lagoonal Complex (figure 5).

The occupation of sites from group B, which occurred between 3,699/3,600 and 1,500 cal. years BP, includes specimens from the Ariidae family as their main source of fish resources. This quantitative change in the frequency of fish resources was directly accompanied by changes in the bone mounting technology: the frequency of worked fish spines abruptly decreased while, at the same time, there was a rapid increase of bone points (see figure 5). In agreement with the quantitative shift in the consumption of fish and fishing technology, shellfish resources also had quantitative and qualitative changes, although in a more gradual fashion. Species such as *Anomalocardia brasiliana* (Gmelin), that are commonly found in lagoon bottoms saw their presence increased in 3,699/3,600 years BP, as opposed to the decreased amounts of shellfish captured in mangrove areas, such as specimens from the genus Ostrea and the *Lucina pectinata* species (Gmelin).

The change identified in the collection of shellfish resources brought, as a consequence, a shift in the matrix composition of the shellmounds: a slow substitution of the shell matrix for one that can be characterized as mineral-organic. In this

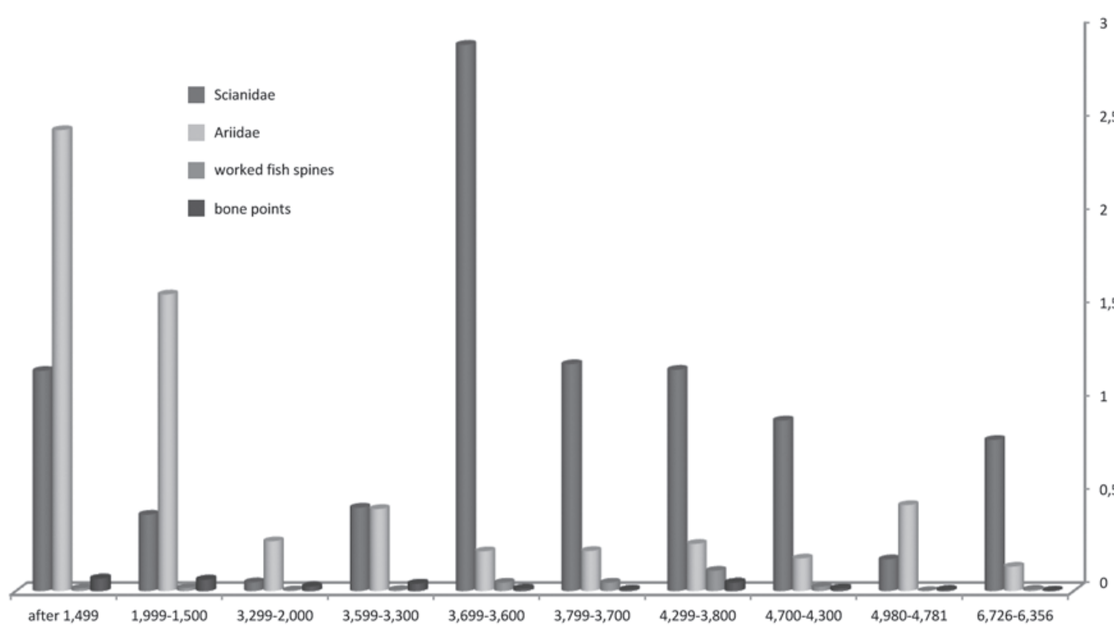

Figure 5 - Distribution of bone artifacts and fish remains according to occupational periods of the Saquarema Lagoonal Complex.

matrix, black in color, the *A. brasiliana* and other shellfish were distributed in lenses and / or pockets located within the black sediment.

I associate this quantitative shift in the diet and, consequently, in the fishing technology, to environmentally related factors, notably the sea level variation occurred during the mid- and late Holocene periods (Dias et al. 2009, Garcia et al. 2004, Laslander et al. 2006, Nagai et al. 2009, Scheel-Ybert 2000, Sylvestre et al. 2005).

Thus, the occupation of Itaúnas site, between 6,726 and 6,356 cal. years BP, coincides with a period in which the relative sea level was still close to the current level (F. Dias, unpublished data). At this time, there were abundant populations of Scianidae specimens. No data for this period in paleobotanical studies conducted by Scheel-Ybert (2000, 2001) were found for the area in question. Probably this period was characterized by a warmer weather.

The setting described above would have been modified when the Saquarema Lagoonal Complex was reoccupied, after a hiatus of approximately 1,300 years, which was associated with a rise in the sea level (F. Dias, unpublished data).

The reoccupation of this region with the settlement of shellmounds builders in Manitiba I site, between 4,980 and 4,700 cal. years BP (layer VII), occurred when the sea reached its maximum level (2.5 m), with a period of dry weather (F. Dias, unpublished data, Pessenda et al. 2004, Garcia et al. 2004). At the same time, the dominance of fish specimens belonging to the Ariidae family is observed, along with an increase in bone point technology. During this period, shellfish species in the mangrove are present, as well as species from areas with intertidal substrates. In the subsequent period, between 4,700 and 3,763 cal. years BP, the construction of Beirada shellmound (layers IV to II) and other shellmounds from group A showed a prevalence of fish from the genus Micropogonias and the technology of the worked fish spine. Although there is the presence of mangrove specimens (Kneip and Pallestrini 1989), palaeobotanical analyses did not identify representative examples of this ecosystem in samples of Beirada shellmound (Scheel-Ybert 2000). Considering the absolute timing, the presence of mangroves must have been a fast event, occurred around 3,338 cal. years BP (layer VI of Jaconé shellmound).

Thus, it is possible to observe, during the 3,600 cal. years BP, the beginning of a gradual decreasing period in the availability of Micropogonias fish and an increase in the Ariidae family fish. This shift also influenced the availability of mangrove and estuarine shellfish (such as *Ostrea* sp. and *L. pectinata*), causing an abrupt reduction of these resources and an enlargement in the numbers of *A. brasiliana*, species that prefer areas with muddy and sandy-muddy bottoms.

DISCUSSION

Providing support to the vast majority of the cited archaeological studies, especially to those which address the shellmounds - more direct evidence of fishermen and gatherers groups (also called shellmounds builders) –, geo-morphological studies have played a fundamental role in understanding the colonization of the Brazilian coast during the Holocene (Backheuser 1945, Bigarella 1962, Gliesh 1930, Guerra 1950a, b, Leonardos 1938, Martin and Suguio 1975, Martin et al. 1979, 1979/80, 1996, 1997, 2003, Suguio et al. 1976, 1988, 1991) (see Scheel-Ybert et al. 2009).

On the other hand, although palynological studies developed for the Southeast region, notably the Região dos Lagos (Laslandes et al. 2006, Ledru et al. 1996, Garcia et al. 2004, Nagai et al. 2009, Pessenda et al. 2004, Sylvestre et al. 2005) provides important data for understanding the paleoclimatic changes and, thus, are closely related to studies on the variation in the relative sea level. So far they have not been systematically used for understanding the pre-colonial occupation on the coast of Rio de Janeiro during the middle and late Holocene.

The coast of Rio de Janeiro is a privileged space for the development of studies that are added to the variation of the sea level data and fishermen-gatherer occupation data. At a first moment, the curve proposed by Fairbridge (1976) was used to explain the cultural change from the unifactorial environmental vector, followed by the proposals of the Cultural Ecology of Julian Steward and the theoretical palimpsest of the National Program of Archaeological Research - Programa Nacional de Pesquisas Arqueológicas (PRONAPA) (Beltrão 1978, Dias 1969, 1980, 1992, Mendonça de Souza 1981). At a second moment, considering the curves constructed by Martin and Suguio 1975, 1986, Martin et al. 1997, 1979, 1979/80, 2003, Suguio et al. 1976, 1988, Dominguez et al. 1990, the data on the variation of the relative sea level served much more to question the ecological model proposed by PRONAPA and his followers, from the processualist approach, than to explain the occupation of Rio de Janeiro coast, from paleo-environmental studies (Gaspar 2004). Exception should be made to Scheel-Ybert´s study (2000), since it is not an archaeological study but a paleobotanical one.

A third time would still appear at the construction of curves proposed by Angulo and Lessa (1997), Angulo et al. (2002) and Souza et al. (2001). This model was used by Barbosa-Guimarães (2011) in the study of the socio-cultural change in the shellmounds occupations of the Saquarema Lagoonal Complex, as well as by Ybert (2002) and Ybert et al. (2003) for samples of organic sediments collected in the coastal lowland of São Paulo State, in order to understand the *shellmounds* occupation in the low Ribeira do Iguape river.

F. Dias (unpublished data) has recently proposed an average curve of variation of the sea level, for the coast of Cabo Frio and Búzios, in which the highest level of 2.44 m is related to the "Maximum Holocene" and the lowest level of 0.82 m is related to the lowering of the sea after the 1,976 years cal. BP. This curve shows that the sea level exceeded the zero current around 6,300 cal. years BP, suggesting a maximum transgression of approximately 2.5 m around 5,500 – 4,700 cal. years BP and a gradual marine regression until 1,976 years cal. BP, when the level of the sea was approximately 1.37 m.

Thus, environmental factors related to the intensification of semi-arid conditions would have influenced changes in the availability of aquatic resources, most notably shellfish that grew in mangrove areas around 3,699/3,600 cal. years BP, in the region of Saquarema. This hypothesis can be supported through researches completed by L. A. Tasayco-Ortega (unpublished data) who proposed the existence of five episodes of reinforcement of semi-arid conditions in the Região dos Lagos (3,600-3,500 BP; 3,100-3,000 BP; 2,200-2,000 BP; 1,200-1,100 BP; and 600-500 BP), along with two episodes of strong precipitation (2,300-2,100 BP and 700-600 BP), as well as by Laslandes et al. (2006), who observed a highly variable climatic phase between 3,600 and 2,900 years BP.

The changes in food resources also affected the technology of shellmounds builders, who had to invest more in the production of bone points, decreasing the production of artifacts manufactured with worked fish spines, the so-called "needles".

Although the technology of bone points was present in the technological apparatus of shellmounds builders, from 6,726 / 6,356 cal. years BP, their dominance only occurred from 3,600 cal. years BP, associated with the predominance of the Ariidae family representatives and the *A. brasiliana* species.

Considering the available paleo-environmental data (F. Dias, unpublished data, L.A. Tasayco-Ortega, unpublished data, Laslandes et al. 2006) and the recurrence of the association between different technological strategies and specific fishing resources, it was possible to distinguish two periods in the archaeological record: an older one (6,726 / 6,356 and 3,699 / 3,600 cal. years BP) and a more recent one (from 3,699 / 3,600 cal. years BP).

The earlier period was characterized by the presence of abundant fish of the species *M. furnieri* ("corvina") and a greater variety of shellfish (representatives of mangrove, muddy and sandy-muddy bottoms, and intertidal substrates), which corresponded to the peak of the shellmounds occupation, having in the manufacture of worked fish spines, the artifacts needed for the fishing of "corvina". It is still unknown how this artifact was used: as needles for making fishing nets or as "hooks to swallow". Portions of mangrove existed during this period and may be evidenced by the presence of *L. Pectinata*, and the genus Ostrea sp in the zoo-archaeological records of Itaúnas and Jaconé shellmounds.

The most recent period was marked by significant changes in aquatic resources occurring on the coast of Saquarema. Species of the Ariidae family became prevalent in the zoo-archaeological records, accompanied by bone points and the collection of A. brasiliana species. It is believed that this gradual change in water resources occurred due to the closure of the Saquarema lagoon during the progressive decline in the sea level, which isolated it with the creation of the sandy barrier, and caused the retraction of the mangrove.

Although this change in resource availability due to environmental variations occurred during the mid- and late Holocene, coastal populations were able to remain stable from the economic point of view, making use of different fishing strategies. However, the gradual decline in the sea level, notably from 2,000 cal. years BP, when added to endogenous changes, coincided with the arrival of ceramist populations at the coast, bringing new technologies and more complex social behaviors, which contributed to the disintegration of fishermen and gatherers coastal groups.

RESUMO

Duas tecnologias pesqueiras distinas foram identificadas junto aos grupos construtores de sambaquis do Complexo Lagunar de Saquarema, no estado do Rio de Janeiro, Brasil: a tecnologia das pontas ósseas e a dos espinhos de peixe trabalhados. Essas tecnologias estavam relacionadas à aquisição de recursos ictiológicos específicos; os espinhos de peixe trabalhados foram usados na captura do *Micropogonias furnieri* (Desmarest) e as pontas ósseas foram usadas na pesca de representantes da família Ariidae. A tecnologia dos espinhos trabalhados foi predominante entre 6.726 anos cal AP e 3.699 anos cal AP, enquanto que a tecnologia de pontas ósseas foi predominante após 3.699 anos cal AP. Acreditamos que essas diferenças estratégicas para obter recursos aquáticos antes de 3.699 anos cal AP estejam relacionadas a fatores de ordem ambiental, notadamente à gradual regressão do nível relativo do mar ocorrido ao longo do Holoceno médio e tardio.

Palavras-chave: meios de subsistência, estratégia de pesca, sambaqui, Holoceno.

ACKNOWLEDGMENTS

I would like to Angela Buarque for her valuable comments and Daniela Klökler for translation and suggestions. I am responsible for the final form of this paper.

REFERENCES

Angulo RJ and Lessa G. 1997. The brazilian sea level curves: a critical review with emphasis on the curves from the Paranaguá and Cananéia regions. Mar Geol 140: 141-166.

Angulo RJ, Pessenda LCR and Souza MC. 2002. O Significado das Datações ao 14C na Reconstrução de Paleoníveis Marinhos e na Evolução das Barreiras Quaternárias do Litoral Paranaense. R Bras Geoscien 32(1): 95-106.

Backheuser EA. 1945. Os sambaquis do Distrito Federal. B Geog 32: 1052-1068.

Baleé W. 1998. Historical Ecology: Premises and Postulates. In: BALEE W (Ed), Advances in Historical Ecology, New York: Columbia University Press, p. 13-25.

Barbosa M. 2003. Revisitando conceitos: a estrutura social dos pescadores-coletores pré-coloniais. R Mus Arqueol e Etnol 13: 261-267.

Barbosa-Guimarães M. In press. Mudança e colapso no Litoral Fluminense: os sambaquieiros e os outros no Complexo Lagunar de Saquarema, R Mus Arqueol e Etnol 21: 71-91.

Beck A. 1974. O Sambaqui de Enseada I - SC LN 71 - um estudo sobre tecnologia pré-histórica, 1nd ed., Florianópolis: Universidade Federal de Santa Catarina, 96 p.

BECK A. 1978. Sambaquis: tecnologia e subsistência. An Mus Antropol 10(11): 124-138.

BECK A, ARAÚJO EM, DUARTE GM, FOSSARI TD AND BELANI EM. 1970. O sambaqui de Enseada I – um estudo da tecnologia pré-histórica. An Mus Antropol 3: 35-56.

BELTRÃO MCC. 1978. Pré-História do Rio de Janeiro, 1ª ed., Rio de Janeiro: Forense, 82 p.

BELTRÃO MCC AND KNEIP LM. 1969. Arqueologia dos estados da Guanabara e Rio de Janeiro: linhas de pesquisa. Pesq 20: 93-112.

BETTINGER RL. 1991. Hunter-Gatherers: Archaeological and Evolutionary Theory (Interdisciplinary Contributions to Archaeology), 1st ed., New York: Plenum Press, 280 p.

BIGARELLA JJ. 1962. Os sambaquis na evolução da paisagem litorânea sul-brasileira. B Geog 20(171): 648-663.

BINFORD L. 2001. Constructing Frames of Reference: An Analytical Method for Archaeological Theory Building Using Ethnographic and Environmental Data Sets, 1st ed., Berkeley: University of California Press, 624 p.

BOWDLER S. 1974. Coastal archaeology in eastern Australia, 1st ed., Canberra: Department of Prehistory, Australia National University Press, 231 p.

BOWSER BJ. 1993a. Fish Remains. In: ERLANDSON M AND GERBER J (Eds), Archaeological Investigations at CA-BA-1731: A Transitional Middle-to-Late Period Site on the Santa Barbara Channel, Dames and Moore: Santa Bárbara, California, p. 141-170.

BOWSER BJ. 1993b. Dead Fish Tales: Analysis of Fish Remains from Two Middle Period Sites on San Miguel Island, California. In: GLASSOW MA (Ed), Archaeology on the Northern Channel Islands of California, Salinas, California: Coyote Press, Archives of California Prehistory 34: 95-136.

COLTEN R AND ARNOLD J. 1998. Prehistoric Marine Mammal Hunting on California's Northern Channel Islands. Amer Antiquity 63(4): 679-701.

CRANCIO F. 1995. O estudo da indústria lítica do sambaqui de Saquarema, RJ. Doc Trab 3: 53-64.

CRANCIO F AND KNEIP LM. 1992. Tipo e forma da cerâmica pré-histórica de Saquarema (Estado do Rio de Janeiro). In REUNIÃO CIENTÍFICA DA SAB, 6, Rio de Janeiro Anais... Rio de Janeiro: UNESA/SAB 2: 716-722.

CRANCIO F AND KNEIP LM. 2001. Artefatos e matéria-prima. Doc Trab 5: 35-53.

CRUMLEY CC. 1994. Historical Ecology: A Multidimensional Ecological Orientation. In: CRUMLEY CC (Ed), Historical Ecology: Cultural Knowledge and Changing Landscapes, Santa Fé: School of American Research Press, Santa Fé, p. 1-16.

CRUMLEY CC AND MARQUARDT WH. 1990. Landscape: A Unifying Concept in Regional Analysis. In: ALLEN KM ET AL. (Eds), Interpreting Space: GIS and Archaeology, London: Taylor and Francis, p. 73-79.

DAVENPORT D, JOHNSON JA AND TIMBROOK J. 1993. The Chumash and the Swordfish. Anthropol 67: 257-272.

DE MASI MA. 2001. Pescadores-coletores da Costa Sul do Brasil. Pesq 57: 1-136.

DELCOURT PA AND DELCOURT HR. 2004. Prehistoric Native Americans and Ecological Change: Human Ecosystems in Eastern North America since the Pleistocene. Cambridge: Cambridge University Press, 216 p.

DIAS O. 1969. A fase Itaipu. Sítios sobre dunas no estado do Rio de Janeiro. Pesq 20: 5-12.

DIAS O. A 1980. Tradição Itaipu e os sambaquis. Anu Divul Cient 7: 33-43.

DIAS O. 1992. A tradição Itaipu, costa central do Brasil. In: MEGGERS B (Ed), Prehistoria Sudamericana - Nuevas Perspectivas, Washington: Taraxacum, p. 161-176.

DIAS O AND CARVALHO E. 1995. A tradição Itaipu no Rio de Janeiro. Discussão dos tópicos: a questão da imobilidade cultural. In: BELTRÃO MC (Org), Arqueologia do Estado do Rio de Janeiro. Rio de Janeiro. Rio de Janeiro: Arquivo Público do Estado do Rio de Janeiro, p. 105-110.

DIAS FF, CASTRO JWA, SEOANE JCS AND CAMARGO LHR. 2009. Indicadores de mudanças climáticas e de variações do nível na costa do Rio de Janeiro: Aquecimento ou Resfriamento? R Observatorium 1(1): 21-32.

DOMINGUEZ JML, BITTENCOURT ACSP, LEÃO ZMAN AND AZEVEDO AEG. 1990. Geologia do Quaternário Costeiro do Estado de Pernambuco. R Bras Geocien 20 (1-4): 208-215.

EASTOE CJ, FISH S, GASPAR MD AND LONG A. 2002. Reservoir corrections for marine samples from the south Atlantic coast, Santa Catarina State, Brazil. Radiocarbon 44(1): 145-148.

ERLANDSON JM. 2001. The Archaeology of Aquatic Adaptations: Paradigms for a New Millennium. J Archaeol Reser 9: 287-350.

FAIRBRIDGE RW. 1976. Shellfish-eating preceramic indians in coastal Brazil. Science 191: 353-359.

FIGUTI L. 1998. Estórias de arqueopescador. R Arqueol 11: 57-70.

FIGUTI L AND KLÖKLER DM. 1996. Resultados preliminares dos vestígios zooarqueológicos do sambaqui Espinheiros II (Joinville, SC). R Mus Arqueol Etnol 6: 169-188.

GARCIA MJ, DE OLIVEIRA PE, SIQUEIRA E AND FERNANDES RS. 2004. A Holocene vegetational and climatic record from the Atlantic rainforest belt of coastal State of São Paulo, SE, Brazil. R Palaeobot Palyno 131: 181-131.

GASPAR MD. 1995. Espaço, rito e identidade pré-histórica. R Arqueol 8(2): 221-237.

GASPAR MD. 1998. Considerations of the sambaqui of the Brazilian coast. Antiquity 72: 592-615.

GASPAR MD. 2004. Aspectos da Organização de um Grupo de Pescadores, Coletores e Caçadores: Região Compreendida entre a Ilha Grande e o Delta do Paraíba do Sul, Estado do Rio de Janeiro. Pesq 59: 1-163.

GASPAR MD AND DE BLASIS P. 1992. Construção de sambaqui. In: REUNIÃO CIENTÍFICA DA SOCIEDADE DE ARQUEOLOGIA BRASILEIRA, 6, Rio de Janeiro Anais...Rio de Janeiro: UNESA 2: 811-820.

GLASSOW MA. 1980. Recent Developments in the Archaeology of the Channel Islands. In: MULTIDISCIPLINARY SYMPOSIUM, Santa Bárbara, Proceedings... Santa Bárbara: POWER DM (Ed), p. 79-99.

GLIESCH R. 1930. Sobre a origem dos sambaquis. Egatea 17(3): 199-208.

GUERRA AT. 1950a. Contribuição da geomorfologia ao estudo dos sambaquis. B Carioca Geog 4: 5-13.

GUERRA AT. 1950b. Apreciação sobre o valor dos sambaquis como indicadores de variações do nível dos oceanos. B Geog 91: 850-853.

HAMMER O, HARPER DAT AND RYAN PD. 2001. PAST – Paleontological Statistics Software Package for Education, versão 2.02. Paleontol Elect 4(1): 1-9.

HUGHEN KA ET AL. 2004. Marine 04 marine radiocarbon age calibration, 0–26 cal ka BP. Radiocarbon 46: 1059-1086.

INGOLD T. 1993. The temporality of the landscape. World Archaeol 25: 152-174.

JOCHIM M. 1990. The Ecosystems Concept in Archaeology. In: MORAN EF (Ed), The Ecosystem Approach in Anthropology: from Concept to Practice, Ann Arbor: University of Michigan Press, USA, p. 75-90.

KELLY RL. 1995. The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways, 1st ed., Washington, D.C: Smithsonian Institution Press, 462 p.

KENNETT DJ AND KENNETT JP. 2000. Competitive and Cooperative Responses to Climatic Instability in Coastal Southern California. Amer Antiquity 65: 379-395.

KNEIP LM. 1976. Arqueologia Brasileña: proyeto Saquarema. In: CONGRESO INTERNACIONAL DE AMERICANISTAS, 31, cidade do México, México Actas... México: Universidad Autonoma 2: 22-25.

KNEIP LM. 1978. Salvaguarda do patrimônio pré-histórico de Saquarema, Cabo Frio e Araruama, RJ -plano de ação. R Mus Paulista 25: 87-100.

KNEIP LM. 1992. As habitações 1 e 2 do sambaqui da Pontinha (Saquarema, RJ). In: REUNIÃO CIENTÍFICA DA SOCIEDADE DE ARQUEOLOGIA BRASILEIRA, 6, Rio de Janeiro Anais... Rio de Janeiro: UNESA/SAB 2: 730-737.

KNEIP LM. 1994. Cultura material e subsistência das populações pré-históricas de Saquarema, RJ. Doc Trab 1: 1-76.

KNEIP LM. 1995. O sambaqui de Saquarema, RJ. Estruturas e estratigrafia. Doc Trab 3: 39-52.

KNEIP LM. 1998. Os pescadores-coletores e caçadores pré-históricos da área arqueológica de Saquarema, RJ. R Arqueol Amer 15: 12-20.

KNEIP LM. 1999. O sambaqui do Saco e de Madressilva – Saquarema, RJ. Doc Trab 4: 1-67.

KNEIP LM. 2001. O sambaqui de Manitiba I e outros sambaquis de Saquarema. Doc Trab 5: 1-60.

KNEIP LM, ARAÚJO DSD AND FONSECA VS. 1995. Áreas de Exploração de Recursos Abióticos e Bióticos das Populações Pré-Históricas de Saquarema, RJ. Doc Trab 3: 1-102.

KNEIP LM AND CRANCIO F. 1988. O significado cultural da indústria lítica, óssea e conchífera do sambaqui da Beirada (Saquarema, RJ). An Acad Bras Cienc 60: 259.

KNEIP LM, CRANCIO F, SANTOS CMC, MAGALHÃES RMM AND MELLO EMB. 1997. O sambaqui do Saco e de Madressilva – Saquarema, RJ. Doc Trab 4: 1-67.

KNEIP LM AND FRANCISCO B. 1988. Contribuição ao estudo da indústria lítica do Sambaqui da Beirada (Saquarema, Rio de Janeiro). An Acad Bras Cienc 60: 258-259.

KNEIP LM AND MACHADO LMC. 1992. Cremação e outras práticas funerárias em sítios de pescadores-coletores pré-históricos do litoral de Saquarema, RJ. B IAB 5: 1-42.

KNEIP LM AND MACHADO LMC. 1993. Os ritos funerários das populações pré-históricas de Saquarema, RJ: sambaquis da Beirada, Moa e Pontinha. Doc Trab 1: 1-76.

KNEIP LM, MAGALHÃES RMN, VOGEL MAC, MELLO EMB AND CORREA MGO. 1989. O sambaqui da Beirada (Saquarema, RJ): dados culturais, faunísticos e cronológicos. In: CONGRESSO BRASILEIRO PALEONTOLOGIA, 11 Curitiba Anais... Curitiba: Sociedade Brasileira de Paleoentologia 1: 651-665.

KNEIP LM AND PALLESTRINI L. 1990. Sambaqui da Beirada a luz da metodologia por superfícies amplas, Saquarema, Rio de Janeiro. Dédalo 28: 171-193.

KNEIP LM, PALLESTRINI L, CRANCIO F AND MACHADO LMC. 1991. As estruturas e suas inter-relações em sítios de pescadores-coletores pré-históricos do litoral de Saquarema, RJ. B IAB 5: 1-42.

LASLANDES B ET AL. 2006. Enregistrement de la variabilité hydroclimatique au cours des 6500 derniè res anné es sur le littoral de Cabo Frio (Rio de Janeiro, Brésil). Compets Rendus Geoscien 338: 667-675.

LEDRU MP ET AL. 1996. The last 50,000 years in the Neotropics (Southern Brazil): evolution of vegetation and climate. Palaeogeogr Palaeoclimatol Palaeoecol 123: 239-257.

LEONARDOS OH. 1938. Concheiros naturais e sambaquis. Avulsos 37, DNPM: Rio de Janeiro, 45 p.

LIMA TA AND SILVA RCP. 1984. Zooarqueologia: alguns resultados para a pré-história da Ilha de Santana. Rev Arqueol 2: 10-40.

LIMP WF AND REIDHEAD VA. 1979. Economic Evaluation of the Potential of Fish Utilization in Riverine Environments. Amer Antiquity 44(1): 70-78

LINDSTROM SG. 1996. Great Basin fisherfolk optimal diet breadth modeling of the Truckee River prehistoric subsistence fishery In INTERNATIONAL SEAWEED SYMPOSIUM (DEVELOPMENTS IN HYDRO-BIOLOGY), 15, New York Proceeding... New York: Springer, p. 299-313.

MACHADO LC. 2001. Os sepultamentos, contextos arqueológicos e dados bioesqueletais. Doc Trab 5: 71-79.

MACHADO LC AND KNEIP LM. 1994. Padrões dentários, dieta e subsistência das populações dos sambaquis de Saquarema, RJ. R Arqueol 8(1): 45-57.

MAGALHÃES RMM, CURVELO MA AND MELLO EMBA. 2001. A Fauna na Alimentação. Doc Trab 5: 75-63.

MARTIN L, DOMINGUEZ JML AND BITTENCOURT ACSP. 2003. Fluctuating Holocene sea levels in Eastern and Southeastern Brazil: Evidence from multiple fossil and geometric indicators. J Coastal Res 19(1): 101-124.

MARTIN L AND SUGUIO K. 1975. The state of São Paulo coastal marine Quaternary geology: the ancient standlines. An Acad Bras Cienc 47: 249-263.

MARTIN L AND SUGUIO K. 1986. Excursion Route along the Coastal Plains of the States of Paraná and Santa Catarina. In: INTERNATIONAL SYMPOSIUM ON SEA LEVEL CHANGES AND QUATERNARY SHORELINES, São Paulo Special Publication... São Paulo, 124 p.

MARTIN L, SUGUIO K, DOMINGUEZ JML AND FLEXOR JM. 1997. Geologia do Quaternário costeiro do Litoral Norte do Rio de Janeiro e Espírito Santo, 1ª ed., Belo Horizonte: CPRM, 112 p.

MARTIN L, SUGUIO K AND FLEXOR JM. 1979. Le Quaternaire marin du littoral brésilien entre Cananéia (SP) et Barra de Guaratiba (RJ). In: INTERNATIONAL SYMPOSIUM ON COASTAL EVOLUTION IN THE QUATERNARY, 1978, São Paulo Proceedings... São Paulo: Suguio et al. (Eds), p. 296-331.

MARTIN L ET AL. 1979/1980. Le quaternaire marin brésilien (Littoral pauliste, sud fluminense et bahianais). Cahiers 11(1): 95-124.

MARTIN L ET AL. 1996. Registro das Variações do Nível do Mar e do Clima nos Sedimentos das Pequenas Lagunas Hipersalinas de Cabo Frio (RJ). In: CONGRESSO BRASILEIRO DE GEOLOGIA, 39, Sergipe-Bahia Anais..., Sergipe-Bahia: Sociedade Brasileira de Geologia, p. 523-525.

MELLO CL. 2001. Considerações Estratigráficas e Sedimentológicas a respeito da formação do sambaqui Manitiba I. Doc Trab 5: 81-91.

MELLO EMB. 1988. Fauna malacológica de sítios do Estado do Rio de Janeiro, Brasil: Veneroida (Mollusca, Bivalvia). Pub Avul Mus Nac 75: 1-38.

MELLO EMB. 1999. Fauna malacológica de sítios arqueológicos do Estado do Rio de Janeiro, Brasil: Mesogastropoda, Neogastropoda (Mollusca, Gastropoda, Prosobranchial). Pub Avul Mus Nac 79: 1-36.

MENDONÇA DE SOUZA A. 1981. Pré-História Fluminense, 1ª ed., Rio de Janeiro: Instituto Estadual do Patrimônio Cultural e Secretaria de Educação e Cultura, 200 p.

NAGAI RH, SOUSA SHM, BURONE L AND MAHIQUES MM. 2009. Paleoproductivity changes during the Holocene in the inner shelf of Cabo Frio, southeastern Brazilian continental margin: Benthic foraminifera and sedimentological proxies. Quartern Inter 206: 62-71.

NELSON MC, HEGMON M, KULOW S AND SCHOLLMEYER KG 2006. Archaeological and Ecological Perspectives on Reorganization: A Case Study from the Mimbres Region the U.S. Southwest. Amer Antiquity 71: 403-432.

OSBORN AJ. 1977. Strandloopers, mermaids, and other fairy tales: ecological determinants of marine resource utilization - the Peruvian case. In: BINFORD LR (Ed), For Theory Building in Archaeology, New York: Academic Press, p. 157-205.

PÁLSSON G. 1988. Hunter-gatherers of the sea. In: INGOLD T ET AL. (Eds), Hunters and Gatherers: History, Evolution and Social Change, Oxford: Berg, p. 189-204.

PERLMAN SM. 1980. An optimum diet model, coastal variability, and hunter-gatherer behavior. In: SCHIFFER MB (Ed), Advances in Archaeological Method and Theory, New York: Academic Press, p. 257-310.

PESSENDA LCR, GOUVEIA SEM, ARAVENA R, BOULET R AND VALENCIA EPE. 2004. Holocene fire and vegetation changes in southeastern Brazil as deduced from fossil charcoal and soil carbon isotopes. Quartern Inter 114: 35-43.

RAAB L, MARK JF, PORCASI KB AND YATSKO A. 1995. Debating Cultural Evolution: Regional Implications of Fishing Intensification at Eel Point, San Clemente Island. Pacific Coastal Archaeol Soc Quart 31(3): 3-27.

REDMAN C. 2005. Resilience Theory in Archaeology. Amer Anthropol 107: 70-77.

REDMAN C AND KINZIG AP. 2003. Resilience of Past Landscapes: Resilience Theory, Society, and the Longue Dureé. Conserv Ecol 7: 10-14.

RENOUF MAP. 1988. Sedentary coastal hunter-fishers: an example from the Younger Stone Age of northern Norway. In: BAILEY G AND PARKINGTON J (Eds), The Archaeology of Prehistoric Coastlines, Cambridge: Cambridge University Press, p. 102-115.

RICK TC AND ERLANDSON JM. 2000. Early Holocene Fishing Strategies on the California Coast: Evidence from CA-SBA-2057. J Archaeol Scien 27(7): 621-633.

RICK TC AND ERLANDSON JM. 2008. Human Impacts on Ancient Marine Ecosystems: A Global Perspective, 1st ed., Berkeley: University of California Press, 336 p.

RODRIGUES-CARVALHO C ET AL. 2001. Remanescentes esqueletais do sambaqui do Moa – Saquarema, RJ – recuperados na escavação de salvamento de 1998: dados preliminares In REUNIÃO CIENTÍFICA DA SAB, 10, Recife Anais...Recife: UFPE/SAB.

RODRIGUES-CARVALHO C AND SOUZA SM. 2005. Marcadores de estresse mecânico-postural (MEP) e estilos de vida de populações sambaquieiras do estado do Rio de Janeiro. Habitus 3: 241-259.

ROHR JA. 1977. Terminologia Queratosseodontomalacológica. An Mus Antrop 9-10(1): 5-83.

SCHEEL-YBERT R. 2000. Vegetation stability in the Southern Brazilian coastal are from 5500 to 1400 yr BP D-deduced from charcoal analysis. R Palaeobot Palynol 110: 111-138.

SCHEEL-YBERT R. 2001. Man e vegetation in Southeastern Brazil during the Late Holocene. J Archaeol Scien 28: 471-480.

SCHEEL-YBERT R ET AL. 2009. Considerações sobre o papel dos sambaquis como indicadores do nível do mar. Q Environ Geosci 1(1): 03-09.

SHENNAN S. 2005. Holocene climate and human populations: an archaeological approach. In: MACKAY A ET AL. (Eds), Global Change in The Holocene, London: Hodder Education, p. 36-48.

SOUZA MC, ANGULO RJ AND PESSENDA LCR. 2001. Evolução paleogeografica da planície costeira de Itapoá, Litoral norte de Santa Catarina. R Bras Geosci 31(2): 223-230.

STUIVER M AND REIMER, PJ. 1993. Calib – Radiocarbon Calibration Program, versão 6.2. Radiocarbon 35: 215-230.

SUGUIO K, MARTIN L AND FLEXOR JM. 1976. Les variations relatives du niveau moyen de la mer au Quaternaire récent dans la région de Cananéia-Iguape, São Paulo. B Inst Geol 7: 113-129.

SUGUIO K, MARTIN L AND FLEXOR JM. 1988. Quaternary sea-levels of the Brazilian coast: recent progress. Episodes 11(3): 203-208.

SUGUIO K, MARTIN L AND FLEXOR JM. 1991. Paleoshorelines and the sambaquis of Brazil. Chapter 4. In: JOHNSON LL (Ed.), Paleoshorelines and Prehistory: An Investigation of Method. Boca Raton, Ann Arbor, London: CRC Press, 239 p.

SYLVESTRE F ET AL. 2005. Hydrological changes related to the variability of tropical South American climate from the Cabo Frio lagoonal system (Brazil) during the last 5000 years. The Holocene 15: 625-630.

TENÓRIO MC, PINTO DC AND AFONSO MC. 2009. Dinâmica de ocupação, contatos e trocas no litoral do Rio de Janeiro. Arq Mus Nac 66: 311-321.

THOMAS DH. 2008. Why Did Ascribed Social Inequality Develop on St. Catherines Island? In: THOMAS DH (Ed), Native American Landscapes of St. Catherines Island, Georgia. Anthropol Pap Amer Mus Nat Hist 88(1-3): 1080-1094.

THOMSON VD AND TURCK JA. 2009. Cycles of Coastal Hunter-Gatherers. Amer Antiq 74(2): 255-278.

TILLEY C. 1994. A Phenomenology of Landscape: Places, Paths and Monuments, 1st ed., Oxford: Berg, 221 p.

TRIGGER BG. 1992. A History of Archaeological Thought, 1st ed., Cambridge: Cambridge University Press, 710 p.

UCHÔA DP. 2007. Arqueologia de Piaçagüera e Tenório: análise de dois tipos de sítios pré-cerâmicos do litoral paulista. 1st ed., São Paulo: Sociedade de Arqueologia Brasileira, 170 p.

VOGEL MAC AND MAGALHÃES RMM. 1989a. Primeiro registro de crucifixo (Pisces- Siluroidei) em sambaquis do Litoral do Rio de Janeiro. In: CONGRESSO BRASILEIRA DE PALEONTOLOGIA, XI, Curitiba Anais...Curitiba: Associação Brasileira de Paleontologia, 1: 667-673.

VOGEL MAC AND MAGALHÃES RMM. 1989b. Aplicação dos otólitos (Pisces-Teleostei) no reconhecimento do NMI. In: CONGRESSO BRASILEIRA DE PALEONTOLOGIA, XI, Curitiba Anais...Curitiba: Associação Brasileira de Paleontologia 1: 675-683.

VOUVELLE P. 1993. A História e a Longa Duração. In: LE GOFF J (Org), A História Nova, Rio de Janeiro: Martins Fontes, p. 68-97.

YBERT JP. 2002. Évolution de L'Environnement dans zone littorale Sud et Sud-Est du Brésil à L'Holocene Supèrieur; variations du climat et du niveau relative de la mer; leur influence sur l'occupation humaine. Quaternaire 13(3/4): 237-245.

YBERT JP, BISSA WM, CATHARINO ELM AND KUTNER M. 2003. Environmental and sea-level variations on the southeastern Brazilian coast during the Late Holocene with comments on prehistoric human occupation. Palaeogeogr, Palaeoclimatol, Palaeoecol 189: 11-24.

YESNER DR. 1980. Maritime Hunter-Gatherers: Ecology and Prehistory. Curr Anthropol 21: 727-735.