

## Use of *Pristis* spp. (Elasmobranchii: Pristidae) by Hunter-Gatherers on the Coast of São Paulo, Brazil

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Artifacts made from rays (rostral teeth and spine) are very common in shell mounds on the coast of São Paulo, Brazil. The presence of the genus *Pristis* among the studied species of elasmobranch fishes in this shell mounds reinforces the hypothesis these animals occurred in southeastern Brazil, and were used by hunter-gatherers. I analyzed twelve rostral teeth of the genus *Pristis* from shell mounds. The teeth have artificial marks left from making arrows and harpoons. The basic function of the teeth found in these shell mounds was the production of tools and ornaments. From the analyzed teeth, ten (83%) were associated to the faunal remain and two (17%) were associated with burials, and they can be considered as ceremonial or votive elements. There had been no new records of occurrence of the genus *Pristis* on the coast of São Paulo State in Brazil, and there are a few studies on the use of their products in many ancient and contemporary human communities. This paper provide data about the distribution of rays of this genus in archaeological sites and the use of this resource by hunter-gatherers on the coast of São Paulo.

A utilização de pontas (dentes rostrais e ferrões) provenientes das raias é muito comum em sambaquis do litoral de São Paulo. A presença do gênero *Pristis* entre as espécies de elasmobrânquios estudadas reforça a hipótese da ocorrência destes animais no sudeste brasileiro e sua utilização pelos grupos de caçadores-coletores. Eu analisei 12 dentes rostrais do gênero *Pristis*. Os dentes possuem marcas artificiais provenientes do trabalho realizado para a confecção de flechas e arpões. As funções básicas destes dentes seriam somente a de produção de ferramentas. Dos dentes analisados, 10 (83%) estavam associados aos vestígios faunísticos e, dois (17%) estavam associados à sepultamentos, podendo ser considerados como elemento cerimonial ou votivo. Estes são novos registros de ocorrência do gênero *Pristis* para o Estado de São Paulo, além de demonstrar a utilização destes por comunidades passadas e contemporâneas. Este trabalho contribui com dados sobre a distribuição das raias deste gênero em sítios arqueológicos e o seu uso como fonte de recursos para os grupos de caçadores-coletores do litoral de São Paulo.

**Key words:** Sawfish, elasmobranchs, shell mounds, zooarchaeology, human ecology.

### Introduction

Elasmobranch products have been used since the first societies of hunter-gatherers consisting of small groups of less than 100 people moved seasonally to exploit wild (undomesticated) food resources (Kelly, 1995; Renfrew & Bahn, 2000). Evidence that these groups inhabited our coast come from the studies carried out on five shell mounds in the region of the baixada santista (Duarte, 1968; Uchôa & Garcia, 1971; Guidon, 1964; Figuti, 1993; Gonzalez & Amenomori, 2003). In addition to the manufacture and use of shark and ray artifacts is the ritualistic and religious relationship that occurred between this group of fish and man. This is demonstrated by the

association of teeth, vertebrae and spines (stings) with human burials (Bohering, 1961; Silva, 2001; Cione & Bonomo, 2003).

Archaeological research into shell mounds has shown they were used by these groups of hunter-gatherers on the coast for periods that varied from 7.000 to 1.000 years AP. The shell mounds are non-natural accumulations that occur all along the Brazilian coast (mainly in the States of São Paulo, Rio de Janeiro, Paraná and Santa Catarina) (Prous, 1991). They can have varied arrangements (vertical or horizontal), forms (rectangular, elliptical, etc) and sizes (30 cm to 30 m) (Kneip, 1987, Barbosa, 1999), and are associated with artifacts and burials remains (Kneip & Machado, 1993; Gaspar, 2000; Lima, 2000).

The study of the bone structures found in archaeological sites is fundamental to the descriptions of artifacts and instruments (Gaspar, 1995). Artifacts can be recognized through the modifications made by people (Bower, 1986), and instruments are artifacts with signs of use (Johnson, 1985).

The teeth of mammals, sharks, ray and alligators can be useful as instruments and ornaments (due to their natural shape), with or without some intentional modifications of shape (form and anatomical structure) and evidences of use (Bryan, 1993). Sawfish are marine rays in the Pristidae family represented by two genera and seven species: *Anoxypristis cuspidata*, *Pristis clavata*, *P. microdon*, *P. pectinata*, *P. perotteti*, *P. pristis* and *P. zijsron* (Nelson, 1994). The Pristidae has circumglobal distribution occurring in the Atlantic Ocean and in the Indic Ocean off Indian coast (Nelson, 1994) and in the Pacific Ocean off the Australian coast (Daley *et al.*, 2002). The species *Pristis pectinata* and *P. perotteti* are found in tropical and subtropical waters of the Atlantic (Compagno, 1984). Both species occur in Brazil (Figueiredo, 1977), where they are more common in the north, where they can be caught in large rivers (Thorson, 1974). They can reach total length ( $T_L$ ) of 5 m, and the rostrum length ranges from 1/3 to 1/5 of the  $T_L$  of the specimen (Miller, 1974).

According to Figueiredo (1977), Allen (1991) and Nelson (1994), the main characteristic of sawfish is the presence of a rostrum with the same number of teeth in both sides and the absence of barbels, which occur in the sharks of the genera *Pristiophorus* and *Pliotrema* (Compagno, 1999). The sawfish rostrum is used by this fish for defense and feeding (Breder, 1952).

The species of the genus *Pristis* are now included in the Red List of Threatened Species published by International Union for Conservation of Nature and Natural Resources – IUCN (2000). The impacts caused by the fisheries (the sawfish are routinely captured and their rostral expansion, and fins are sold), and the conservation of these species in Brazil has been widely discussed (Rosa & Menezes, 1996; Charvet-Almeida *et al.*, 2002; Rosa, 2003).

The goal of this paper is to analyzing data about the occurrence of rays of the genus *Pristis* on the coast of São Paulo and the use of this resource by hunter-gatherers, based in archaeological sites data.

### Methods

This study was based on the analysis of the materials from the collection of Museu de Arqueologia e Etnologia of Universidade de São Paulo (MAE-USP), collected from studies conducted at seven shell mounds from São Paulo State: Piaçaguera, Cosipas (1, 2, 3, and 4), Mar Virado and Tenório (coordinated by Caio Del Rio Garcia and Dorath Pinto Uchôa), Buracão, Mar Casado and Maratuá (coordinated by Paulo Duarte). The dates of these sites range from 4930 to 1875 YBP (Table 1).

Twelve rostral teeth of *Pristis* sp. were analyzed. They were certainly modified by hunter-gatherer groups from the

coast. A terminology was created for these rostral teeth in order to make the description of the data easier (Fig. 1). I measured the length and thickness of the teeth (Appendix I), to establish some morphological parameters for species identification.

The teeth were classified according to the kind of modification: drilled (usually a single perforation was drilled although some teeth had two holes), abraded (the labial, lingual, or both surfaces of the root were ground to create flattened surfaces), filed (basal serrations (lateral cusp) of the tooth were removed), or cut roots (Kozuch, 1993; Gonzalez & Amenomori, 2003).

The NISP (number of identifiable specimens in a collection [Specimen is an archaeological/paleontological part of a skeleton that can consist of a complete bone or fragment thereof, a complete tooth or fragment thereof, or a bone (such as mandible) with teeth in it], where “identified” usually means identified to taxon but may mean identified to skeletal element represented) and the MNI (minimal number of (complete) individuals animals necessary to account for (to have contributed) the specimens observed) (Lyman, 1994; Lyman, 2001; Reitz & Wing, 2001) were used to determine the proportion of these species in the archeological context. The estimate of MNI is based on the number of teeth and their relative length because other structures related to these fish were not found.

### Results

**General Information.** The sawfish teeth (Fig. 2) were found in four of the seven shell mounds: Maratuá, Mar Casado, Piaçaguera and Tenório. Coastal hunter-gatherers used the teeth in handicrafts, and they can be classified the artifacts as drilled and abraded. Ten (83%) of the analyzed teeth were associated to the faunal remains and two (17%) were associated to burials. When a correlation was established between MNI and NISP of the sawfish (Table 2) with estimates of other species of rays found in the shell mounds from the coast of São Paulo, it is observed that sawfish had low occurrence (Gonzalez, 2003).

**Teeth Analysis.** The rostral teeth are structures similar to spines, anteroposteriorly aligned to the lateral margins of the rostrum in modern sawfishes (Pristidae) (Fig. 3), sawsharks (Pristiophoridae) and extinct sawfishes (Sclerorhynchidae) (Welton & Farish, 1993). The rostral tooth of sawsharks and sclerorhynchid rays consist of a crown and a weak to strongly bilobate root and the crown is enameloid covered. The teeth of sawfish are dorsoventrally flattened with the shape of an equilateral triangle. The lateral edge has a strong cusp, and the medial side insert into the rostrum. The teeth are mineralized, without the formation of ectodermic enamel as in the other rays and sharks (Miller, 1995).

The species identification was impossible because distinction between alive species inside by the number of rostral teeth (Bigelow & Schroeder, 1953), and also because no rostrum was found to help with the identification. Hence all of

**Table 1.** Radiocarbon dates for shell mounds on the Coast of São Paulo.

Site	Years B.P.	Source
Buracão	1950 ± 100	Schmitz <i>et al.</i> , 1980
Cosipa 1	4300 ± 180	Schmitz <i>et al.</i> , 1980
Mar Casado	4400 ± 130	Schmitz <i>et al.</i> , 1980
Mar Virado	2570 ± 70	Nishida, 2001
Maratuá	3865 ± 95	Schmitz <i>et al.</i> , 1980
Piaçaguera	4930 ± 110	Schmitz <i>et al.</i> , 1980
Tenório	1875 ± 90	Schmitz <i>et al.</i> , 1980

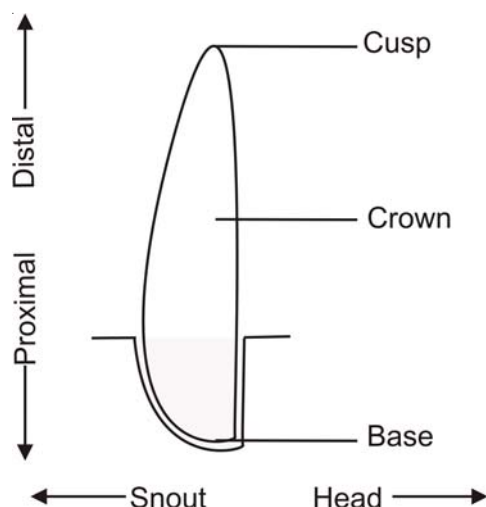
**Table 2.** Element frequencies of sawfish identified from shell mounds.

Site	NISP	MNI
Maratuá	1	1
Mar Casado	3	1
Piaçaguera	1	1
Tenório	7	3
<b>Total</b>	<b>12</b>	<b>6</b>

the specimens reported here are *Pristis* spp.. In Brazil, two species of the genus *Pristis* occur; *Pristis pectinata* and *Pristis perotteti*. To identify between these species the complete rostrum is required because *P. pectinata* has 24-32 rostral teeth while *P. perotteti* has 16-20 (Figueiredo, 1977).

**Rostral Teeth as Tools.** Ten of the teeth were abraded on the dorsal and ventral sides, characterized by groves that ranged from shallow to deep, possibly in order to decrease the teeth thickness, besides presenting with lateral abrasion, making the tooth more conical and slender. Five teeth presented specific abrasions on the lateral sides, forming anchors to permit attachment. The teeth associated with burials were the ones that showed fewer modifications.

The tooth Te-712 (Fig. 2) was used as a tip of an arrow and/or harpoons. The tooth was abraded on its medial edge, modeling the tip base (place where the tool was inserted) and the lateral edge was slightly in order to file the tip, for an easier introduction.

**Fig. 1.** Rostral teeth terminology.

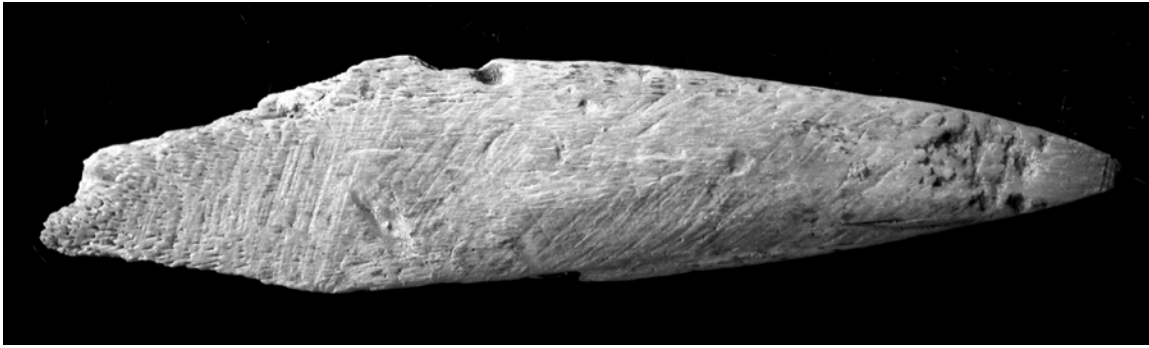
**Human Burial.** Two teeth were found near Burial XV at the Tenório site. They belonged to an adult human, and neither the sex nor the age was determined. Some materials were also found with the teeth. These include: one tooth of *Galeocercus*, with some modifications and polishing on the base used as fixation; one fragmented forked tip made of mammal bone; two tips of bone fish fin rays; one fragmented tip of fish fin ray, one fragmented external of bone fish fin ray; one chip of bird bone; one fragment of polished diabase; one fragment of gneiss with traces of polishing; 609 external bone fish fin rays (475 complete and 134 fragmented); 447 internal bone fish fin rays (199 complete and 248 fragmented); one valve of *Maetra alata*; one fragmented mammal incisor (capybara) without modifications, half jaw of paca with all teeth and without modifications; chips of bird bone without modifications (Silva, 2001).

## Discussion

As rostral teeth do not have ectodermic enamel (Miller, 1995), they are more subject to have taphonomic deterioration than the teeth of sharks and rays (Lyman, 2001). This may be a reason for the low occurrence of *Pristis* teeth in studied sites. The characteristics presented by the drilled and abraded teeth can be considered as made by people and not by taphonomic processes (Lyman, 2001) commonly found in fish structures in archeological sites, rising doubts in their analysis and classification (Colley, 1990).

Three hypotheses for acquisition of raw sawfish teeth material are proposed. The first one suggests that people caught these fishes using nets aimed to catch all kinds of fish or using harpoons, because the sawfish has benthic habits (benthic fishes, such as rays, may be also caught by long lines and baited hooks). The second hypothesis would be that this group of people found subfossil teeth from Pleistocene reserves that came to shore (Ritcher, 1987; Renz, 2002; Gonzalez & Amenomori, 2003). The probable season of the year for catching the sawfish is very difficult to determine, due to the scarcity of fishing data for these species in southeastern of Brazil (Figueiredo, 1977). The hunter-gatherers could easily capture these exemplars, because they came near the shore in their migration in bays, estuaries and rivers (Thorson, 1974; Last & Stevens, 1994), places where six out of seven shell mounds were located. The last hypothesis is related to the system of exchange or trade that involved the diverse hunter-gatherer populations, principally of the north and northeast. This trade may have provided the internal strengthening of these populations.

In my opinion, the first hypothesis is the most likely one. The occurrence of these species from the southeast of Brazil as described by Figueiredo (1977) may be questionable, as no examples of these species from this area are known to the author, but the paleoambiental conditions of the coast of São Paulo can be considered as ideal for the occurrence of these species, and the disappearance of these rays could have occurred because of climatic alterations rather than the effects



**Fig. 2.** Photograph of rostral tooth (43 mm) utilized by hunter-gatherers of Tenório Site. (Photo: Wagner Silva). The tooth was abraded on its medial edge, modeling the tip base and the lateral edge was slightly in order to file the tip.

of fishermen.

An MNI of one was estimated in some shell mound collections, such as these from Maratuá and Piaçaguera, where just one tooth was found, and also it was not found any relation with the exchange system among the studied groups up to now. There are many difficulties in calculating the MNI for elasmobranch fishes (Rick & Erlandson, 2000; Rick *et al.*, 2002), especially when there are no vertebrae and few teeth.

Hunter-gatherers on the Brazilian coast, as in other countries, use many parts of the cartilaginous fish for ornaments and tools (Kozuch, 1993; Cione & Bonomo, 2003; Pinto & Tenório, 2003; Gonzalez & Amenomori, 2003). The artifacts from rays present special characteristics, compared to objects made from other fishes, because they are made from specific body parts, specifically teeth and spines (Borhegyi, 1961; Bryan, 1993).

Analyzing the specific utilization of these artifacts by these groups is a very difficult task, due to the data and the methodology used in this study. The basic functions would be the use of the teeth for making hunting weapons, like the pointed spines of fish found in shell mounds on the Brazilian coast (São Paulo and Rio de Janeiro coasts) (Guidon & Palestrini, 1962; Uchôa & Garcia, 1971; Gaspar, 2003).

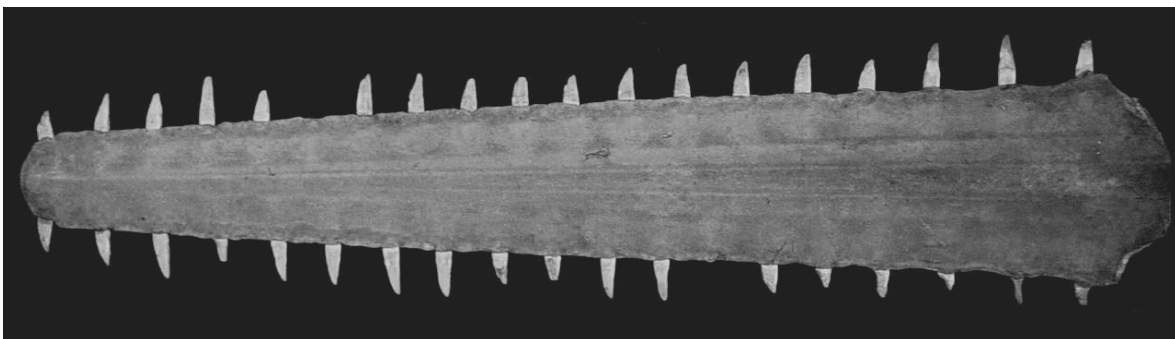
The rostrum of the genus *Pristis* is commonly associated with Aztec burials, in Mexico. According to McDavitt (2002), a sawfish represented the God Cipactli, and the rostrum of this species was used as sacrifice tool with the symbol of a

sword to bleed and feed the divinity. Unfortunately it is difficult to relate the presence of these teeth in burials to sacrifice rituals or ceremonials, as possible for Aztec sites in Mexico (McDavitt, 2002). Such ceremonial uses are also shown in ethnographic studies in fishermen villages in Hong Kong (Anderson, 1969).

Although shark and ray teeth and also ray stings are related to burials found in shell mounds on the Brazilian coast (Palestrini, 1964; Uchôa & Garcia, 1971; Silva, 2001; Gonzalez & Amenomori, 2003), it is difficult to establish accurate parameters of religious connection of these groups of hunter-gatherers with elasmobranchs. They most probably respected some species of sharks, according to Anderson (1969), that are considered “sacred fish”, mainly due to size, behavior and some anatomical characteristic anomalous from other species of fish. For the sawfish this characteristic would be the rostrum.

### Conclusion

Many conclusions about the use of objects made of bone by groups of hunter-gatherers of the coast are related to their analogy with ethnographic records. This association does not happen with teeth of *Pristis*, but this paper confirms the presence of the genus *Pristis* in archaeological sites and the use of this resource by the groups of hunter-gatherers on the coast of São Paulo.



**Fig. 3.** Living sawfish rostrum (*Pristis perotteti*), dorsal view, NUPEC 018, 627 mm, Brazil, Amazonas.

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