Animals for humans in life and death

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Resumo: Sambaquis fluviais compostos por gastrópodes terrestres estão atualmente localizados a 50 km do litoral na Mata Atlântica, Brasil. Eles foram construídos por grupos de caçadores-coletores que explotaram a floresta a partir de, pelo menos, c. 9.250 a 1.200 anos AP. Amostras arqueológicas de remanescentes humanos e faunísticos de um sambaqui fluvial datado de 6.000-4.000 anos AP, sítio Moraes, foram submetidos a análises de isótopos de carbono e nitrogênio e estudo zooarqueológico para investigação da importância de mamíferos e gastrópodes na composição da dieta destes grupos. Este estudo focou em como a dieta nos sambaquis fluviais foi afetada pelo ambiente do entorno e pela influência sociocultural. Mais do que isto, a pesquisa considera o descarte da fauna e sua utilidade na dieta cotidiana neste sítio.

Palavras-chave: Sambaquis fluviais – Caçadores-coletores – Zooarqueologia – Paleodieta – Isótopos estáveis.

Introduction

The *sambaquis* (shellmounds) are artificial hills of varied dimensions (from 50 to 1,000 meters in length and 1 to 30 meters in height), whose sediment is composed of more than 80% by shells of bivalve molluscs (Figuti 1991). According to historical records, many *sambaquis* were quarried for colonial buildings; recently many were destroyed for the sake of the expansion of coastal cities (Garcia 1972; Uchôa 1982).

Coastal *sambaquis* are widespread in 1500 km of the southeast-south Brazilian coast. They are in the tropical-subtropical climatic zones, associated with the Atlantic Tropical Rain Forest and it's coastal formations. In a geomorphological point of view, most *sambaquis* are located at the estuarine – lagoon areas, dune zone and open beaches, it's less frequent to find *sambaquis* at pure rocky shores environments.

Riverine *sambaquis* seem to concentrate specifically in areas of the Ribeira Valley (southeast São Paulo state), as Itaoca (middle-upper valley) and at tributaries as the Jacupiranguinha River (southern affluent) and the Juquiá River (northern tributary).

According to Barreto (1988), the specificity of these areas would suggest an integrated system of settlement. Because of their proximity to big rivers, and the dates believed to be later than the coastal ones, the hypothesis of a coastal migration from the rivers to inland to reach better economic resources was suggested.

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She also suggested that as a result of the coastal migration it is possible to find some similarities between coastal and riverine *sambaquis*, the construction of the same kind of structure (the shellmounds), although on a different scale, as well as to find faunal remains from the coast on riverine *sambaquis*. In the riverine *sambaquis*, as in the coastal ones, there is high density of burials. Thick layers composed of land snail shell form circular and convex shapes over the ground which can vary in size from 500 to 1900 m^2 (Figuti 1991).

The faunal remains found in the Riverine *sambaqui* are mostly composed of land snail shells of *Megalobulimus* spp., and bones of terrestrial mammals. Fish, amphibian, bird and reptile vestiges appear with variables and minor frequencies. It has been suggested that this assemblage could reflect the main diet of that population.

The riverine *sambaqui* present an abundant industry of faunal material (bones, teeth, antler and shell), mostly projectiles tips and adornments. Although few, the sea faunal remains as shark teeth beads, ray spine tips and shells are presented on these sites. The lithic industry remains are also abundant and are characterized by knapped tools and polished artefacts as arrowheads, mortars and axes, which show significant techno-typological and quantitative inter-sites variations.

A project with the title of *Archaeological and Geophysical Investigations on Riverine Sambaquis of São Paulo* (IAGSFL) was developed from 1999 to 2004 and carried on by professors from the Archaeological and Ethnological Museum and the Biology and Geology Departments of University of São Paulo, Brazil.

This project aimed at investigating the São Paulo state riverine *sambaquis* from different methodologies, geophysical, archaeological and bioarchaeological (Figuti *et. al.* 2004). Regarding the structural and cultural characteristics of these sites, the project pointed out the preference of these groups for a settling of these sites on plains or low lands, with exceptions, some few sites are located on the top of mountains or valleys far from water resources.

This project generated a series of radiocarbon dating for 18 sites (Table 1). For that, it was then tried to obtain samples from top and bottom of the sites from Jacupiranguinha (5), Juquiá (3) and Itaoca (10) areas (Map 1).

Through the graphs above it is possible to note three chronological sets for the riverine sambaqui.

> The first one is the early riverine *sambaquis* (9250 to 8500 yr. B.P.). These sites are concentrated on the Jacupiranguinha area.
>
> - 1st Interval: 8,500 to 7,000 yr. B.P. (1500 yr.).
>
> The second one is the riverine *sambaqui* expansion (7,000 to 3,500 yr. B.P.). That represents 9 sites spread in three areas of research.
>
> - 2nd Interval: 3,500 to 1,700 yr. B.P. (1,800 yr.).
>
> The third one is the late period of riverine sambaquis (1,700 to 1,200 yr. B.P.). 7 sites located at Itaoca area represent this set.

Overall, the settings of obtained ages pointed out that the riverine sambaquis inhabitants in this area are among the earliest ones already known from all the Brazilian area, which the burial II from Capelinha site (8,869 yr. BP) is the earliest one in São Paulo state.

The Moraes site

The Moraes site is located aside Moraes stream, tributary of São Lourenço river, in Miracatu city (UTM 23 J 0256908/7313340).

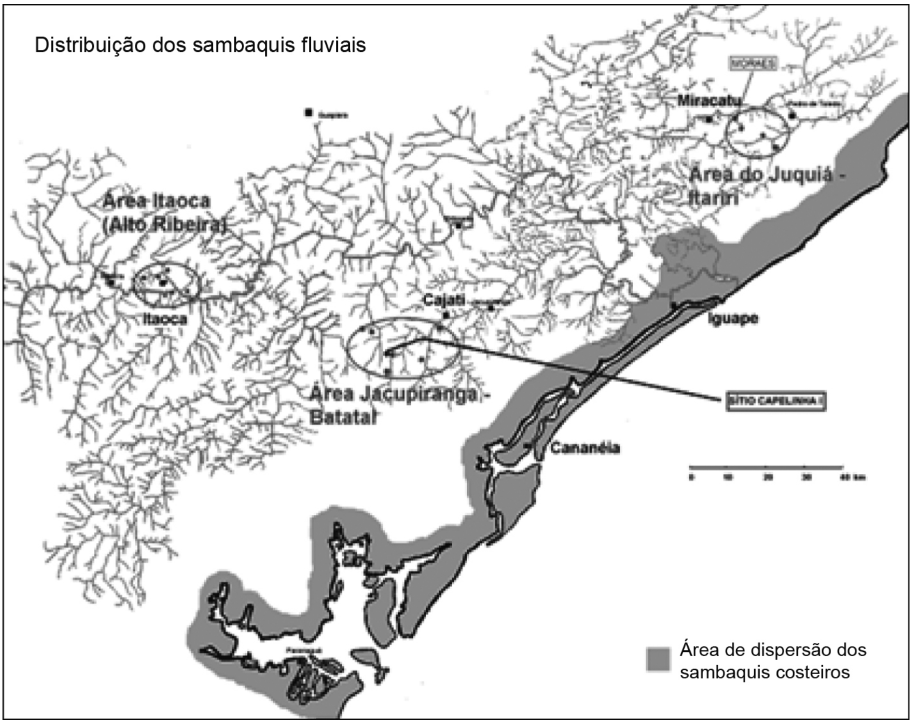
In the south side of the site there is a granite/gneiss bedrock and an irrigation ditch; in the east there is Moraes stream and in the north a plain terrain. In the west (north-south direction), a road has been opened, exposing the site's profile.

Nowadays the site presents an elevation with 30 m of diameter and 2 m height all covered by low vegetation and it is located in the middle of a banana plantation. In the last few decades, diverse plantations were placed

Table 1

Radiocarbon dates of riverine sambaquis obtained by IAGSFL. Source: **Figuti *et al.*** (2004)

Area	Site	Provenience	Deep (cm)	Conventional Age	Calibrated Age	Sample	Lab. No.
Jacupiranguinha	Capelinha I	J10	10-20	9,250 +/– 50	10,560 to 10,250	shell	Beta 189331
Jacupiranguinha	Batatal I	S1	50-60	9,050 +/– 100	10,415 to 9,915	shell	Beta 189329
Jacupiranguinha	Capelinha I	V'41 (sep. 2)	0-30	8,860 +/– 60	10,180 to 9,710	bone	Beta 153988
Jacupiranguinha	Capelinha I	R11	90-100	8,795+105/–100		coal	A 11239
Jacupiranguinha	Capelinha I	R11	80-90	8,500 +/– 70		shell	A 11236
Juquiá	Laranjal	S1	40-50	6,980 +/– 90	7,965 to 7,645	shell	Beta 189337
Jacupiranguinha	Capelinha I	Sep. 5	10-20	6,090 +/– 40	7,020 to 6,850	bone	Beta 184619
Juquiá	Moraes	F19 (Burial 3.)	130	5,895 +/– 45	6,777 to 6,665	bone	KIA 15561
Jacupiranguinha	Timbuva	S1	20-30	5,740 +/– 50	6,660 to 6,410	shell	Beta 189339
Juquiá	Moraes	F07 (Sep. 37)	35	5,420 +/– 30	6,289 to 6,174	bone	KIA 20843
Juquiá	Alecrim I	S1	10-20	5,310 +/– 50	6,250 to 5,940	shell	Beta 189330
Jacupiranguinha	Capelinha II	S1	30-40	5,000 +/– 70	5,910 to 5,600	shell	Beta 189332
Juquiá	Moraes	F20 (Burial 5)	100	4,985 +/– 35	5,745 to 5,658	bone	KIA 15562
Jacupiranguinha	Capelinha III	S1	90-100	4,530 +/– 50	5,320 to 4,990	shell	Beta 189333
Juquiá	Moraes	G26 (Burial 25)	25	4,511 +/– 32	5,200 to 5,048	bone	KIA 20844
Jacupiranguinha	Capelinha III	S1	90-100	4,500 +/– 40	5,310 to 4,980	coal	Beta 189334
Itaoca	Estreito	Burial 6	130	4,124 +/– 27	4,658 to 4,567	bone	KIA 20846
Itaoca	Tatupeva	S1N2	10-20	3,990 +/– 70	4,800 to 4,770	shell	Beta-184623
Itaoca	Estreito	Burial 1	25	3,655 +/– 26	4,011 to 3,893	bone	KIA 20845
Itaoca	Pavão II	S1	10-20	3,530 +/– 70	3,980 to 3,640	shell	Beta 178127
Itaoca	Itaoca I	S3	50-60	1,730 +/– 40	1,720 to 1,540	coal	Beta 189336
Itaoca	Gurutuba IV	S3	50-60	1,650 +/– 40	1,620 to 1,430	coal	Beta 189335
Itaoca	Caraça	S5N8	70-80	1,607 +/– 24	1,434 to 1,416	coal	KIA 20839
Itaoca	Pavão XVI	Burial 1	30	1,571 +/– 24	1,525 to 1,408	bone	KIA 20842
Itaoca	Itaoca I	S1	20-30	1,460 +/– 60	1,500 to 1,280	shell	Beta 178126
Itaoca	Lageado IV	S1	10-20	1,460 +/– 60	1,500 to 1,280	shell	Beta 178128
Itaoca	Caraça	S5	10-20	1,300 +/– 60	1,310 to 1,070	shell	Beta 178125
Itaoca	Guaracuí	S1	10-20	1,270 +/– 70	1,300 to 1,050	coal	Beta-184621
Itaoca	Pavão III	Burial 1	20	1,219 +/– 24	1,182 to 1,062	bone	KIA 20840



Map 1. Geographical distribution of riverine shellmounds and its relation with the coastal ones.
Source: Figuti et.al (2004).

above the site (including banana plantations). These plantations provoked a series of taphonomical processes, which were particularly intense on the first layers.

The site was built above a palaeobeach with alluvial sandy-clay sediment formed by Moraes stream. There is the possibility that this beach had higher dimensions than nowadays. However, this palaeobeach is thicker under the archaeological site today because of the site protection from intemperisms. The palaeobeach is discreet on the surrounding of the site due to intemperism and human actions that impacted the entire area.

On the top of the beach there are 4 archaeological layers that compose the Moraes site (Profile 1):

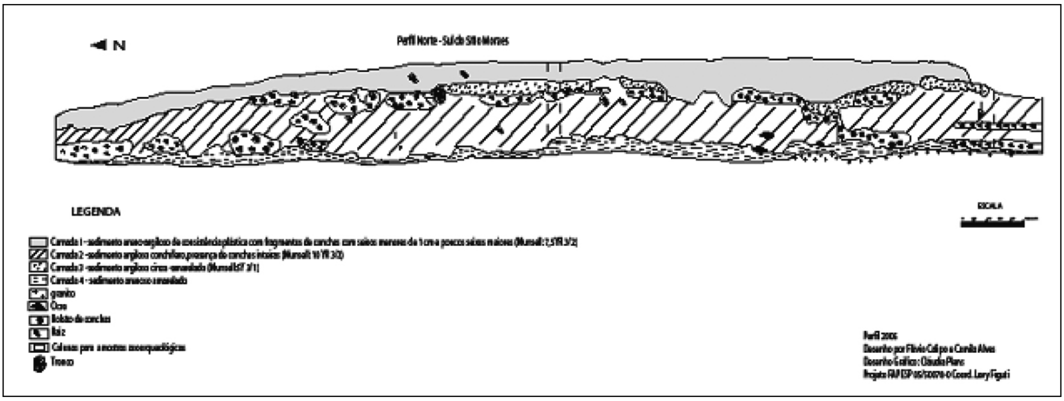
1 Dark Sandy-clay layer. Responsible by the cover of the site, this layer presents low quantity of archaeological remains and higher quantity of rubbles bigger than 1 cm. Its thickness varies between 10 and 30 cm;

2 Dark clay-sandy layer. Landsnail shells concentrations were found at this layer and a high quantity of archaeological remains (lithic, osteodontokeratic and malacologic artefacts and faunal remains). It was found high quantity of human burials. Its thickness varies in general between 50 and 100 cm;

3 Light grey clay-sandy layer. This layer has similar composition on archaeological remains. Its thickness varies between 30 and 50 cm;

4 Yellow-orange clay layer. Part of the "palaeobeach" is also compounded by sediment decomposition of the matrix rock next to the site. From the point of view of archaeology, this layer is almost sterile, however, the first burials were put in this layer.

Dating on burials from different places in the site indicate 2,000 years of building process for the site (6,000-4,000 BP).



Profile 1. Moraes site profile.

Methods

Zooarchaeological analysis

The faunal assemblage from the Moraes site was recovered from excavations carried out from 2001 until 2004, through artificial level of 10 cm.

Aiming at understanding the relationship between the faunal assemblage and the building process of the Moraes site, some procedures were adopted to the curatorial work, identification and analysis. The assemblage was described according to the protocol proposed by Figuti (personal communication): trench, provenience number, initial and final levels, class, anatomical elements, preservation degrees [type of fragmentation and burning], the observation traces, anatomical sides and species. Finally, the data was compiled in a computer and converted into graphs using Microsoft Excel. For data treatment, beyond distinguish classes of mammals, it was considered more three categories for unidentified species but identified anatomical element: big, medium and small animals.

Two indexes were considered for this report, Number of Identified Specimens (NISP) and the Minimal Number of Individual (MNI). NISP is the index that indicates the number of species on the global assemblage. Above all, this index is important because of the degree of the bone fragmentation that does not allow the total identification of the specimen in some cases. However, it might be imprecise in relation to the quantity of found species, because a higher tendency to the fragmentation of some anatomical elements may over estimate the number of specimens identified.

The MNI is the index employed to reduce the number of identified specimens to a minimal number of individual necessary to compound an assemblage. Although more selective than NISP, this index is just employed as an indicative, once the material may be fragmented by bad conservation and also not be properly identified. In order to obtain an accurate number of MNI, it is necessary an evaluation of age, sex, anatomical side and also the contemporaneity of the archaeological layers of the fauna provenience.

The purpose of this report is to use the fauna's MNI as a general proportion estimative of the fauna assemblage by identified anatomical side in comparison with the NISP, to discuss amphibious and mammal proportion (the most abundant classes present in the Moraes site).

Some taphonomical analyses are important to indicate natural and cultural processes that occurred in the site (Lyman 1994). Natural taphonomical processes may protect or destroy the bones [e.g. break pattern of the bone (related to the bone structure, as porosity degree, morphology, size and mineral density)]. Cultural taphonomical processes imply at human choices and actions that may lead to different degrees of bone fragmentation during the transport process, cooking, consumption and distribution (Kipnis 2002:205).

Faunal presence in archaeological site may imply different choices and natural causes. Costamagno *et al.* (2002: 51) and Worley (2002: 63) have suggested that burned bones in archaeological site may lead to different causes (accidental, utilitarian and rituals). Accidental reasons are resulted from the processing of food or bone utilisation as fuel. Ritual reasons are in cases of food offer during ceremonies. However, these three points may also be valid to not burned bones, and may be considered for the comprehension of the building events of the site.

Carbon and Nitrogen Stable Isotopes analysis

Firstly applied in Archaeology by Vogel and van der Merwe in 1977, the stable isotope technique has been explored to answer ancient diet through the analysis of human and faunal archaeological collagen (Milner *et al.* 2003: 9). The isotopes of the collagen generally represent the consumption of protein that used to be consumed during the last 10 years before death. Because the diet is responsible for the formation of our skeletons, it makes food to be reflected in the remodeling of bones. Therefore bones are not just the result of genetic history but also the outcome of a cultural expression thorough the diet pattern.

Thinking about stable isotopes analysis in human bones, because it reflects the individual isotopes, this analysis allows not just inter-group comparative studies but intra-group analysis as well, helping the archaeologist to understand the variation in alimentary taboo among people of different gender and age (Eriksson 2003: 14). On the other hand, the advantage in making the stable isotope analysis is that it reveals, in comparison with the fauna's data, a picture of the environment in which the group was inserted and its relation with the animals and, because of that, it may help to trace migration routes (De Masi 2002: 113).

Not just the human bones can be evaluated by stable isotope but also the teeth as well – though, through the dentine and not from the collagen –, and because it is formed during the first years of the individual life, it reflects the prevalent diet only during the age of the formation of the dentin, which is the infancy (Liden *et al.*2003: 1). In other words, the teeth indicate the food consumption in childhood and, on the other hand, the bone indicates the collagen from the food in the last 10 years according to the age formation of the bone structure (Richard *et al.* 2001).

On the whole, the isotopes used with the aim of locating the environmental place where the food came from (e.g. sea coast or terrestrial landscapes) are of carbon and nitrogen (Richard *et. al.* 2001: 6528). The isotopes applied for diet analysis are: $^{12}C/^{13}C$ (^{13}C) and $^{15}N/^{14}N$ (^{15}N). Through the ^{13}C analysis is possible to distinguish marine protein consumption from that of terrestrial proteins. The plants are divided in three categories, C_3, C_4 and CAM plants depending on how many carbons it has. C_4 plants such as maize and grasses (eaten by herbivores) are usually found in arid environments, C_3 in most fruits and plants found in temperate climates. The CAM plants (Crassulacean Acid Metabolism) have an inverted metabolism from others plants because they absorb CO_2 at night. This process facilitates the water utilization and therefore this kind of plant is found especially in warm environment.

The analysis of ^{15}N makes it possible to differentiate the proportion of consumed plants compared to animal protein. Because of the fractionation effect, the nitrogen is an indicator of the position of a food item in a food chain. It means that the ^{15}N will increase from carnivores to herbivores at the food chain. Due to the difference in the length of the food chains between aquatic and terrestrial environments it is possible to evaluate the consumption of different resources. Thus, the value of marine carnivores and fish are higher than herbivorous terrestrial animals. In the same way the consumption of aquatic resource normally means a ^{15}N higher value than terrestrial resources consumption (Richards *et al.* 2001).

Other criticism in respect of the stable isotope methods has been pointed by Milner *et al.* (2004) in relation to the debate about the transition from Mesolithic to Neolithic periods in Europe. Some researchers point out that because of the difference in the stable isotope ratios in human bone collagen, the consumption of shellfish during these two periods seems to differ. If in the Mesolithic the shellfish consumption seems to be predominant, on the other hand a complete avoidance of it would prevail in the Neolithic period according to the stable isotope data. Although in the archaeological assemblage the shellfish remains is still found in the Neolithic.

Discussing about the avoidance of the shellfish in the Neolithic, Milner *et al.* (2004: 16) argue that, although important for the archaeological interpretation of the diet, some care should be take in the use of the stable isotope to avoid misunderstanding the data. Therefore, the results should be put in a wider context. The presence of marine carbon in the bone collagen does not mean necessarily that it was used for direct consume, but it could fix at the collagen through the beach scavenger, for example. In the same way, because terrestrial detritus can be present in the marine food chain (it can generally happens to the mollusc consume because its facility to consume a high proportion of terrestrial carbon), the ingestion of marine food can be misunderstood in stable isotope. Trying to control this problem it is necessary measure human bone, marine molluscs, fish and marine mammals.

Bailey and Milner (2003-4: 10) call attention for the food remains in shell mounds used to refer to time consumption by many individuals over a long period of time, whereas the isotope measurement is related to the last ten years of life of an individual. Rather than a problem both associated methodologies may contradict each other in different scales and contribute for a better understanding about the consumption in past.

Bones and permanent teeth *samples of* human individuals from Moraes site (6,000-4,000 year BP), Capelinha site (9,000 years BP) and Estreito site (3,000 years BP) were submitted to $^{12}C/^{13}C$ (^{13}C) and $^{15}N/^{14}N$ (^{15}N) analysis on *Beta Analytics Laboratory.* Also, faunal bones samples (mammals, amphibious and fish) from Moraes site were submitted to the same laboratory for the same analysis.

For the purpose of having the (^{13}C) and (^{15}N) stable isotopic signature of the land snail *Megalobulimus sp.* one alive specimen was taken above another riverine shellmound (Laranjal site), 5 Km from Moraes site. The *Megalobulimus sp.* specimen flesh was first lyophilised at the Faculdade de Ciências Farmacêuticas, Departamento de Tecnologia Bioquímico-Farmacêutica (USP), grounded at the Zooarchaeological Laboratory at the Museu de Arqueologia e Etnologia (USP) and then submitted to stable isotopes analysis at CENA (USP).

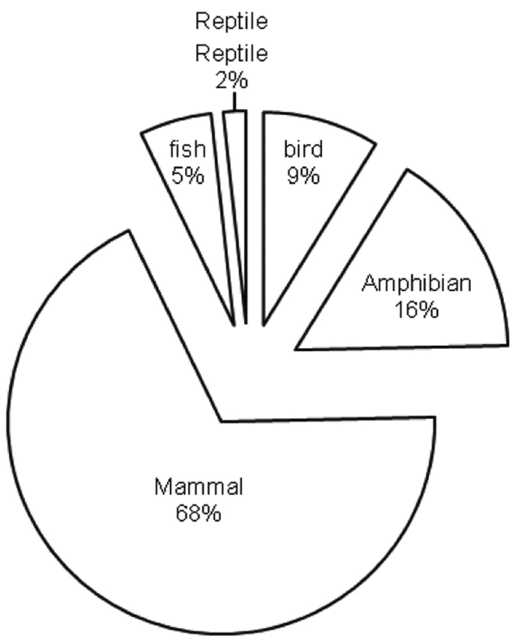
Finally, for purpose of the discussion, it was employed frequency and prevalence of carie on Moraes human's teeth. The primary analysis carried out by Veronica Wesolowski was kindly given for data treatment and discussion of this paper.

Results

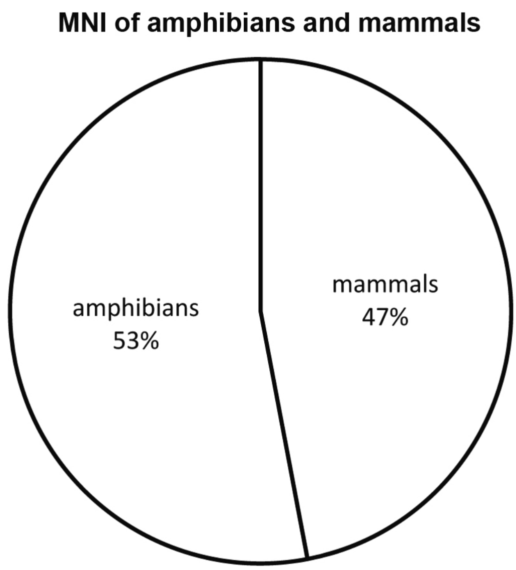
34,160 vertebrate fragments of all sizes and classes were identified on the faunal assemblage. This assemblage is a result of the excavation by artificial levels of 10 cm, totalling an area of 70 $m^{2.}$ of the site.

The evaluated fauna NISP indicates the predominance of mammals, followed in decreasing order by amphibious, bird, fish and reptiles (Graph 3). Taking into account that the riverine shellmounds are settled in a tropical rain forest environment, the Atlantic Forest, the high frequency of mammal (68%) is not surprising, however, the important presence of amphibious is an uncommon fact in archaeological sites. Moreover, because mammal and amphibian proportions becomes inverted in the MNI [(amphibians (233) exceed mammals (203)] (Graph 4).

The high frequency of amphibious bones presented at Moraes site was considered under two hypotheses to be tested. First, the groups which built the riverine shellmounds used amphibious as food resource as any other animal class, and second because of the location of the archaeological site settlement, a marsh area, the amphibious would have died above the site by natural causes.



Graph 3. NISP of vertebrate faunal assemblage of Moraes site by class of animals

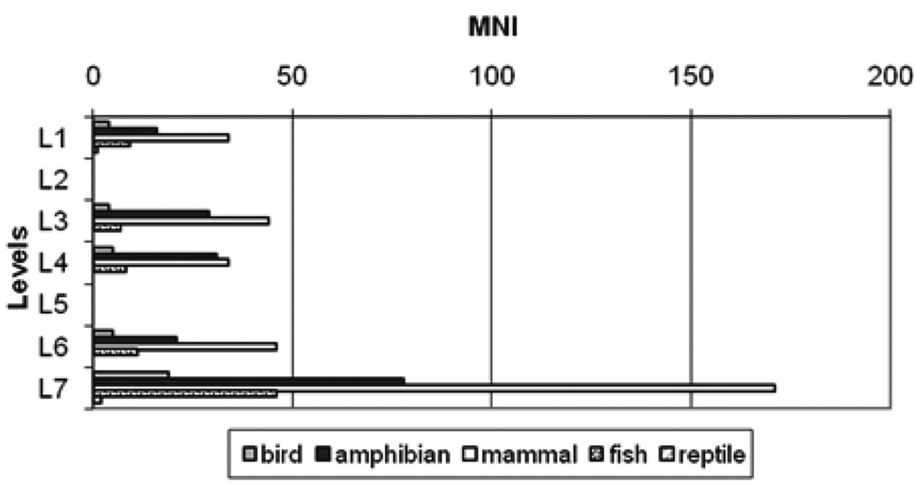


Graph 4. MNI of amphibious and mammals.

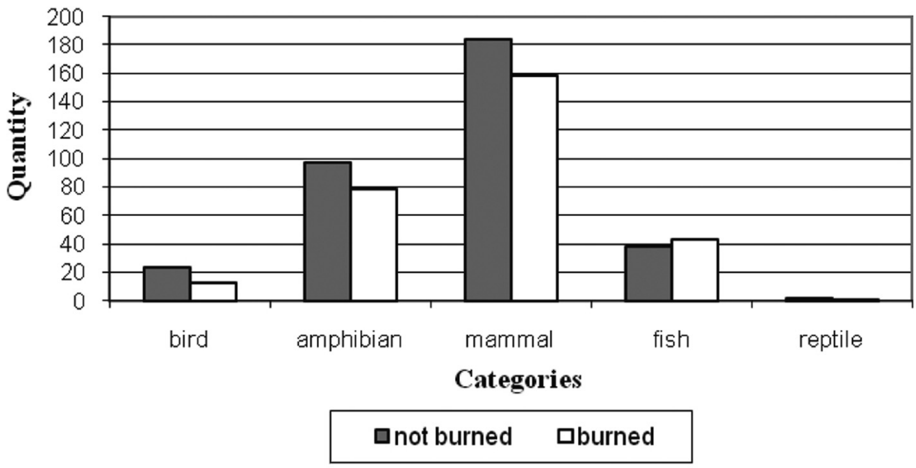
To test both hypotheses the dispersion of the zooarchaeological assemblage by artificial levels of 10 cm in the trenches was evaluated. The pattern showed in the results is exemplified by the case of the trench S22 (Graph 5).

The frequency of amphibious fragments seems to follow the mammal pattern. As pointed out on the graphs above, mammals and amphibious elements increase according to the excavation depth. The graph of burned fragments versus not burned reflects the same pattern of burning between mammals and amphibious. These results point out to the same disposal condition for amphibious as others classes of animals, above all, mammals. In this case, it is possible to conclude that amphibious were deposited in the site by humans as the others animals (Graph 6).

The most recurrent fish remains in the collection came from fresh water fishes, as



Graph 5. Faunal distribution by artificial levels. S22 trench.



Graph 6. Faunal categories by burned and not burned bones. S22 trench.

sheat-fish and cook's aprons *(Pimelodidae e Locariidae* families). The amphibious could not be identified by species, just as member of the *Anura* Order. Among the reptile, turtles and Brazilian lizard (*Tupinambis teguixin*) were identified. The bird vestiges could not be identified by specie. The fragments of those classes of animals were found in all trenches and levels of the Moraes site.

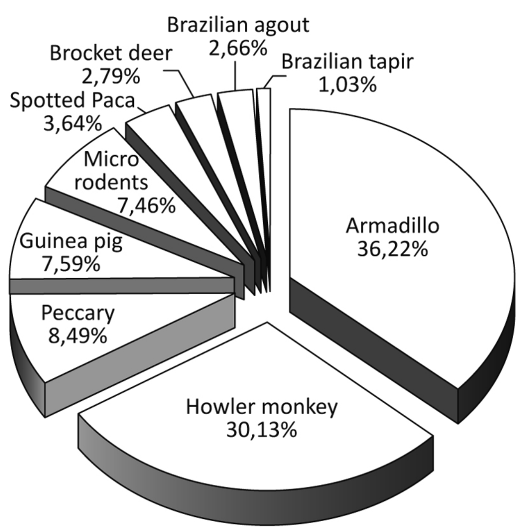
On the other hand, the mammal vestiges could be identified in larger number of species. The mammals NISP is 2,343 among which it was observed 198 individuals through MNI index (11 species and 2 orders) (Graphs 7 and 8; Tables 2 and 3).

In decreasing order of mammal NISP are armadillo, howler monkey, peccary, Spotted Paca, Guinea pig, Brazilian agouti, Brazilian tapir, opossum, brocket deer, which presented different patterns of bone preservation. The remains of the armadillo are predominantly represented by the preserved scutes.

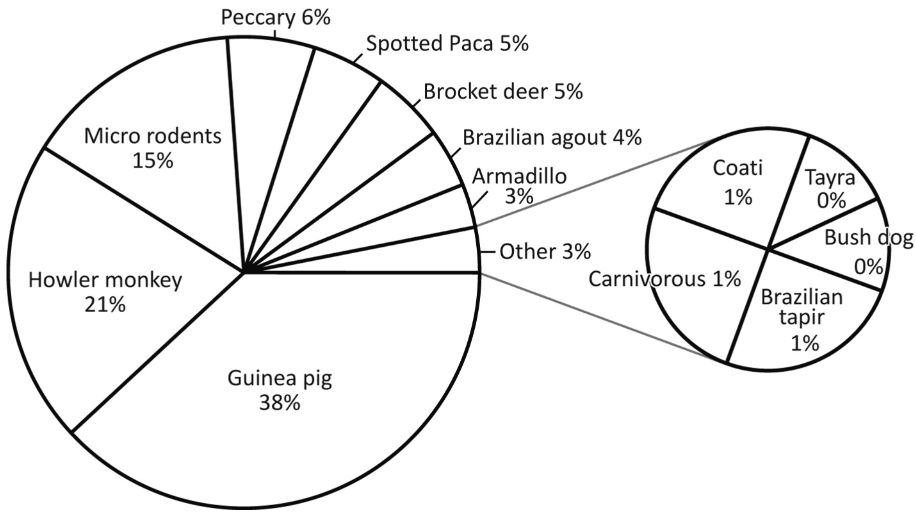
The major NISP is represented by the armadillo (*Dasypodidae),* which is the animal that presents the highest number of scutes by individual. However, the MNI index (calculated through bones) changes this specie position to the 8th place, representing only five individuals.

In general, there is no variation between NISP and MNI indexes for the others species, except for the Brazilian Guinea Pig (*Cavia aperea)*, the most significant case. The Brazilian Guinea Pig occupies the 4th according to the NISP, but the MNI grants it the first position as the most present specie among the remains.

The howler monkey (*Allouata sp)* presented more cranial evidences, probably due to higher conservation degree especially on teeth. Peccary (*Tayassu* sp.*)* remains follow the howler monkey with higher quantity of identified specimens from skulls, especially teeth. However, in this case the elevated presence of astragalus and calcaneous indicates that this animal might have been taken as a whole to the site.



Graph 7. Mammal percentage by NISP at Moraes site.



Graph 8. Mammal percentage by MNI at Moraes site.

Table 2

Mammals NISP from Moraes site

Taxa	Popular name	NISP	%
Dasypodidae	Armadillo	845	35.87
Allouata sp.	Howler monkey	703	29.84
Tayassu sp	Peccary	198	8.40
Cavia aperea. Sp	Guinea pig	177	7.51
Micro rodents	–	174	7.39
Agouti paca	Spotted Paca	85	3,61
Mazama sp.	Brocket deer	65	2.76
Dasyprocta	Brazilian agouti	62	2.63
Tapirus terrestris	Brazilian tapir	24	1.02
Didelphis sp	Opossum	13	0.55
Nasua nasua	Coati	5	0.21
Carnivorous	–	3	0.13
Eira barbara	Tayra	1	0.04
Speothos venaticus	Bush dog	1	0.04
Total		2,343	100%

Spotted Paca *(Agouti paca)*, Guinea pig *(Cavia),* Brazilian agouti (*Dasiprocta* sp.), Brazilian tapir *(Tapirus terrestris)*, opossum *(Didelphis* sp.*)* present higher teeth preservation in comparison to bones. In general, the main cause for the lower NISP for these animals is the high fragmentation presented by these bones and also the similarity among rodent bones.

The most identified specimens of brocket deer *(Mazama* sp.*)* were bones rather than teeth. In that case, bone conservation seems be higher than in other animals, probably because the compactness of these bones.

Spotted Paca was sparsely found in its distribution throughout the site. Big size animals have presented a higher tendency of bone fragmentation and this is probably the most important cause for the low rate identified bone elements.

Big Mammals

These specimens are found widespread throughout the site, although in a heterogeneous and sparse manner. Most of the specimens are midshaft diaphises and teeth. The high quantity of fragments of diaphises is caused by the tendency of fragmentation of these bones. Whilst the high teeth fragmentation indicates that physical strength is an important taphonomical process that acts on this element.

The other majority elements on this category are vertebrae, shifts and phalanges. This indicates that the big size animals were taken as a whole to the site. In this case it is important to notice that limb bones were found proportionally

Table 3

Mammals MNI from Moraes site

Taxa	Popular name	MNI	%
Cavia Sp	Guinea pig	76	37.44
Allouata sp.	Howler monkey	41	20.20
Micro rodents	–	30	14.78
Tayassu sp	Peccary	12	5.91
Agouti Paca	Spotted Paca	9	4.43
Mazama sp.	Brocket deer	9	4.43
Dasyprocta	Brazilian agouti	7	3.45
Dasypodidae	Armadillo	5	2.46
Didelphis sp	opossum	5	2.46
Tapirus terrestris	Brazilian tapir	3	1.48
Carnivorous	–	2	0.99
Nasua nasua	Coati	2	0.99
Eira bárbara	Tayra	1	0.49
Speothos venaticus	Bush dog	1	0.49
Total		**198**	**100%**

Middle mammals

Spatial distribution of middle size mammals fragments, not identified taxonomically, shows higher ratios than big size mammals, concentrated in areas next to burials.

In relation to anatomical distribution, the most abundant remains are diaphises, although the high degree of fragmentation did not allow the taxonomical identification. Shifts and cranial fragments were also abundant elements. Among long bones, fragments of femurs and humerus were identified. The highest degree of preservation among middle size mammals is found on vertebras probably due to its compactness.

Small mammals

Small size mammals are presented in lesser quantity than big and middle size ones. This assemblage could be properly identified anatomically, although it could not be taxonomically identified because of the similarity of the small size mammal bones.

80% of small size mammals were identified as being rodents. Once more, the most preserved element in this category are incisive teeth (22.7%) followed by rodents' mandibles and long bones.

Spatial distribution of vertebrate fauna (NISP)

The spatial distribution of identified zooarchaeological specimens reveals disproportional among trenches (e.g. P11, P12 e S21, S22). This may occur due to the fact that a higher bone fragmentation (above all mammals) and higher material deposition occur in specific trench levels (Table 4).

Trenches on F, P and S lines present high quantity of identified specimens, while in the trenches on lines E and D the quantity of fragments are smaller. This difference probably occurs because of the impact that the road cut made on the site. The smaller quantity of fragments on G line occurs for different reasons. In general, trench excavations on G line were restricted to the first levels.

Of the 51 excavated trenches, 20 presented burials, representing 39% of the excavated trenches, where 41 skeletons were found. The fauna directly found in trenches with burials represent 71% (24,255 NISP) of total NISP in Moraes site (34,160 from 51 trenches). Observing the faunal distribution, it may be noticed the variations in quantity in the faunal distribution among the site is related to the trenches where burials were identified (Graph 9).

In order to understand the relationship between faunal and burial distribution, trenches from different areas of the Moraes site were selected to evaluate patterns of spatial distribution. For that matter, the results of five trenches will be shown (F22 with five burials, F16, S22 and P12 with one burial each and L24 without burial).

For this purpose, the data of two types of graphs was converted, one in relation to quantity of animal classes and another one with faunal distribution by artificial levels. The categories related on the graphs are described as followed: **a**-bird, **b**-*batráquio* (amphibious), **u**-undetermined vertebrate, **m**-mammal, **f**-fish, **r**-reptile.

Table 4

Spatial distributions of identified specimens at Moraes site

Trenches	D	E	F	G	L	P	S
07			284				
11			459			48	
12			932			**3,966**	
13			1,011				
14			1,816				
15			193				
16			1,499	16			
17			471				
18			831				
19	44	165	134	121			
20			727	24			
21		65	468				1,218
22		30	1,213				2,722
23		11	2,611				
24			2,855	327	468		
25			1,780				
26		118	1,926	50			
27			51	169			
28		395	404				
29		64	241	109			
30	3	39	258				
31			1,655	4			
33		651	338				
34		539	307				
36		254	63				
38			10				
40			3				

The faunal assemblage on trench F22 followed the pattern presented by the entire site, presenting predominance of mammals (56%), followed by amphibious (20%) and fresh water fish (3%) (Graph 10).

The distribution graph by levels indicates that the increase of faunal remains starts on the level in which the first burials, from a total of five superposed burials, appear.

The trench S22 does not present distinction on specie proportion presented by the site: mammals (48%), amphibious (25%) and fish (11%). The peculiarity in this trench is the presence of one invertebrate specimen (crustacean) from marshy area (0.15%) (Graph 11).

About the faunal disposal by levels, it may be noticed that the number of fragments triplicate in the last level of S22 trench (48% of the faunal is found in the last layer 2.20–2.30m), next to the burial no. 15, which was located between 1.90–2.44 m (levels 4 to 9).

In P12 trench the proportion pattern presented by the site is Brazilian tapir: mammal (67%), amphibious (16%) and fish (5%). Once more the presence of one crustacean fragment from a marshy area is noticed (Graph 12).

The burial no.14 was found in this trench between naturals levels of 2.33 and 2.73 m (artificial levels 3 to 7), in which 58% of the total fauna of the trench was displayed. If included the level between 2.73–2.83 m (above where the burial was disposed), the proportion increases to 78% of the total fauna of the trench.

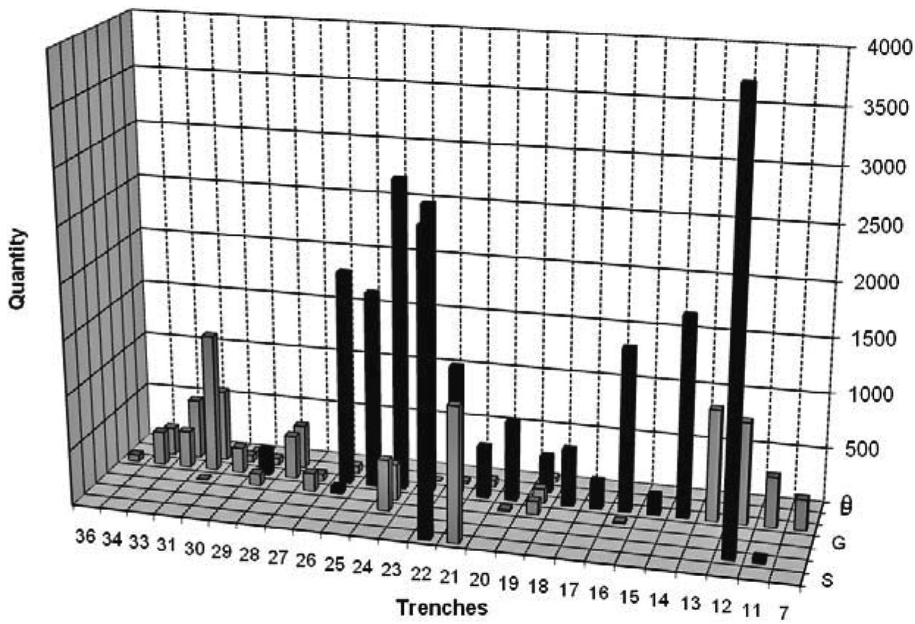
In L24 trench, the proportion of mammals is maintained above 50%, though there was a subtle inversion in the second category: the fresh water fish (19%) surpasses the quantity of amphibious (15%) (Graph 13).

This trench does not present burials and its levels with higher quantity of fauna are located among clay-sandy compact sediment, which is found above a thick layer of land snail shell.

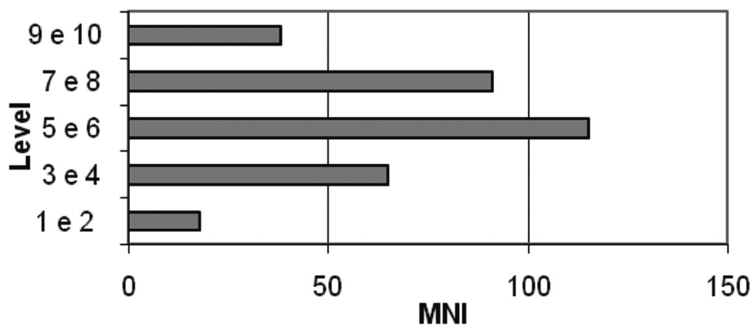
In F16 trench, the proportion of species presented is similar to the entire site pattern, with one peculiarity that is a subtle increase of reptile specimens (2.5%). Mammal (59%), amphibious (18%) and fish (7%) (Graph 14).

Once more, the highest proportion of fauna is concentrated in levels which correspond to a burial (68%). The burial no.3 is present from level 1.95 m to approximately 2.35 m (level 4 to 8).

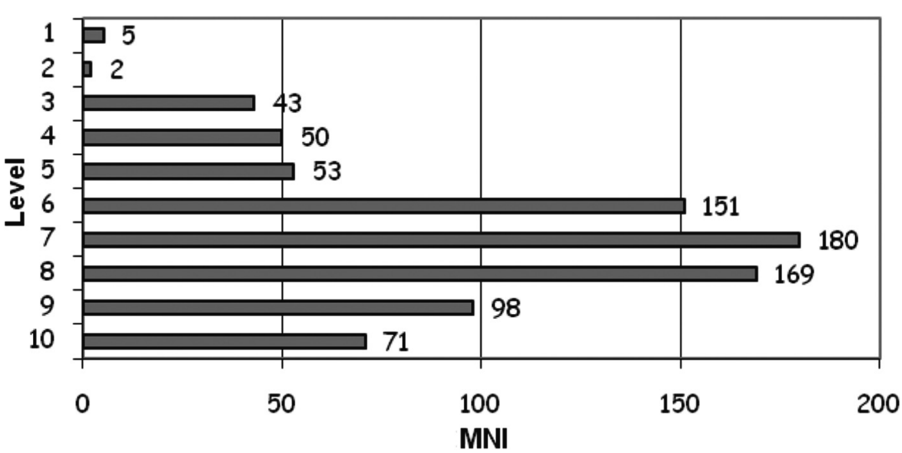
In general, the analysis of faunal distribution by artificial levels permitted to correlate fauna



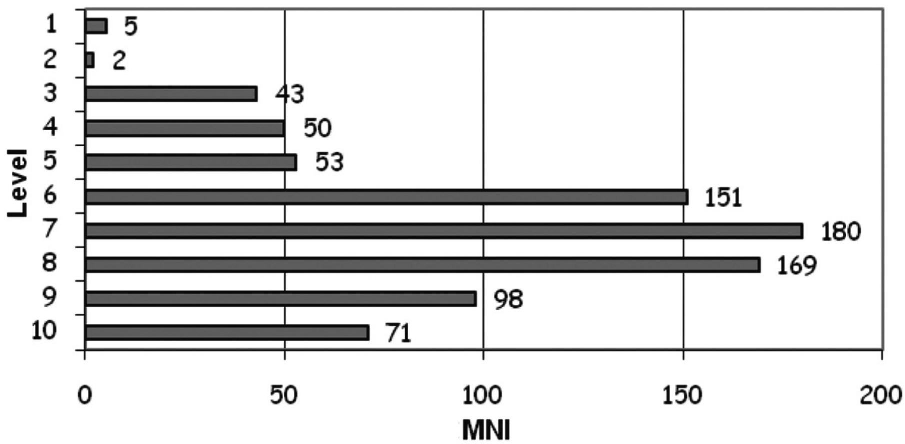
Graph 9. Faunal distribution by excavated trenches on Moraes site. In black are outlined burials that presented burials.



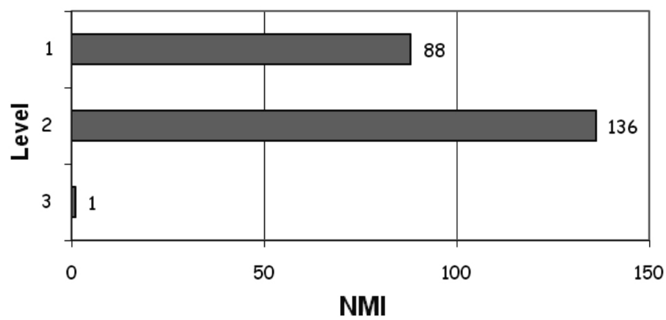
Graph10. Faunal distribution by artificial levels.



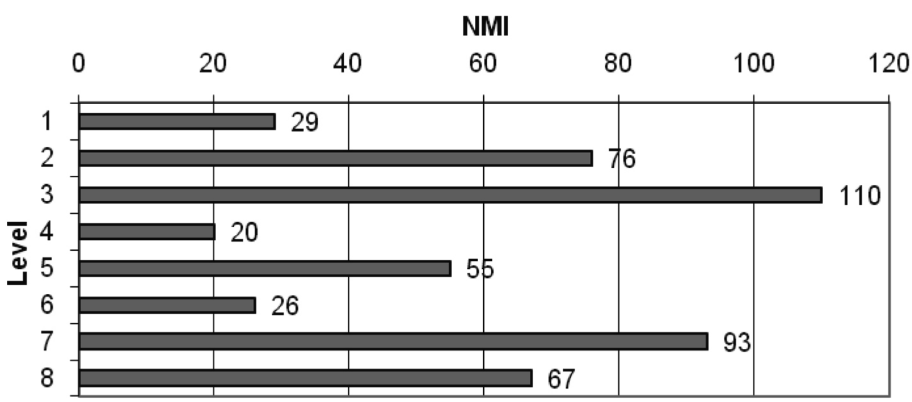
Graph 11. Faunal distribution by artificial levels



Graph 12. Faunal distribution by artificial levels.



Graph 13. Faunal distribution by artificial levels.



Graph 14. Faunal distribution by artificial levels.

concentration to burial areas. Even trenches without evidence of burials showed traces of human bones on the profile, suggesting some correlation between fauna and burial in these cases too.

Carbon and Nitrogen Isotope Analyses

The association of identification and spatial distribution of faunal remains with palaeodiet, obtained at this research by stable isotopes analysis of carbon and nitrogen from human bones and teeth and faunal bones, allowed to develop a discussion about the riverine shellmound group's consumption.

For complementation of the ratios evaluated at this research, comparative data of archaeological literature was utilized (De Masi 2002; Keegan & DeNiro 1988), aiming at amplifying the discussion about stable isotopes from different environments.

The liophilized samples of *Megalobulimus* spp. were submitted for three repetitions. However, the three values presented relatively similar indexes and therefore it was selected the intermediary values for the graph confection.

The results of stable isotopes analysis of carbon and nitrogen of human individuals from three riverine shellmounds with different chronology[1] presented little variation on values of $\delta^{13}C$ and $\delta^{15}N$ among the individuals: $\delta^{13}C$ (–19.2 and –21.4; pattern deviation= 0.86), and $\delta^{15}N$ (9.6 to 11.9; pattern deviation=1.04) for human bones and $\delta^{13}C$ (–21 to –23) and $\delta^{15}N$ (11.9 a 12.6) for teeth. These values, with variation lower than two points, indicate homogeneity in relation to food consumption for these groups during, at least, 7,000 years (Table 5).

Isotopic results from bones show that riverine shellmounds human individuals compound a homogenous group, which is corroborated by teeth results. The teeth cluster, not distant from human bone (lower than two points), is explained by the fact that dentine is formed during the infancy of the individual period of breastfeeding and that led to an increase of proteic values.

According to Lubell & Jackes (1994: 205) stable isotopic data interpretations might occur through the reading of "trophic level effect", in which enrichment indicates the individual relation to the consumed items in $5\%_0$ in carbon collagen fractioning and between 3 a 4% in relation to nitrogen.

(1) Dates: Moraes Site (5,895 yr. B.P. to 4,511 yr. B.P.), Estreito Site (4,100 –3,600 yr. B.P.) and Capelinha Site (9,250 yr. B.P.).

From Lubell's collagen fractioning interpretations of food consumption, it is possible to notice that just the Spotted Paca (*Cuniculus Spotted Paca*) have values compatible with the "trophic level effect" cluster of riverine sambaquis, among all the other animals analysed in the graph 15. The others mammals recovered at Moraes site, which collagen could be obtained, presented a higher distance of 4% for nitrogen, sometimes reaching 8% (e.g. peccary case). Unfortunately, it was not obtained collagen preservation for Brazilian tapir, armadillo, Guinea pig and amphibious (Tables 6, 7, 8 and Graph 15).

Looking carefully at the Spotted Paca case, it is possible to evaluate that, even though this animal appears on "trophic level effect" cluster of human individuals, this was probably not an important item of the diary food, once zooarchaeological indexes point to a maximum of five individual by MNI. Spotted Pacas are rodents of super-family *Cavioidea,* and as well as the Brazilian agouti, Spotted Pacarana, moco, prea and capivara, they eat fruits, seeds and succulent vegetables.

Unfortunately, there was no collagen preservation for stable isotopes analysis for the guinea pig of Moraes site. Further research may test the hypothesis that this animal was an important consumption item of riverine *sambaqui* groups.

In relation to carbon "trophic level effect" of riverine *sambaquis'* human individuals, it is clear that there is no direct relation to C_3 or C_4. Its positioning is above CAM plants cluster. These plants are still unknown from the consumption perspective and more studies on that must be carried out.

Discussion

After 6,000 years BP, with humidity increase and density of *Mata Atlântica*, the fauna diversification allowed the sambaqui groups to obtain new species as resource from this environment [e.g. monkey, an arbricola

Table 5

Carbon and nitrogen stable isotopes (Beta Analytic [EUA])
Human Skeletons, Moraes, Estreito and Capelinha 1 sites

Site	Unit	Trench	Level (m)	Identification	$\delta^{13}C$	$\delta^{15}N$	Code
Moraes	Child	F22	2.26-2.34	Rib	12	-19.9	MO F22 01
Moraes	Burial 6 A	F11	2.65-2.80	Diaphisis	9.6	-19.26	MO B6A 01
Moraes	Burial 6 A	F11	2.65-2.80	2º. inferior left pre molar	12.1	-20.8	MO B6A 01
Moraes	Burial 7	F21	2.80	Rib	11	-19.9	MO B7 01
Moraes	Burial 8	E-F20/21	2.38-2.46	Diaphisis	10	-20.4	MO B8 01
Moraes	Burial 8	E-F20/21	2.38-2.46	1º right superior pre molar	12.8	-22.5	MO B8 02
Moraes	Burial 13	F20		Rib	9.9	-20.28	MO B13 01
Moraes	Burial 25	G27	1.73-1.93	Rib (2)undetermined (2)	10.2	-19.89	MO B25 01
Moraes	Burial 25	G27	1.73-1.93	Right superior Canine	12.6	-21.8	MO B25 02
Moraes	Burial 25 A	E20/21	2.40	Cranium	11.9	-20.3	MO B31A 01
Moraes	Burial 32 A	F14	2.55-2.96	Undetermined	10.3	-20.8	MO B32A O
Moraes	Burial 35 A	E-F18	2/3 (1.72-1.91)	Diaphisisundetermined	10.6	-20.7	MO B35 01
Moraes	Burial 35	E-F18	2/3 (1.72-1.91)	2º inferior pre molar	11.9	-21.4	MO B35A 02
Moraes	Burial.41	N30	1.63-1.79	Rib	11.2	-20.9	MO B41 01
Estreito	Burial 6			Undetermined	9.9	-20.15	EST B6 01
Estreito	Burial 6			Left lateral incisive	11.4	-21.4	EST B6 02
Estreito	Burial 6 – A	S4E4	2.00	Falange - hand	9.6	-19.26	EST B6A 03
Capelinha	Burial 2	U 41		Rib	10.9	-19.7	CAP1 B2 01

Table 6

Faunal stable isotopes results of Moraes site
([-] data not obtained because of low quantity of collagen and nitrogen)

Fauna	Identification	Trench	Level (m)	$\delta^{13}C$	$\delta^{15}N$	Code
Brazilian tapir	Right lower molar tooth	F14	1.95 –2,05	-26.4	–	MO TATE 01
Peccary	Right calcaneus	F14	1.84 –1,95	-22.3	6.5	MO TAY 01
Howler monkey	Distal fragment of left humerus	F14	1.95 –2,05	-21.6	6.3	MO ALO 01
Armadillo	Scutes	P12	0.10 –0,20	–	–	MO DAS 01
Spotted Paca	Molar and premolar teeth	P12	0.20 –0,30	-22.2	8.7	MO CUPA 01
Guinea pig	Right jaw fragment	F14	2.48 –2,60	-23.8	–	MO CAVI 01
Amphibians	Left humerus /Right Radio-ulna / Right Ilium / Radio	F14	2.00 –2,30	-21.8	–	MO ANF 01
Fish	Vertebre	F14	2.30 –2,45	-21.7	–	MO F15 01

animal that needs a close forest to dislocate through branches, appears in high quantity from bottom to top of the Moraes site (6,000-4,000 years BP)].

Nonetheless, stable isotopes data indicates that even though there was great presence of mammals in the Atlantic Forest, and in particular at Moraes site, meat consumption of mammals does not seem to be intense. Data indicates that these mammal species were not consumed in every day meals, but in a sporadic and restrict manner as a more elaborate meal, as in celebration episodes. Like in feasting meals during funerary cults, or animal tenders to the dead.

Moreover, isotope data indicates that although in high quantity in riverine *sambaqui* layers, the Megalobulimus land snail did not represent an important item of their consumption. In that case, this resource must have been employed as a construction material rather than a result of "kitchen midden". The high

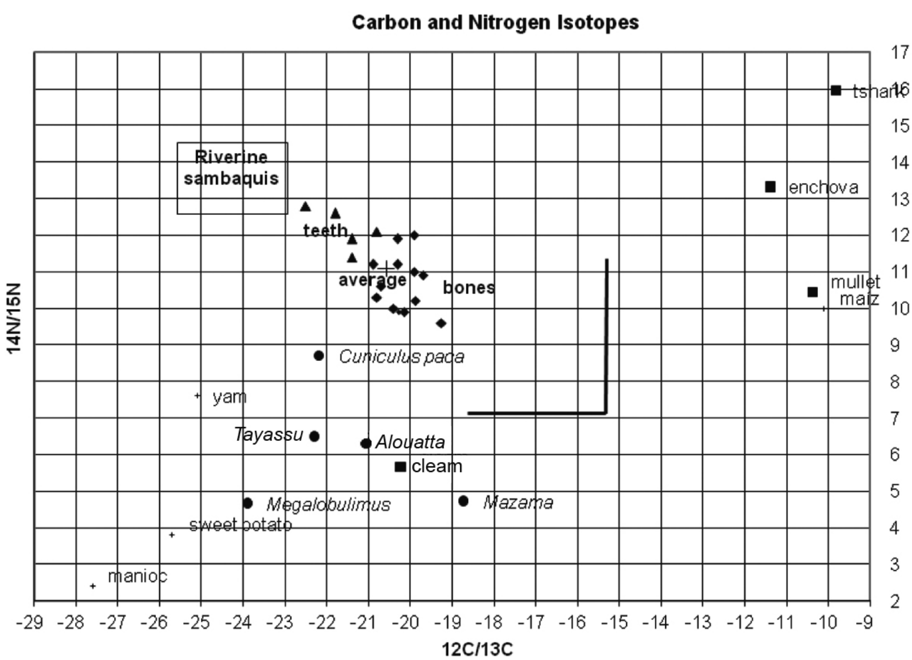
Table 7

Isotopic analyses $^{13/12}C$ and $^{15/14}N$, from vegetables and fauna Sources:[1] De Masi 2002;[2] Keegan & DeNiro 1988			
Taxa	**Popular name**	**$\delta^{13}C$**	**$\delta^{15}N$**
Manihot esculenta	Maíz [2]	-27.6	2.4
Ipomoea batatas	Sweet potato [2]	-25.7	3.8
Dioscorea	Yam [2]	-25.1	7.6
Tayassu sp	Peccary	-22.3	6.5
Agouti Spotted Paca	Spotted Paca	-22.2	8.7
Alouatta sp.	Howler monkey	-21.06	6.3
Anomalocardia brasiliana	Cleam [1]	-20.233	5.669
Mazama sp.	Brocket deer [1]	-18.729	4.731
Pomatomus saltatrix	*Enchova* [1]	-11.395	13.328
Mugil sp.	Mullet fish [1]	-10.373	10.444
Zea	Corn [2]	-10.1	10
Selachimorpha superordem	Shark [1]	-9.825	15.965

Table 8

Carbon and Nitrogen isotopic determination (delta per mil in relation to PDB - Pee Dee Belemnite) and content of C (%) from liophilized samples of *Megalobulimus sp*

Repetition	C content (%)	Carbon isotopic value (delta per mil)	N content (%)	Nitrogen isotopic value (delta per mil)
1a	33,94	- 23.93	9.32	4.78
2a	34,03	- 23.89	9.16	4.67
3a	34,06	- 23.89	9.11	4.63



Graph 15. Stable isotopes analyses on human bone and teeth and faunal bones.

intensity of resource catchment must have been caused by the necessity of bone conservation for the maintenance of the sacred place.

Lithic identification permitted some discussion in this perspective. The elevated traces of burning presented in the lithic assemblage indicate high bonfire temperatures. However, just some thin layers of fire, that could not have been enough to burn the quantity of lithics recovered at Moraes site, were found. This information suggests that lithics had been burned outside the site and, then, taken and deposited in the site.

Among the lithic assemblage, mortars and pestles were objects that presented higher intensity on use traces. For this reason, these tools seem to characterize the importance on vegetable resources processing in the everyday life of this group, since these tools are generally employed on these activities. Disposal recurrence of lithic with daily characteristics in a funerary context reveals the cultural concern of these groups in taking important objects from individuals' lives to the dead world.

Considering that the analysed fauna was consumed in a sporadic way, stable isotopic values of nitrogen and carbon from the considered mammals may have misled other resources' ingestion. Besides, as the data indicates that meat from mammals from Moraes site was not consumed in an intense way for this group, other animals and specially vegetable resources, play an important role in this perspective.

The comparison of isotopic values from the graph and archaeological literature indicates two hypotheses for vegetable utilisation by this group. As carbon values are positioned inside the cluster related to CAM plants, this may indicate the intense consumption of these plants or an important consumption of both C_3 and C_4. In the last case, the mixed consumption of C_3 and C_4 may mislead the isotopic results taking the results to an intermediary position, above CAM plants values.

Further, vegetable resources importance for riverine *sambaqui* consumption is corroborated by human dental data from Moraes site. Accordingly to Wesolowski (2007: 5),

> *"...even though carie is an infection disease which is developed in presence of cariogenic bacterial* (bacterian) *flora, its expression is strongly modelled by diet, and the introduction or increase of consumption of carbohydrate-rich aliment may lead to an increase of carie frequency and prevalence (...)"*

It has been analysed carie frequency and prevalence from eight individuals from Moraes site (one young individual ± 15 to 20 years old and seven adult individuals ± 25 a 40 years old), aiming to comprehending the carie importance for this group. Prevalence values express carie distribution among the skeletal series and carie frequency of affected teeth by cariosa lesions inside the skeletal series analysed.

Carie prevalence in the skeletal series was 87.5% ({8/7}*100) and carie frequency of 18.05% ({24/133}*100). From eight analysed individuals (5, 6a, 6b, 9, 12, 13, 17 e 35), seven have carie, of which one individual presented two extensive caries (one with total crown destruction and one with 50% crown destruction). Other six individuals presented carie in the root (occasionally they compromised the crown teeth). In media, each individual presented three cariogenic lesions (24/8).

To comprehend the values above, other data about the same subject for comparisons will be presented. Wesolowski (2007: 153) obtained data for coastal *sambaquis Morro do Ouro* site (recent and old layers), *Enseada I* site, *Marechal Luz* site, and *Itacoara* (ceramic) site (Table 9).

Data from above table indicates high carie prevalence and frequency in Moraes site individuals. In comparative terms, if coastal *sambaquis'* people present a "generalised consumption of amiladeo food" (Wesolowski 2007), it is possible to conclude throughout the index above that the same happens to Moraes individuals, even so more intensively.

Other indexes corroborate to the interpretations of high carie intensity associated to carbohydrate ingestion for Moraes individuals. Walker & Erladson (1986: 378) show high carie prevalence (80%) and frequency (13.3%) index to caries of Canada Verde site (3,000 to 4000

Table 9

Comparative table of carie prevalence and frequency in coastal and riverine sambaquis

Site	Number of observed individuals	Carie prevalence (%)	Carie frequency	Carie lesion media by individual
*MO-REC	14	50.00	8.85	2.71
*MO- ANT	20	50.00	8.24	2.05
*Enseada I	20	10.00	1.64	0.30
*FML –SCR	9	22.22	1.85	0.33
*Itacoara	26	11.54	1.27	0.23
Moraes	8	**87.5**	18.05	**3.5**

***Fonte** Wesolowski (2007:92).

years BP), in California, USA. These indexes were interpreted as result of an intense roots and tuber consumption, among other cariogenic plants.

The high carie prevalence and frequency, uncommon phenomenon for hunter-gatherer groups in Brazil among Moraes site individuals, would be the result of intense consumption of carbohydrate associate to low proteic ingestions, as indicated by the stable isotopes results.

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PLENS, C.R. Animals for humans in life and death. *Revista do Museu de Arqueologia e Etnologia*, São Paulo, 20: 31-51, 2010.

Abstract: Riverine *sambaquis*, shellmounds compounded of land snail shells, were <50 km from the contemporary coastline in the highland rainforest (*Mata Atlantica*) in Brazil. They were made by groups of hunter-gatherers who exploited the rainforest from at least c. 9,250 to 1,200 BP. Archaeological samples of human and faunal remains dating from 6,000-4,000 BP of a riverine shell mound, Moraes site, were submitted to stable carbon and nitrogen isotope analysis and zooarchaeological study in order to investigate the importance of mammals and land snail on the subsistence of these groups. This study focussed on how the dietary regime of the riverine sambaquis' people was affected by the widespread environmental and sociocultural influence. More generally, the research considers the disposal of the fauna and its utility on daily dietary in this site.

Keywords: Riverine shellmounds – Hunter-gatherers – Zooarchaeology – Palaeodiet – Stable isotopes.

References

BAILEY, G.; MILNER, N.
2002 *Coastal hunters and gatherers and social evolution: marginal or central?* Before Farming: the Archaeology of Old World Hunter-Gatherers, *3-4* (1): 1–15.

BARRETO, C.
1988 A ocupação pre-colonial do vale do Ribeira do Iguape, SP: os sítios concheiros do médio curso. Dissertação de Mestrado. Faculdade de Filosofia, Letras e Ciências Humanas da Universidade de São Paulo.

COSTAMAGNO, S.; THERY-PARISOT, I.; BRUGAL, J.; GUIBERT, R.
2002 Taphonomic consequences of the use of bones as fuel. Experimental data and archaeological applications. In: O'Connor, T. (Ed.) *Biosphere to Lithosphere. New studies in vertebrate taphonomy*. Proceedings of the 9th ICAZ Conference, Durham. Oxbow Books: 51-62.

DE MASI, M. N.
2002 *Pescadores Coletores da Costa Sul do Brasil.* Revista Pesquisas, Antropologia, nº 57. Instituto Anchietano de Pesquisas. São Leopoldo. Unisinos.

ERIKSSON, G.
2003 Norm and difference. Stone Age dietary in the Baltic region. Ph.D. Thesis. Archaeological Research Laboratory, University of Stocolm.

FIGUTI, L.
1991 Les sambaquis COSIPA (4200 à 1200 ans BP): étude de la subsistance chez les peuples préhistoriques de pêcheurs-ramasseurs de bivalves de la côte centrale et l'état de São Paulo, Brésil. Tese de doutorado, Musée National d'Histoire Naturelle, Institut de Paléontologie Humaine, Paris.

FIGUTI, L.; EGGERS, S.; MENDONÇA, C.A.; PORSANI, J.L.; ROCHA, E.B.; DE BLASIS, P.A.D.; BISSA, W.M.
2004 Investigações Arqueológicas e Geofísicas dos sambaquis fluviais do Vale do Ribeira do Iguape, Estado de São Paulo. Fundação de Amparo à Pesquisa do Estado de São Paulo. Relatório Final de Atividades do projeto Temático (Processo Fapesp no.99/12684-2).

GARCIA, C.D.R.
1972 Estudo comparado das fontes de alimentação de duas populações pré-históricas do litoral Paulista. Tese de Doutorado. Instituto de Biociências da Universidade de São Paulo.

KEEGAN, W.F.; DENIRO, M.
1988 Stable Carbon- and Nitrogen-Isotope Ratios of Bone Collagen Used to Study Coral-Reef and Terrestrial Components of Prehistoric Bahamian Diet. *American Antiquity, 53*: 320-336.

KIPINIS, R.
2002 Foraging Societies of Eastern Central Brazil: An Evolutionary Ecological Study of Subsistence Strategies During the Terminal Pleistocene and Early/Middle Holocene. Ph.D. Dissertation, University of Michigan, US.

LUBELL, D.; JACKES, M.
1994 The Mesolithic-Neolithic Transition in Portugal: Isotopic Dental Evidences of Diet. *Journal of Archaeological Science*, *21*: 201-216.

LYMAN, R.L.
1994 *Vertebrate Taphonomy*. Cambridge University Press, Cambridge Manuals in Archaeology.

MILNER, N.; CRAIG, O.E.; BAILEY, G.N.; PERDSEN, K.; ANDERSEN, S.H.
2004 Something fishy in the Neolithic? A re-evaluation of stable isotope analysis of Mesolithic and Neolithic coastal populations. *Antiquity*, *78*: 9-22.

RICHARDS, M. P.; STINER, M.; TRINKAUS, E.
2001 Stable isotope evidence for increasing dietary breath in the Europeans mid-Upper Paleolithic. *Proceedings of the National Academy of Sciences*, *98* (11): 6528–6532.

UCHÔA, D. P.
1982 Ocupação do litoral sul-sudeste brasileiro por grupos coletor-pescadores holocênicos. *Arquivos do Museu de História Natural.* Belo Horizonte, Universidade Federal de Minas Gerais, 6-7: 133-143.

WALKER, P.L.; ERLADSON, J. M.
1986 Dental evidence for prehistoric dietary change on the Northern Channel Islands, California. *American Antiquity*, *51* (2): 375-383.

WESOLOWSKI, V.
2007 Cáries, desgaste, cálculus dentários e

micro-resíduos do dente entre grupos pré-históricos do litoral norte de Santa Catarina: É possível comer amido e não ter cáries? Tese de Doutorado. Departamento de Endemias Samuel Pessoa, Escola de Saúde Pública Sérgio Arouca/ FIOCRUZ. Rio de Janeiro.

WORLEY, F.
2002 Taphonomic influences on cremation burial deposits: implications for interpretations. In: O'Connor, T. (Ed.) *Biosphere to Lithosphere. New studies in vertebrate taphonomy*. Proceedings of the 9th ICAZ Conference, Durham. Oxbow Books: 63-68.

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