Biodiversity of Marine Fishes from Shellmounds of Ilha Grande Bay, Rio de Janeiro, Brazil

Biodiversidad de Peces de Concheros de la Bahía de Ilha Grande, Rio de Janeiro, Brasil

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ABSTRACT

Ilha Grande Bay region comprises a large biological biodiversity distributed in different ecological compartments and also is surrounded by shellmounds dating between 8.000 and 2.000 years B.P.A check list of Fish fauna from 11 of these shellmounds was done and compared with nowadays fish inventory for the region. Most of the species recorded for the shellmounds belongs to the class Chondrichthyes (53.5%), which is represented in the check list by 9 families and 38 species, being *Carcharhinus* Blainville, 1816, the genus with the highest number of species. Regarding the Osteichthyes, 16 families and 33 species were recorded. Micropogonias furnieri (Desmarest, 1823) was recorded for all sites. Most of the fish identified has a wide distribution in the western Atlantic (35.2%), pelagic behavior (35.2%) and inhabits estuarine environments (36.6%). Almost all the records are composed of noble fish representing top chain carnivorous which can reach large sizes, especially the Chondrichthyes. Comparisons done with current ichthyofauna data for the area (Ministry of Environment-Brazil) have shown high similarity between past and present pattern of biodiversity, although some discrepancies were found for comparisons sorting species by their ecological compartments. The results show that shellmounds are valuable repositories of information concerning species composition in the past and, therefore, to the study of evolution of biodiversity patterns over time. Data on this nature are important for conservation and management strategies.

Key Words: Shellmounds, Biodiversity, Marine Fishes, Conservation, Archaeozoology

RESUMEN

La región de la bahía de Isla Grande cuenta con una gran biodiversidad ictiológica distribuida en diferentes concheros fechados entre 8.000 y 2.000 años A.P. Se presenta una lista de las especies a partir del registro en once concheros y se discute la presencia de estas especies en los registros de la fauna actual. La mayor parte de las especies estudiadas pertenecen a los Chondrichthyes (53,5%), discriminadas en 9 familias y 38 especies. Entre éstas Carcharhinus Blainville, 1816, es el género con

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mayor número de especies. En cuanto a los Osteichthyes, se registraron 16 familias y 33 especies. La corvina rubia Micropogonias furnieri (Desmarest, 1823) se registró en todos los concheros. La mayoría de los peces identificados presentan una amplia distribución en el Atlántico occidental (35,2%), son demersales (35,2%) y de ambientes estuarinos (36,6%). La mayor frecuencia de los registros está representada por especies de Chondrichthyes com grandes tamaños que conforman el tope de la cadena alimentar.. Las comparaciones entre la biodiversidad ictiológica del Holoceno al Reciente muestran similitudes significativas. Sin embargo, se observan discrepancias cuando se comparan los ambientes ecológicos. Los resultados muestran que los concheros son reservatorios valiosos para estudiar la diversidad ictiológica del Holoceno y de las condiciones prístinas, para poder evaluar las estrategias de conservación y manejo.

Palabras Claves: Concheros, Biodiversidad, Peces Marinos, Conservación, Arqueozoología

INTRODUCTION

Eight thousand years before present, a large part of the Brazilian coast was inhabited by human groups of fishermen-gatherers. These prehistoric human populations left as evidence of their existence archaeological sites called "sambaqui" (or shellmounds or shellmiddens), a term derived from Tupi language (tamba-shell and ki-mound). Thus, "sambaquis" are artificial accumulations of mollusc shells, fish and mammals' bones, as well as charcoal, lithic materials and other cultural remains all mixed with sandy or clayey sediments (Lima 2000).

"Sambaquis" occur in sheltered areas such as bays and harbors, which present high biotic productivity both in density and in diversity of life forms (Lima et al. 2003, Lima 2000). The remains found in the "sambaquis" can provide information about prehistoric societies, their eating habits and use of resources for making ornaments and artifacts (Gaspar 2000). Moreover, these remains comprises information about the fauna and flora existing at the time it was formed, enabling recovery of aspects related to biodiversity and biogeography of these species (Froyd & Willis 2008, Lindbladh et al. 2007, Ybert-Scheel et al. 2006, Fürsich 1995).

A comprehensive approach to biodiversity should include history, placed in an evolutionary perspective. In other words, the knowledge about the biodiversity in a given region should include not only an inventory of the living species, but also of its fossils (Furon 1969). Therefore, recovering information about species composition in the past is an important contribution of zooarchaeological studies to biodiversity knowledge (Tchernov 1992).

In this work, patterns of biodiversity of marine fishes were investigated at Ilha Grande Bay (Rio de Janeiro, Brazil). An inventory of fish species registered for "sambaquis" was built and compared with current data of ichthyofauna for the same area. The biodiversity pattern inferred as number of families and genera shown to be the equivalent between past and present. However, comparisons done using species clustered by ecological compartments revealed differences.

The Ilha Grande Bay (22°50' - 23°20'S, 44°00' - 44°45'W) (Figura 1) comprise a rich fauna and flora, even though is still not fully recorded. The peculiar geography, hydrography and oceanography patterns allied to factors such as connectivity of coastal systems, organic matter input from rivers and a high variance of physical and chemical factors are probably responsible for the highly diverse environment found in this region (Costa 1998, Brandini *et al.* 1997, Lana *et al.* 1996). The coastal zone at Ilha Grande Bay is considered a hot spot for conservation of the marine environment and the area has already established several conservation units (Alho *et al.* 2002, Diegues & Nogara 1999).

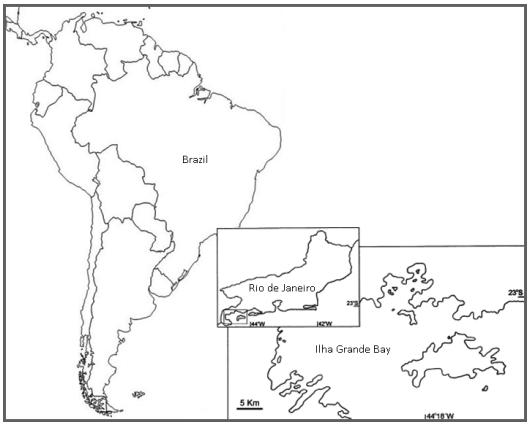

Figure 1: Location of Ilha Grande Bay, Rio de Janeiro, Brazil.

Figura 1: Localización de la Bahia de Ilha Grande, Rio de Janeiro, Brasil.

METHODOLOGY

A literature survey was done focusing present day ichthyologic citations for the region (Ministry of Environment, Brazil-MMA; Ferreira *et al.* 2007, Gaelzer *et al*, 2007) and data on eleven archaeological sites (Sambaqui da Caieira, Sambaqui da Caieira II, Sambaqui do Algodão, Sítio do Bigode I, Sítio do Major, Sítio do Peri, Sítio Ilhota do Leste, Abrigo Ponta do Leste II, Sambaqui Olho D'Água, Sítio Trindade III and Toca do Cassununga) were compiled for fishes records.

Taxonomic, biogeographical and ecological data about the recorded species (environment, habit, behavior, feeding, depth in the water column) were defined according to Carvalho-Filho (1999) and databases *Integrated Taxonomic Information System* (http://www.itis.gov) and *FishBase* (http://www.fishbase.org). Patterns of biodiversity were described by means of species composition and richness as well as number of genera and families.

RESULTS

Seventy one fish species were recorded for the 11 "sambaquis" surrounding Ilha Grande Bay. Most of the species recorded (53.5%) belonging to the Chondrichthyes class, which comprised 9 families and 38 species. *Carcharhinus* Blainville, 1816 was the genus which showed the greater number of species (13). For the class Osteichthyes 16 families and 33 species were recorded. *Cynoscion* Gill, 1861 was the genus with the higher number of species (4). Most of the species recorded has a wide distribution in the Western Atlantic (35.2%) and presents a pelagic behavior (35.2%) as shown in Figure 2. Furthermore, almost all species recorded comprises food chain's top fishes which can reach large sizes.

A comparison between inventories (Past-Shellmounds X Present-MMA) revealed nine species in common: *Dasyatis guttata* (Lesueur 1817), *Larimus breviceps* (Curvier 1830), *Pomatomus saltatrix* (Linnaeus 1766), *Diodon hystrix* (Linnaeus 1758), *Lobotes surinamensis* (Bloch 1790), *Sphoeroides spengleri* (Bloch 1785), *Sphoeroides testudineus* (Linnaeus 1758), *Chaetodipterus faber* (Broussonet 1782) and *Orthopristis ruber* (Cuvier 1830).

The pattern of biodiversity inferred by means of recording number of families and genera is equivalent between inventories (Figure 3a), although Osteichthyes are over represented in the present day records (97,9% of all species) compared with the shellmounds inventory (46,5% of all species). The MMA inventory was done based on a Marine Rapid Assessment Protocol which uses beach seine for fish sampling. On the other hand, shellmounds are artificial accumulations that were selected by prehistoric populations according to its utility such as food, ornament, tools etc. Therefore, the observed distortion in the species number of Osteichthyes for the MMA inventory is probably due to "methodological" differences.

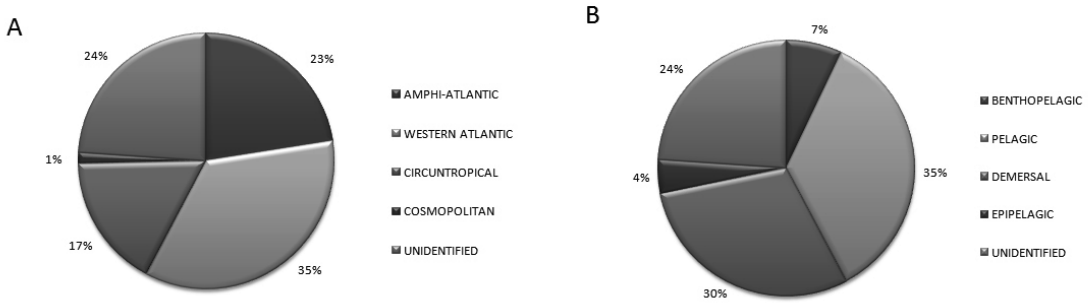

Figure 2: a) Biogeographical distribution of fish species recorded for the analyzed shellmiddens; b) Environmental distribution of fish species recorded for the analyzed shellmiddens.

Figura 2: a) Distribución biogeográfica de las especies de peces registradas en los concheros analizados; b) Distribución ambiental de las especies de peces registrados a los concheros analizados.

A peculiar feature and quite evident from archaeological sites is that the presence of organisms is related to the selectivity of the people who built them. Various factors such as culture, preferences, technical level, food taboos and how the fish bones were discarded or reused as building material were certainly an important role in the composition of the fauna found in the shellmounds. Other issues to consider are the potential for species conservation and the choices of the researcher (which the excavated area, which mesh was used, what were your goals, etc.) (Prummel & Heinrich 2005). Furthermore, cognitive and symbolic aspects are involved even in scientific sampling, since there is a cultural perception of the environment which is guided by culture (in this case the scientific knowledge itself). Such are the differences referred latter as "methodological".

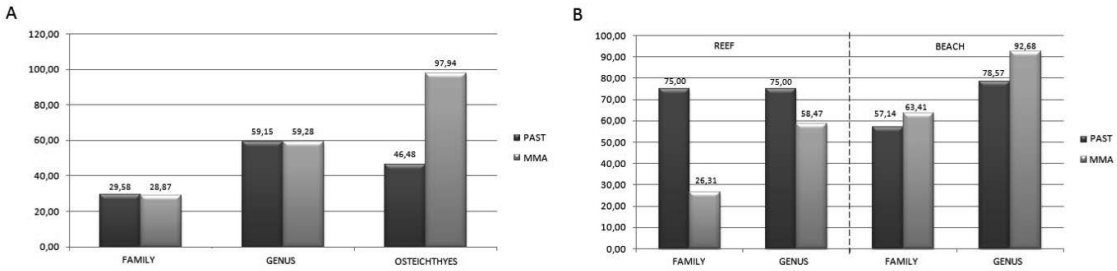

Figure 3: a) Comparison of pattern of biodiversity (proportion of genera and families) between inventories (past-shellmiddens and present-MMA); b) Comparison of pattern of biodiversity (proportion of genera and families) between inventories (past-shellmiddens and present-MMA) in relation to different environments (beach and reefs).

Figura 3: a) Comparación de los patrones de la biodiversidad (proporción de géneros y familias) entre inventarios (pasado-concheros y presente-MMA); b) Comparación de los patrones de la biodiversidad (proporción de géneros y familias) entre inventarios (pasado-concheros y presente-MMA) en relación con distintos entornos (playa y los arrecifes).

Bearing it in mind, a second comparison for patterns of biodiversity between inventories was done using only the Osteichthyes species which were sorted in two different environments: beach and reef. The Chondrichthyes were excluded from this analysis due to the fact that their number was negligible in the MMA inventory. Furthermore, these species moves virtually along all marine environments what makes very difficult to define their resident habitat. This approach revealed divergent results as

shown in Figure 3b. Shellmounds presented higher diversity for reef fishes and current day inventory for fishes from the surf zone (beach). Despite the effort to take on board cognitive perception of the environment, clustering together fishes by habitat, the divergent results obtained can still be caused by the huge differences in "sampling methodology": beach seine adopted by the Marine Rapid Assessment Protocol versus selective capture by prehistoric human communities.

In summary, the construction of biodiversity inventories past and present and their comparative analysis provided valuable information. However, lack of standardization for different data set can be a problem to analysis. A procedure which can reduce the heterogeneity involved in such comparisons is the cluster of the data, such as the one which was done here clustering species in different environment categories (beach and reef fishes). Although the results achieved were not fully satisfactory, the adoption of the clustering procedure enhanced the interpretative ability and also revealed the limitations involved in comparing data sets originating from very different "sampling methodologies".

Despite any methodological limitation, the results presented shows that shellmounds are repositories of valuable information concerning species composition in the past and, therefore, to the study of evolution of biodiversity patterns over time. Furthermore, shellmounds can contribute for a better understanding of marine biodiversity and biogeography of fish species at the Brazilian coast. Data on this nature are especially important for conservation and management strategies for areas of ecological relevance such as the coastal zone of the Ilha Grande Bay.

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