Subsistence fishery at Hatahara (750–1230 CE), a pre-Columbian central Amazonian village

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A B S T R A C T

Aquatic resources play a major role in modern Amazonian societies, however little is known about their importance in pre-Columbian economies. In this paper, we present results of the first zooarchaeological study in the Central Amazon, carried out at the Hatahara site, a large pre-Columbian settlement situated at the confluence of the Amazon and Negro rivers. The faunal assemblage comes from archeological features belonging to the Paredão phase occupation (750–1230 CE) and reveals that fish were the primary animal resource. The richness of ichthyofaunal spectrum (37 taxa) recovered is the most varied continental fish spectrum described to date in South-American archeology and shows the fisherman’s profound knowledge of specific ecological niches and fishing techniques. Amazon aquatic turtles (Podocnemis spp.) were the second most frequently exploited aquaaristic resource. These data demonstrate the key role of aquatic resources in ancient Amazonia economies and suggests that fishing could have provided long-term subsistence to large Amerindian settlements.

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1. Introduction

Nowadays, fishing has a major importance in riverine economies at the confluence of the Amazon and Negro rivers; however, little attention has been paid to past Human-Animal interactions (Smith, 1979, 1981). In the 1960s and 1970s, some scholars working in the Amazon considered riverine animal protein consumption to be a major source of resources for ancient indigenous populations, arguing that abundant and accessible aquatic resources were principal correlates of regional population growth and settlement nucleation. In spite of that, the debate never fully developed for lack of archeological fauna. For scholars such as Carneiro (1968), Lathrap (1968) and Gross (1975), the availability of animal protein in environmental settings would either “enable” or “limit” population growth of Amerindian societies. Therefore, the pursuit of animal resources in the tropical forest would force groups living in interfluvial areas to develop high mobility strategies, while settlements situated on the bluffs of major rivers, with easier access to aquatic resources, would show sedentary patterns (Carneiro, 1968; Lathrap, 1968).

Although recent advances in Amazonian archeology have brought forth a wider interest in the understanding of ancient South American societies (Silverman and Isbell, 2008), very few studies have focused on specific areas such as zooarchaeology. Research on this topic has been carried out in scattered areas, such as the Amazonian coast and estuary (Inazio da Silveira, 1994; Nogueira de Queiroz and Carvalho, 2010, Roosevelt et al., 1996) and in the Llanos de Mojos, Bolivia (Hutterer, 1997; Béarez and Prümers, 2007; von den Driesch and Hutterer, 2012). The lack of faunal studies can be explained by the poor preservation of bone material in tropical contexts (Stahl, 1995) and the rarity of reference collections for Amazonian vertebrate fauna. Representative reference collections, for both taxonomy and the developmental stages of individual species, are a prerequisite for accurate zooarchaeological analysis especially in areas with high diversity.

Recent archeological surveys and excavations conducted at the confluence of the Amazon and Negro rivers have offered a good opportunity to evaluate and to put into perspective the role of animal resources at large Amerindian settlements. Over 100 sites dating between 300 BCE and 1500 CE reveal long and intensive pre-Columbian occupations, with dense populations living in structured large settlements (Neves et al., 2004; Neves and Petersen, 2006; Neves, 2013). Considering this context, what kind of resources would be necessary to sustain such dense populations? How were environments exploited? And finally, how were the animals and their niches used? The Hatahara site, one of the best known archeological sites of the Central Amazon region, delivered exceptionally well preserved organic matter which allowed...
us to carry out the first zooarchaeological study in the region (Neves and Petersen, 2006). As a result this study has highlighted the importance of fishing in this pre-Columbian settlement.

2. The research area: the central amazon

The research area covers about 1000 km$^2$ size at the confluence of the Amazon River and the Negro River near the city of Manaus, in the Central Amazon (Fig. 1). This area includes a wide floodplain (also known as várzea) that is inundated annually. Water level oscillations drive aquatic and terrestrial phases configuring a dynamic mosaic of environments such as flooded forests (igapós), sandy beaches, seasonal lakes and temporary river streams (igarapés) (Latrubesse and Franzinelli, 2002). The Amazon River was classified by Sioli (1984) as a white water river. It transports high amounts of sediments and organic matter, which provides nutrients to a large group of aquatic species of fauna and flora. This environmental setting makes the region one of the richest ecosystems in the world in terms of biodiversity (Turner, 2001).

Although the study of human-environment interactions has recently become a central issue in ecological and political debate in the Amazon (Barlow et al., 2012), research on past environmental management in the Central Amazon is still in its early stages. The first archeological surveys were undertaken in the 1950's and 1960s by Peter Hilbert and Mário Simões, but systematic studies only started in 1995 when a multidisciplinary research program called the Central Amazon Project (CAP) was launched (Neves, 2013). More than 100 sites were registered at the Negro-Amazon confluence delivering dates ranging from 6000 BCE to 1500 CE (Neves et al., 2004; Neves and Petersen, 2006). Archeological sites were identified in different settings, but the majority of the settlements were situated in high and non-flooded areas of the river bluffs.

Global archeological studies at the confluence area demonstrate that evidence of intense landscape transformation and constant reoccupation of settlements dates back to the beginning of the first millennium of the Common Era (CE). Systematic excavations associated with radiocarbon dates provided a stable chronology along with the recognition of four major ceramic phases: Açutuba, Manacapurú, Paredão and Guarita dating between 300 BCE and 1500 CE (Neves, 2007). A central feature of most sites is a set of large patches of anthropic soils called Amazonian Dark Earths (ADE), some of them combined with structured artificial mounds and large amounts of ceramic sherds (Neves et al., 2004). At the Lago do Limão site, an excavated feature about 6 m in diameter and 1.2 m deep may have been used as a turtle pond (Moraes, 2006). This pattern of settlement was well described during colonial times in different parts of Amazonia and it might be related to the development of more stable and sedentary societies that combined the cultivation of domestic crops with the management of wild plants and animals (Neves and Petersen, 2006; Neves, 2007; Moraes, 2006).

The majority of the work undertaken in the CAP project was conducted in Hatahara (Fig. 1), which is an open-air site situated on a bluff on the North Bank of the Solimões (Amazon) river, 20 km upstream from the confluence with the Negro river. Excavations have shown the presence of all four ceramic phases in the site; however, in this study, we are particularly interested in the Paredão phase occupation, defined by Neves and Petersen (2006) as a regional complex group of the Incised Rim Tradition dated between 750 CE to 1020 CE.
During this period, the site reached about 20 ha in size and included dozens of artificial mounds forming ring or semi-ring villages.

Phytoliths of maize (Zea mays), yam (Dioscorea spp.) and manioc (Manihot sp.) recovered at Hatahara suggests the cultivation of crops (Bozarth et al., 2009, Cascon, 2010). Several genera of palm trees (genera Astrocaryum, Attalea, Bactris, Mauritia, Oenocarpus) may also have been exploited. Furthermore, anthropological analyses highlight that pioneer vegetation was associated with an intense opening up of the forest, confirming the hypothesis of a strong anthropic management of the vegetation at that time (Caromano, 2010).

Overall archeological data available for the Central Amazon region during the Paredão phase, including anthropic soil dispersion, and the changes in settlement extent and ceramic production, are all indicative of intense landscape transformation related to population growth (Moraes, 2006). In this paper, we are interested in how inferences derived from the preserved archeofaunal assemblage at Hatahara compare to the evidence from larger settlements and to the more sedentary strategies in the Central Amazon around 700 CE.

### 3. Materials and methods

Faunal remains were sampled from one stratum (stratum 3) and three features from Mound 1, both contexts associated with Paredão phase occupation of the Hatahara site. Stratum 3 is associated with a funerary area and lies under an artificial mound (Fig. 2). Rapp Py-Daniel (2009) indicates that the mound, built with large quantities of ceramics and clay soil, must have helped seal the stratum, protecting the organic matter from weathering and preserving all types of bony materials.

About 300 l of sediment, from stratum 3 (140–270 cm depth), were sieved using 1 mm and 2 mm meshes and faunal material was also hand collected during the excavation. Collections then were subsequently brought to the UMR 7209 “Archéozoologie, Archéobotanique: sociétés, pratiques et environnements” and “Archéologie et Environnement” laboratories at the Muséum national d’Histoire naturelle (MNHN-Paris, France) for taxonomic identification, and then returned to Brazil, where they are currently stored at the Museu de Arqueologia e Etnologia da Universidade de São Paulo (MAE-USP). Since no exhaustive osteological collections, nor systematic osteological atlas, exist for most taxa of South-American fish and turtles, remains were assigned to a precise taxonomic level only when diagnostic criteria were recognized with certainty.

Minimum Number of Individuals (MNI) and Number of Identified specimens (NISP) were used in this study. MNI was calculated for each 10 cm of artificial excavation stratification during the taxonomic identification. In an attempt to obtain an idea of relative biomass for fish, we also used weight estimation by comparing the archeological element with a reference collection specimen. The burn damage, fracturing and cutmarks were noted in order to determine how the specimen had been processed.

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(Table 1). During this period, the site reached about 20 ha in size and included dozens of artificial mounds forming ring or semi-ring villages.

![Fig. 2. The Hatahara site](image-url)
The teleostean spectrum presents a high variety of groups, with 37 taxa distributed in Osteoglossiformes (bonytongues), Clupeiformes (pallones), Characiformes, Perciformes, Siluriformes (catfishes) and Synbranchiformes (swamp eels) (Fig. 4, Table 2). However, MNI estimates indicate that three groups are particularly prominent: arapaimids (*pirarucu/paiche*) (48), doradids (35) and serrasalmids (*pacu*) (20).

A large number of small size Characiforms were counted (38% of the NISP), meanwhile if we consider their net weight, they correspond to only 0.5% of the total fish body mass, while *Arapaima* stands for 54% of total fish remains net weight. This indicates that, in terms of biomass, small Characiforms may not have had the same importance as larger fishes.

### 4. Results

A total of 9474 animal vertebrate remains were studied, Table 2 lists the vertebrate species recovered. Six groups of vertebrate (Teleostei, Chondrichthyes, Mammalia, Reptilia, Lissamphibia and Aves) are present with different proportions (Fig. 3). Fish dominate every index (NISP, MNI), representing 76% of the NISP, followed by reptiles with 20% (Fig. 4). In contrast, mammals, lissamphibians and birds are scarcely represented in the spectrum. The MNI graph shows similar proportions. A very high diversity of fishes is observed (Fig. 4) while it is less significant in Reptiles.

The vertebrate assemblage is numerically dominated by poorly preserved teleostean fish elements (vertebrae, scutes, fins) that could not be reliably identified to family or genus level. Birds remains were so fragmented that MNI could not be inferred.

#### 4.1. Fish

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The giant bonytongue fish or *pirarucu* (*Arapaima* sp.) is decidedly the most common fish recovered in the assemblage with 48 individuals. It represents 23% of the MNI fish spectrum (Fig. 4). Vertebrata are the most common element in the collection, but cranial elements are also represented. Until now, *Arapaima gigas* (Schniz, in *Cuvier*, 1822) was long considered to be the only valid species in the Amazon Basin; however there is current evidence of at least 3 other species of this
A high diversity of species was observed ranging in size from small Loricariidae (acari, bodó) and schooling Callichthyid (tamoatá/soldado) to large catfishes such as Pseudoplatystoma tigrinum and Phractocephalus hemioliopterus, which are commonly caught in deep waters of large rivers (Goulding, 1980). Estimated sizes of archeological specimens ranged from the 60 g callichthyids up to the 40 kg P. hemioliopterus.

Characiformes are also well represented in the assemblage at 26% of the MNI. Carnivorous piranhas like Pygocentrus nattereri and Serrasalmus spp., and omnivorous piranhas like Colossoma macropomum (tambaqui) were among the most exploited fish at Hatahara (9% of the fish MNI). C. macropomum is the second largest scaled-fish of the Amazon and is generally caught during the wet season, when this fish comes to the surface to eat fallen fruit in the flooded forests (Goulding, 1980). Perciformes such as Cichla sp. (tucunaré) and Plagioscion squamosissimus (pescada branca), and Synbranchiformes are not as common.
4.2. Reptiles

Chelonians dominate the reptilian NISP counts (N = 1498), followed by crocodilians (N = 322), snakes (N = 86) and lizards (N = 3). A significant number of the Reptiles NISP corresponds to chelonian fragments (Table 2). Crocodilians and snakes are represented in the assemblage, with special attention given to the genus *Eunectes*, an aquatic group that includes one of the largest snakes in the world, the green anaconda (*Eunectes murinus*).

A total of 1498 fragments belonged to the Cheloniida order, but only 21 among the remains were associated to the genus *Podocnemis* following diagnostic elements described by Carvalho et al. (2002) and de França and Langer (2005). The lack of anatomical criteria to distinguish different species of *Podocnemis* (tracajá, tartaruga-da-amazônia) has refrained identification to the genus level. *Podocnemis* comprises more than half of the reptilian assemblage by weight and consists primarily of fragmented turtle shell.

It is interesting to point out that despite a high diversity of chelonians currently available in the Amazonian region (Vogt, 2008), South-American river turtles, *Podocnemis* spp., were the only taxa recovered in an archaeological context. *Podocnemis* spp. are among the largest turtles, attaining a body mass up to around 90 kg. Estimates indicate that archeological individuals measured between 30 cm to 70 cm, excluding the juveniles and the largest adults of the known size range of this species. This reveals that prey selection was guided by both taxa and individual size.

4.2.1. Turtle preparation and consumption

Numerous plates of chelonians presented cut marks especially on the plastron (hypoplastron, epiplastron and entoplastron). The pattern of the marks revealed two different opening techniques, one by cutting the hypoplastron – the lateral side of the plastron (Fig. 7b) – and the other by grooving the entoplastron – the medial part of the animal. Fig. 7a shows furrows crossing the hypoplastron anteroposteriorly. It is also possible to observe that the furrow covers the burnt damage, indicating that the animal was first roasted and then opened.

Carapace and plastron shells were burnt in different levels while other post cranial elements did not present signs of burning. More than half of the dorsal carapace elements show thermal alteration, suggesting that turtles were probably turned upside down and roasted in their shells. Stahl and Oyuela-Caycedo (2007) and Sampson (1998) propose that this specific burning technique is good evidence for human consumption. In Amazonian ethnographic literature, Amazonian ethnographic literature describes this particular roasting technique (Bates, 1979: 237; Werner, 1990; Smith, 1979). *Podocnemis* gathering is currently controlled and regulated by environmental state regulation; however, aquatic turtles are still widely consumed in the Amazon region (Fachín-Terán et al., 2004).

4.2.2. Intensive aquatic turtle’ consumption: hunting or storage?

Anthropic marks identified on chelonian shells revealed that aquatic turtles were intensively consumed by the Amerindians in Hatahara. However, provisioning methods of aquatic turtles are still unclear.

Nowadays, Podocnemidae turtles are collected especially during the dry season, when the females approach quieter waters in proximity to sandy beaches lakes and streams to spawn. During the raining season, they can also be fished, but the pursuit is harder since the animals are spread out through the flooded forests (Barboza et al., 2014).

It is also possible that turtles were kept alive in pens for later consumption in pond type corrals. As mentioned before, one excavated feature in the Lago do Limão site (about 15 km from Hatahara) was interpreted to be a turtle weir (Moraes, 2006). The feature was circular with 6 m in diameter, 1.2 m deep and surrounded by small pit holes used to enclose the structure. Turtle corrals were described in the Amazon region by first explorers such as Gaspar de Carvajal in 1541

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4.1. Fish butchering in the field

Cut marks and fracturing were systematically observed on the proximal part of pectoral fins of doradids catfishes (Fig. 6). Removal of the spines might be linked to the fact that doradids contain a venomous poison covering the fin that can induce serious infections, inflammations, cyanosis and erythema (Perrière and Goudey-Perrière, 2003; Wright, 2009). Therefore, this type of cut may be interpreted as a procedure to prevent venomous injuries. Bone tool fragments made of Siluriform spines were present but were not included in the present study.

Cutting damage was also observed on the medial side of the cleithrum of a large redtail catfish individual (*P. hemioliopterus*). Experimental work undertaken by Willis et al. (2008) demonstrated that this type of mark is associated with cutting off the fish head. These two examples of butchering suggest that fish processing could have taken place in the settlement.

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Fig. 5. (a) Estimated weight of Arapaima sp. vertebrae shows the exploitation of contrasting sizes of individuals, (b) Arapaima fishing illustrated by Franz Keller in an expedition to the Amazon and Madeira rivers (Keller, 1875).

Fig. 6. Cut marks in pectoral catfish fin.
Mammals are underrepresented in the assemblage if we consider the global NISP and MNI spectrum. A total of 331 remains were recovered, representative of only 3.6% of the total NISP or 5% of the MNI (Fig. 3). Rodents account for more than half of the mammal specimens identified. Long bones and vertebrae comprise the greater part of elements present, however identification to family or genus was only possible from molars or premolars. There were two size groups of rodents, the smaller group (about 8 cm in length) of indeterminate taxonomic family, and the larger group (about 25 to 30 cm in length) of Echimyidae.

This larger group, also known as spiny rats, are arboreal or semi-terrestrial rodents. The molar patterns described by Emmons (2005) allowed us to identify 4 individuals as the genus *Echimys*. These species currently inhabit forest environments, their diet consisting of fruits, grains and insects. Ancient consumption of *Echimyidae* was documented in South America by Stahl (1995) and in Central America by Cooke et al. (2008), but no cutmarks or anthropic selection of anatomical elements were observed by us. The presence of *Echimyidae* in the archeological record can be intrusive or related to post-depositional processes and they were not necessarily selected by humans.

**5. Discussion**

**5.1. Fishing as a main subsistence resource**

If we exclude coastal settlements, fish generally represents a small part of the global faunal spectrum usually recovered in archeological records (Cooke and Jiménez, 2008). In Hatahara it represents 76% of total NISP and 81% of total MNI, indicating that fishing activity played a main role in the Hatahara pre-Columbian settlement. Sixteen of the modern 28 fish families attested at the confluence area (Saint-Paul et al., 2000) were recovered in the archeological sample.

Hatahara fisherfolk was able to catch a broad size range of fish going from 20 g cichlids to large sized *Arapaima* weighing over 100 kg. Explorers and naturalists throughout the Amazon report the use of nets and traps for small size fish while arrows and harpoons were used for large fish. We cannot exclude the use of vegetal poison (known as *timbó*) as a very common fishing technique that has been used in the Amazon region (Lowe, 1963), nonetheless, fishing techniques can vary enormously, so far archeological findings do not allow us to affirm which one was used.

Fishing techniques are not only related to fish behavior but also to their distribution according to the annual flooding cycle. The main taxa recovered such as *Arapaima sp.*, *C. macropomum* and *Piaractus brachypomus* undertake lateral migration in accordance with changing water levels and seasonality. During the raining season, water from the main channel overflows and animals spread out across the flooded forests. When water levels drop, they return to river channels, streams and lakes, where they are confined during the dry season (Lowe-McConnell, 1987; Goulding, 1980; Castello, 2008). Therefore, the presence of seasonal species in the archeological record allows us to assert that Hatahara fishers were highly adapted to the annual flooding cycle and probably developed specialized capture techniques according to specific fish dispersals.

The importance of fish in riverine societies has been asserted since the first explorers passed through the Amazon river, a good example is found in Gaspar de Carvajal in 1542: “... there we found so much food, particularly fish, for of this there was found such a variety and so plentifully that we could have loaded our brigantines up well, and this fish the Indians had drying, to be transported into the interior to be sold” (Medina and Valdés, 1934: 207). Similarly, many important scholars working in the Amazon, such as Robert Carneiro (1968), Donald Lathrap (1968) and Stephen Beckerman (1979) claimed a central role of aquatic resources in the pre-Columbian Amazon. Lathrap (1968), for example, asserted that the abundance of riverine resources of the Central Amazon would ensure the development of sedentary settlements; however, at that time, archeological evidence had not yet been collected and could neither reinforce nor reject his theory.

Fish still provide most of the meat for current riverine communities near the confluence of the Amazon and Negro rivers. Batista et al. (1998) revealed that the daily average fish consumption approaches 550 g per person, which exceeds the daily protein requirements of adults. This amount of consumption is very large, even when the large amount of fish available due to present-day fishing techniques is considered.

Moreover research conducted by Murieta and Dufour (2004) in a modern riverine community at Ituqui Island (Pará State) revealed that despite the high intake of manioc in daily food consumption, fish still...
appears as a principal source of protein and also an important source of energy.

Therefore, taking into consideration that plant protein intake may have had substantial input on protein resources, the zooarchaeological results presented here indicate that fish biomass supplied the animal protein needs of the Hatahara settlement during the Paredão phase. These results are compatible with emerging paleobotanical evidence that shows that, despite the presence of domesticated plants in the archeological record, the role of agriculture has been over-estimated compared to other activities for large Amazonian pre-colonial settlements in the late first millennium of the Common Era (Neves and Rostain, 2012; Moraes, 2013). However, an isotopic study of human and animal bones, as well as an analysis of starch grains, are necessary to evaluate the extent of fish and plant consumption.

The importance of the aquatic resource is a major topic to be considered since aquatic and semi-aquatic fauna dominate the assemblage with 90% of total MNI. This predilection may be related to the importance of aquatic landscapes, in this particular region the Solimões river becomes many kilometers wide during the long rainy seasons (about six months). In addition, pollen data provided by Behling et al. (2001) in the confluence of Negro and Amazon rivers shows that around 2000 BP – slightly earlier than the beginning of the Paredão phase occupation at Hatahara – the rate of typical flooded forests plants rose considerably, indicating that the rainy seasons lasted for longer periods.

A correlation between location of archeological settlements and availability of aquatic resources in pre-Columbian Amazonia has also been proposed by authors such as Miller (2009) and Moraes (2013). According to Moraes (2013), archeological evidence of conflict in the Central Amazon region around 1000 CE could be related to disputes for access to the river and its resources.

5.2. A lack of mammals?

On one hand, we have mentioned that fish represents 76% of the NISP and on the other hand, we have observed a low presence of mammals, at 3.6% of the total spectrum. Through ethnographical descriptions, we know that mammals such as monkeys, pacas and tapirs, which are currently consumed, are surprisingly absent in the archeological record. According to Stahl (1995), taphonomic bias related to bone preservation, hunting practices and animal transport in tropical forests tend to “mask” the presence of large mammals in the spectrum. However, the well-preserved bone material of all classes at Hatahara demonstrates that such a bias does not predominate there.

In order to assess if the lack of mammals was consistent across all of the archeological structures, we quantified and compared the remains from each context and strata. However, no significant differences were found in the proportions of taxa observed. Furthermore, all anatomical element types were represented for rodents in the assemblage, indicating no anthropic selection of body parts (Prestes-Carneiro, 2013).

Shepard et al. (2012) proposed that population growth and long term over-exploitation of mammals would provoke depletion of game, reorienting groups towards fishing subsistence and resulting in the low representation of mammals in the archeological record. However our results alternatively indicate that mammals are poorly represented due to the deliberate selection of fish and turtles that were abundant in the riverine environment. These results also corroborate the model of large settlements with a fishing economy, however more zooarchaeological and archeo-environmental studies are essential to evaluate long-term human effects on the Central Amazon environment.

6. Conclusions

Taking into account the vast debate on the capacity of the ecosystem in Ancient Amazonia, this paper provides the first primary data and reveals the important role of aquatic resources, in particular fish and aquatic turtles, in the Hatahara settlement during the Paredão Phase (750 to 1020 CE). The ichthyofaunal assemblage (37 taxa) represents the most diverse fish spectrum described to date in continental South-American archeology. This reveals that Paredão fishermen had a clear understanding of fish ecology and behavior. Despite the wide range of the fish spectrum present, Arapaima sp., catfish and C. macroporum dominate all zooarchaeological indexes. The preference for these groups resembles contemporary fish consumption as these taxa are currently intensively exploited in the Central Amazon region.

Aquatic turtles were strategically selected by taxa and size and were the second most exploited animal resource. Burn damage and cut marks on remains of turtles and large catfish allowed us to identify butchering techniques and preparation methods. The storage of turtles in corral type structures has also been considered.

In conclusion, almost 90% of the species were either captured in aquatic or semi-aquatic environments, including igapós, lakes, the Amazon River bed, streams and sandy beaches. This demonstrates that during this period fisherfolk were able to exploit a large range of ecological niches and highlights the importance of the location of riverine settlements.

Therefore the zooarchaeological data suggest that animal protein availability does not seem to be a limiting factor for the installation of larger Paredão settlements in the Central Amazon described by Moraes (2006) and Neves and Petersen (2006). Combined with the use of crops, the exploitation of fish (and possibly its derived products such as dried fish and fish flour), as well as aquatic turtles, could provide year-round subsistence for large settlements.

This paper reinforces the importance of the use of intensive sieving with small size meshes in archeological excavations as a vital way to evaluate the role of fishing in ancient subsistence systems (Scheel-Ybert et al., 2006). Archeologists should put into practice zooarchaeological and archeobotanical sampling strategies, to expand our view of past Amazonian economies.

In order to construct a regional long-term understanding of animal resources and their relation with human settlements in the Central Amazon, zooarchaeological studies should expand to neighboring sites in interfluvial areas. Future studies should also investigate seasonality of fishing through sclerochronological analysis. Forthcoming research intends to go beyond basic faunal identification and profiles by investigating how these animals were captured, exploited, prepared and manipulated.

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