# SHARK NEWS

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## Neotropical Freshwater Stingrays: diversity and conservation status

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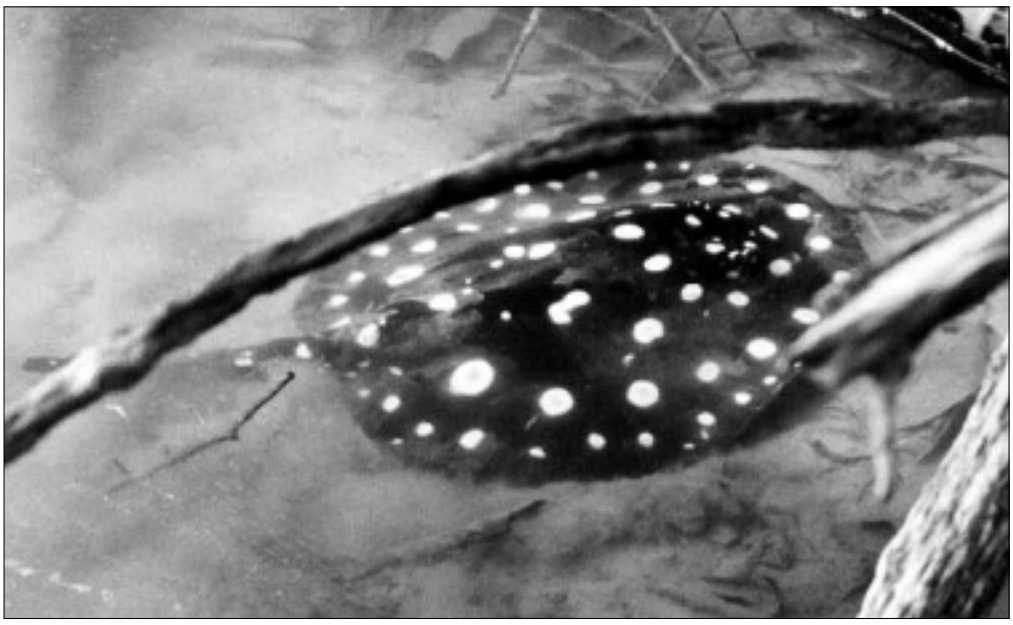
### Diversity

The family Potamotrygonidae, Garman 1877 is comprised of freshwater stingrays with geographical distribution restricted to South America. They occur in several river basins draining into the Atlantic Ocean, and a few species enter estuarine waters. The taxonomic status of the group has been subject to debate in the recent literature, with some authors regarding it as a monophyletic family (Thorson *et al*. 1983, Rosa *et al*. 1987, Lovejoy 1996), while others treat it as part of the Dasyatidae, either as a subfamily (Nelson 1994) or as a paraphyletic assemblage (Nishida 1990). The taxonomic composition of the Potamotrygonidae was revised by Rosa (1985), who reported 32 species clearly assigned to this family, 20 of which were considered valid species in three distinct genera, namely *Plesiotrygon*, *Potamotrygon* and *Paratrygon*. This taxonomic arrangement has been followed by subsequent authors (Eschmeyer 1998, Compagno 1999) although Rosa and others have presented evidence of several undescribed species (Rosa 1985, Carvalho 2001), and of at least one undescribed genus (Ishihara and Taniuchi 1995, Compagno 1999, Charvet-Almeida and Rosa 2001).



*Potamotrygon leopoldi*, searching for food in its natural habitat. This is one of the most valuable species in the ornamental fish market. Photo: Patricia Charvet-Almeida.

### Fisheries

Historically, freshwater stingrays were not valuable to Amazon fishermen as food fish (Ferreira 1886). Nonetheless, these rays are routinely captured as a food resource in some regions of the lower Amazon drainage. In addition, during the last 15 years they have become important as ornamental fish, comprising 1 % of the total ornamental fish exports from Manaus (Amazonas State), with at least six species regularly exported for this purpose. *Potamotrygon motoro*, *P. orbignyi*, *P. schroederi*, *P. leopoldi*, *P. henlei* and *Potamotrygon sp.* comprise 67% of all freshwater stingrays exported from Manaus, and the latter three species are endemic to areas where gold mines, dams, and large ecotourism projects are in progress. Twenty thousand freshwater stingrays are now exported annually from Brazil. Around 57 % are from the Rio Negro Basin (Amazonas State). Despite this demand, the Brazilian Environmental Agency (IBAMA) has no fishery or exportation records for these species from this area. Specimens from other areas are often incorrectly identified and export numbers are certainly underestimated. Nowadays, *P. leopoldi* and *P. henlei* are in fact illegally exported from Brazil. Some other species, from the Amazonas State, are being exported according to law number 022/98 (IBAMA 2001) that establishes a quota system for each export authorised species.

The most important countries involved in the Potamotrygonidae trade are the United States, Japan, Taiwan and Germany, where these stingrays are sold in pet shops according to codes that represent a particular colour pattern rather than a species.

Accidents involving freshwater stingrays are common in most Amazon Basin rivers. Painful results of these accidents certainly make these stingrays extremely non-charismatic and feared animals for local residents and visitors. It has been estimated that in the last three years at least 21,000 stingrays have been removed from the population as a direct result of the tourism industry, with agencies hiring people to "clean-up" the river beaches by killing the stingrays prior to the arrival of tourists. Mutilation of specimens has also been observed. Unfortunately, given that the removal of stingrays in this way does not represent "fishing" as such, IBAMA has been unable to control it.

### Case study of the Tucuruí Dam

The present Brazilian electrical crisis and the subsequent demand for the construction of hydroelectric powerplants has raised questions about the effects of dams on freshwater fishes, especially stingray

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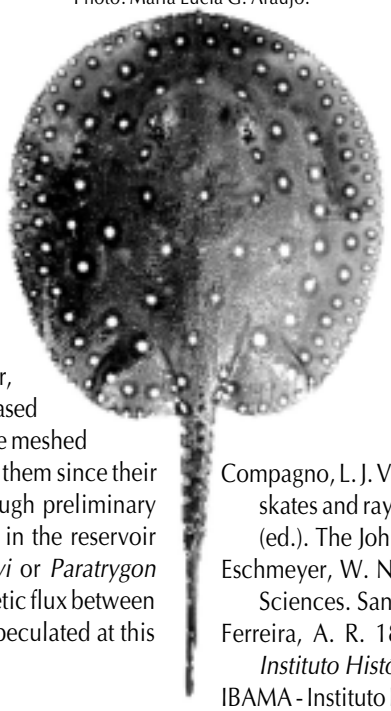
populations. Currently there are 21 dams under construction, and Brazilian scientists are running against time in order to collect as much biological and ecological data as possible, to measure the effects on fish populations. The Tucuruí Dam, closed in 1984, has completely prevented the interchange of stingrays between the Tocantins and Pará rivers.

The Tocantins River is also home to the endemic stingray species *Potamotrygon henlei*, a precious black and white spotted ray for aquarists. Seventeen years since the dam closure, local fishermen report that piranhas and stingrays, especially *P. henlei*, have increased abruptly in number, while some teleosts have disappeared and others decreased in size. The stingrays (*P. henlei*) have learned to eat the meshed fishes caught in the gillnets, and fisherman do not kill them since their meat has no commercial value in the region. Although preliminary evidence indicates a positive situation for *P. henlei* in the reservoir area, the same cannot be confirmed for *P. orbignyi* or *Paratrygon aiereba*, since the implications of the interrupted genetic flux between Tocantins and Amazonas populations can only be speculated at this time.

*Potamotrygon motoro*, a widely distributed species used for ornamental purposes. Photo: Maria Lúcia G. Araújo.



## Ecology and Conservation

Until recently, the life history parameters of potamotrygonid stingrays were virtually unknown, despite the fact that they have already been fished for decades, increasingly for the international ornamental fish trade market. Several species remain undescribed but are being traded and kept by freshwater hobbyists from all over the world.

Lasso *et al.* (1997), Araújo (1998) and Charvet-Almeida (2001) provided information on reproduction and the general biology of several species. The lack of adequate life history parameters for most species of this family prevents precise assessments of their conservation status. On the other hand, direct evidence of impacts on natural populations, including habitat degradation from river damming and mining, as well as the ornamental fisheries pressure has led to preliminary concern for several species. The effect of these activities on the populations is far from being well understood. So far, five species have been cited in the IUCN (2000) Red List as threatened species.

The importance of freshwater stingrays to the ornamental fish industry in the Amazon Region can no longer be ignored because the international demand for these species is growing (Brooks 1995). The hobbyists determine the demand for these fishes and direct the fishing effort. A management plan for this fishery must consider the complex chain that involves the subsistence of the fishermen, the interest of the hobbyists, the environmental conditions in freshwater stingray habitats and the limitations of the life history of each species.

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# Editorial

As we go to press, the future of shark populations in the Galapagos Islands seems once again to be on a knife-edge. A meeting is to be held in Ecuador in April to discuss authorising commercial fishing for tunas and other pelagics in the Galapagos Marine Resources Reserve. The SSG have written a statement to be distributed at this meeting (see p.19). While the SSG recognizes the value of marine fisheries to the economy of the region, the unique status of the Galapagos Islands, a World Heritage Site, requires that management be undertaken in a manner more precautionary than that employed in other areas. Ensuring the survival of this precious natural ecosystem is more than a philosophical exercise; from a practical standpoint, an undisturbed natural system offers very real economic value through ecotourism. Alteration of even a segment of the ecosystem can initiate deleterious changes throughout that will adversely affect Ecuador's ability to attract ecotourists to the region.

On a business note, I would like to draw your attention to the box on p.19 regarding donations to help fund future issues of *Shark News*. With our fulltime Programme Officer now employed we are publishing at least two issues every year, and this is very expensive to the SSG in terms of printing and postage. Over 900 individuals and organisations all over the world, ranging from SSG scientists and government agencies to interested members of the general public, receive *Shark News* for free. We do not have the resources to administer a subscription system, instead we rely on voluntary financial contributions from our readers. Each issue costs us approximately US$3,500 for printing, distribution and editing, and aside from our major sponsors (such as National Audubon, this issue), we receive less than US$100 per year from our readers. This is a request to try and increase the donations made. Any amount, however much you can afford, is greatly appreciated. We can't do it without you.

*Merry Camhi, SSG Deputy Chair. Email: mcamhi@audubon.org*

# Elasmobranch research in Brazil

In November 2001, a workshop was held in Santos on Chondrichthyes, organised by NUPEC (Nucleo de Estudo e Pesquisa em Chondrichthyes), and the Instituto de Pesca. The workshop focused on diseases and parasites of sharks and rays in captivity. In addition, the problems of commercial trade in elasmobranchs in the Amazon region was discussed, as was the issue of shark bycatch in the region.

Brazilian representatives participated in the ICCAT Data Preparatory Meeting for Atlantic Shark Stock Assessments, held in Canada in 2001. This year the Department of Fishery (Departamento de Pesca e Aqüicultura), Ministry of Agriculture (Ministério da Agricultura e do Abastecimento) created a national tuna and alike specialist group (Sub-Comitê Científico do Comitê Consultivo Permanente de Gestão sobre Atuns e Afins-SC/CPG), and has held some meetings in order to work on pelagic shark data from longliners. The national pelagic shark assessment statistical meeting will take place in April 2002.

The major problem in Brazil with the coastal and freshwater elasmobranch catch statistics and trade is the lack of control, and monitoring by species or group of species. The number of specialists here are few, so we do not have appropriate statistics to evaluate the real situation of these animals.

The next SBEEL meeting (Sociedade Brasileira Para O Estudo De Elasmobranquios) will be held in Joao Pessoa, Paraiba, at Universidade Federal da Paraíba, 25-29 November, 2002.

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# Bycatch and Lost Catch in the Uruguayan Longline Fishery

**Andrés Domingo, Dirección Nacional de Recursos Acuáticos, Uruguay**

Swordfish are the main target of the Uruguayan longline fleet which began its activity in 1969. Currently there are nine operating vessels (Mora and Domingo 2001). In 1998, DINARA (the government office in charge of marine and aquatic resources) began conducting an observer program onboard the fleet, with the purpose of obtaining information on the target species (swordfish, bigeye tuna, yellowfin tuna), and those caught as incidental catch (albacore, sharks).

Though shark fins were not traditionally a target of the fishery, there is an increasing fishing effort for this product, and it has become one of the main targets in many of the fishing trips. Traditionally, fins belonged to the crew. However, as a result of the population growth the increase in purchasing power of Eastern markets and the popularity of shark fin soup, there is a growing demand for shark fins which often reaches the highest prices among sea products. For this reason fins are now shared, in most cases fifty-fifty between the crew and the company. Another consequence of the increasing demand is that juvenile specimens previously released are now discarded after finning.

Ten trips with scientific observers were made between 1998 and 2000, and 153 longline sets were monitored. It was found that all sharks caught were finned. Shark bycatch fluctuated between 7-37% of the total capture, and between 18-70% of the captured elasmobranchs. Most of the bycatch consisted of blue sharks less than 1.50 m in length, together with several other species of carcharhinids.

There is a proportion of the total capture that becomes detached from the gear at the moment of recovery. This is known as lost catch and can be caused by operating problems (for example, the tension of the gear, if contrary to the direction of the ship may cause the fish to be lost if the ship does not stop in time), or due to the conflicting interests of the skipper and crew (the skipper is paid only for the target species, whereas the crew earnings are based on the total catch, thus if the species caught are not valuable for the skipper, he will not stop the vessel) (Domingo *et al.* 2001). The lost catch was found to amount to 4-7% of the total capture, with over 50% of the lost catch consisting of elasmobranchs.

Considering that the operating modality of the Uruguayan fleet is similar to that of others operating in the South Western Atlantic Ocean, we believe that the performance of these other fleets are likely to be similar to those described here. The pressure of these fleets in search of fins from juvenile sharks together with the lost catch values indicate that the mortality values due to fishing may differ significantly from values obtained from landing declarations and logbooks. The best way of determining the impact of these fisheries on resources is through scientific observation programs.

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# Sawfishes in the indigenous art of Panama

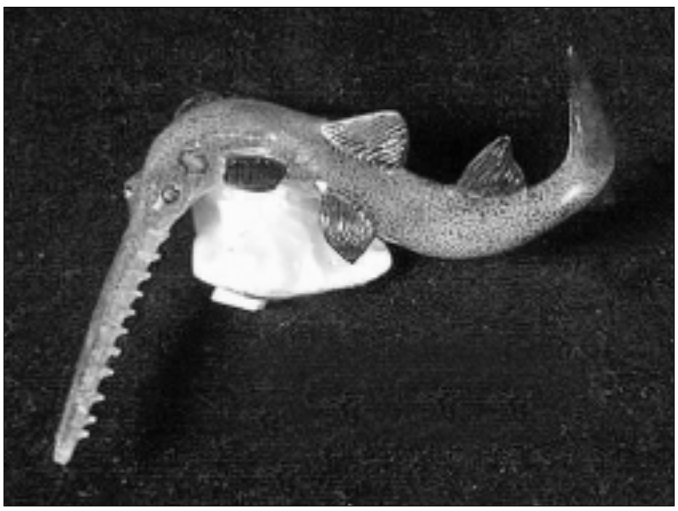
**Matthew T. McDavitt**

Sawfishes have long appeared in the native art of Panama. 1,400 years ago, bold geometric sawfishes adorned the pottery of the Coclé people of Central Panama. Highly stylized, these sawfishes often merge in complex, swirling patterns with other marine and riverine denizens such as crocodiles and sharks. The descendants of the Coclé were annihilated when the Spanish conquered the New World, so we do not know what significance sawfishes held for this culture. Several modern studies of Coclé iconography have put forth two possibilities. Linares suggests that sawfishes, along with other dangerous creatures, symbolized "aggression and hostility", qualities valued by a warrior society (Linares 1977). In contrast, Labbe interprets these sawfishes as shape-shifting manifestations of shamans or their spirit-animal assistants (Labbe 1995). Certainly, modern Native American societies in Panama view sawfishes as spiritually powerful beings sought out by shamans.

## Darién Rainforest

The Emberá and Wounaan peoples, sometimes referred to collectively as the Chocó, inhabit the lush Darién rainforest near the Colombian border in south-eastern Panama. Their villages are grouped along the Chucunaque and Sambú river systems, both emptying into the Pacific Ocean. Sawfishes are common in these rivers (Breder 1928, Bleher 1994), but the exact species of this freshwater pristid has not yet been determined. The Emberá/Wounaan call sawfishes *mona* and small individuals are exploited for food (Breder 1928). These toothy rays are also said to harbour powerful spirits, and Emberá/Wounaan shamans elicit the assistance of sawfish spirits during healing ceremonies. They carve batons from dense cocobolo wood to house these powerful animal spirits, assuring their continued cooperation in fighting supernatural enemies.

Often unable to sustain themselves through traditional subsistence methods due to growing competition for productive forest, many Emberá/Wounaan are finding ways to participate in the cash economy of modern Panama. Skilled artists now sell their carvings and handicrafts to an ever growing tourist and tribal art market; one art form was created purely for sale outside the village. When construction of the Pan American Highway displaced many Darién villages from their lands, artists began carving miniature rainforest animals out of ivory nuts (or tagua) for income.



Freshwater sawfish carved from a *tagua* nut by Gereniño Negria (Wounaan people, Darién, Panama). Tagua carving is a new art form developed to generate cash income for marginalized Wounaans. [Length: 9.6 cm.]
*Collection of the author.*

These charming figurines have been warmly received in world markets, often likened to the highly collected *netsuke* carvings of Japan. Both the Emberá/Wounaan and the sawfishes face an uncertain future due to intensified logging and ranching in the Darién, both contributing to river-choking erosion.

## Kuna Molas

Perhaps the most celebrated indigenous art of Panama is the Kuna *mola*. The Kuna occupy the San Blas archipelago and the adjacent mainland along the Caribbean coast. *Molas* are complex appliqué cloth panels which Kuna women use to decorate their blouses. This art form developed a century ago, a merging of native body painting and forced European standards of dress, compelling Kuna women to wear Western style clothing. The decorative *molas* soon became a symbol of Kuna ethnic identity, and they are now regarded as fine indigenous art.

*Molas* are made by stitching several layers of coloured cloth together. The top layers have intricate geometric designs cut into them, allowing the brilliant coloured layers below to show through. Kuna women use cotton cloth of many vibrant shades, creating works of remarkable beauty and power. Themes are largely drawn from the natural and mythological landscape. The Kuna believe that sawfishes (*suku*) are special protectors of the Kuna people, and will come to their aid to fight off malevolent denizens of the sea, or rescue them from drowning (Nordenskiold 1938). Here too, sawfishes are utilized as spirit guides by indigenous shamans.

Cloth appliqué *mola* (Kuna people, San Blas Archipelago, Panama). A sawfish battles a shark and crocodile while a Kuna spear-fisherman watches from shore. Called '*suku*', sawfishes are considered guardians of the Kuna and are never killed by them.
*Collection of the author*

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# Lake Nicaragua revisited: conversations with a former sawfish fisherman

**Matthew T. McDavitt (contact details on p.4)**

In a series of articles spanning more than a decade, the late Dr. Thomas Thorson chronicled the catastrophic decline of sawfish populations in Lake Nicaragua. During his pioneering tagging study of bull shark movements into the Rio San Juan-Lake Nicaragua system in 1966, he discovered that largetooth sawfishes (*Pristis perotteti*) were remarkably abundant in the lake. In 1970, the Nicaraguan government encouraged the development of a targeted fishery to exploit the lake's rich elasmobranch resources. Two companies and a processing plant were established in Granada, a town in the northwest corner of the lake. By 1975, an estimated 60,000 – 100,000 sawfishes had been harvested (Thorson 1976). The meat was consumed domestically and exported overseas; dried fins were marketed to the lucrative Chinese shark-fin trade (Thorson 1982a).

By 1973, Dr. Thorson sounded the alarm that sawfish populations were reaching critical levels, and that immediate action was required to forestall the impending crash of the sawfish fishery (Thorson 1982a). His recommendations went unheeded, and in the 1980's the industry collapsed, and fishermen refused to target the now elusive sawfishes. Faced with the reality that the once abundant sawfishes were now functionally extirpated from the lake, the Nicaraguan government instituted a temporary moratorium on targeted fishing for sawfishes and sharks (Thorson 1982a). They hoped this would allow the sawfishes time to replenish their stocks, beginning the slow process of re-establishing healthy populations in the lake. Political upheaval in Nicaragua during the 1980's precluded any reassessment studies of sawfish populations in the lake. It remained unclear whether the ban on targeting sawfishes had been effective. Had the sawfishes returned to Lake Nicaragua?

## A new survey

In the summer of 1998, I visited Lake Nicaragua to assist with a preliminary survey of shark and sawfish populations initiated by Dr. William Raschi. Guided by former shark fishermen who knew the best locations to find these elasmobranchs, we set a series of longlines totalling 5,500 meters at depths ranging from 2.4m – 37.8m. We had also planned to set a series of gillnets, but our net vanished the first night it was set. No sharks or sawfishes were caught during the brief survey. Conversations with local fishermen confirmed that sawfish and shark populations have not recovered from the devastating over-harvest two decades ago.

## Interview on Ometepe

With the assistance of Alvaro Molina of the *Estación Biológica de Ometepe*, I interviewed a fisherman who had participated in the sawfish fishery. Eduardo entered the industry near the end of the sawfish fishery; of particular interest are his assertions that he caught substantial numbers of sawfishes during the 1980's, the decade when the fishery collapsed and the temporary moratorium was eventually enacted.

Q: What is your full name and occupation?

A: *Eduardo Lanuza Diaz, fisherman.*

Q: When did you become a professional shark fisherman?

A: *In 1980, now I fish for tarpon (Tarpon atlanticus) and alligator gar (Lepisosteus tropicus).*

Q: How many sawfishes have you caught during your career?

A: *During the 1980's I caught between 150 and 250 sawfishes per week, fishing exclusively for sawfishes. There were three other boats doing the same.*

Q: Where in the lake can sawfishes be found today?

A: *Between Ometepe Island (Maderas volcano side) and Zanate Island, which is the deepest part of the lake.*

Q: At what depth do you usually find sawfishes, and on what kind of substrate?

A: *40 meters in depth, mostly on muddy bottoms.*

Q: What type of gear do you use to catch sawfishes?

A: *With gillnets laid out on the bottom of the lake.*

Q: How many sawfishes are accidentally caught in your nets per year now (1998)?

A: *Between four and six sawfishes per year.*

Q: Do you know anyone who has been injured catching sawfishes?

A: *The animal can be very aggressive and has to be killed before it can be handled. Sometimes they have to drag it to shore to kill it. Injuries can occur when you drag it along the boat to kill it.*

Q: If a sawfish gets caught in your nets, how do you kill it?

A: *By hitting it on the head with a baseball bat type instrument.*

Q: What do the sawfishes eat?

A: *They eat small fishes at the bottom, the same kinds you caught (cichlids). When sawfishes are in heat, they come to the surface to mate.*

Q: Where can baby sawfishes be found in the lake?

A: *In very shallow areas around Ometepe and Zanate Islands.*

Q: How do you cure a sawfish snout?

A: *Hang them from a tree to dry and the cut end is cured with salt.*

Q: Do you think the ban on sawfish fishing has helped?

A: *The population has not recovered from the overkill of the 1980's.*

## Conclusions

Lake Nicaragua is perhaps unique in the world. Nowhere else have sawfishes been recorded in such densities (Thorson 1982a), the population is even more remarkable because it exists in a lake. Dr. Raschi's brief longline survey, in agreement with the opinions of local fisherman, suggests that the government ban on targeted fishing for sawfishes and sharks has been ineffective. While no longer subject to focused harvest, sawfishes continue to be killed in gillnets set for other species. This incidental capture has seemingly prevented any meaningful recovery of elasmobranch populations in Lake Nicaragua. Unless substantial changes are made to current fishing policy, it is doubtful that sawfishes will ever return to their former abundance in the lake.

These observations are supported by examples of sawfish population declines elsewhere in the world. Freshwater sawfishes (*Pristis microdon*) were decimated in Lake Sentani, West Papua, Indonesia, by incidental gillnet capture alone. In Florida, populations of smalltooth sawfish (*Pristis pectinata*) are just now showing signs of slowing decline, only after gillnet fishing had been eliminated from state waters for several decades (Colin Simpfendorfer, pers. comm.). Sawfish populations are extremely sensitive to intensive gillnetting, regardless of the species targeted. This factor must be considered carefully whenever habitat is set aside for endangered sawfishes.

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# Cipactli's sword, Tlaltecuhtli's teeth: deciphering the sawfish & shark offerings in the Aztec Great Temple

**Matthew T. McDavitt**

## Mysterious remains

In 1978, the ruins of the Aztec Great Temple were discovered beneath the central plaza of Mexico City. Over the next few decades, this sacred structure was excavated and studied, revealing a wealth of information about Aztec religious life. Five-hundred years ago, this multi-tiered pyramid marked the literal center of the Aztec universe. Here elaborate ceremonies were performed to maintain cosmic order and sustain the gods. Among the abundant offerings entombed in the foundations were the remains of dozens of sawfishes, sharks, and crocodiles (Lopez Lujan 1994). In fact, these aquatic predators represent the most abundant large animal remains buried beneath the Great Temple. Why did the Aztecs bury so many sawfishes and sharks beneath their main temple? The following paper will briefly examine the role these animals played in the cosmology of the ancient Aztecs.

Rostrum of the sawfish *Pristis pectinata* in Offering 58 of the Great Temple. Used as tools of sacrifice, these spiky snouts symbolized the blood-spilling swords that fed Cipactli. (Photo courtesy of CNCA-INAH-MEX)

## Creation and sacrifice

In Aztec belief, the world had been founded on the premise of divine sacrifice. The gods had drained all their life-force into creation and no longer had the power to sustain themselves. In a kind of cosmic conservation of energy, the Aztecs believed that the sun could not rise, crops could not grow, and rain would not fall without the regular release of life energy back to their creators. To keep the gods alive, humans were obligated to feed them their blood and hearts, the most potent source of life energy. Although the Aztecs recognized hundreds of gods, these diverse deities were just manifestations of the primary forces of the universe such as sun and earth. The sun was a giver of life and a protector of the Aztec people. The earth however, was considerably more hostile…

## The Earth-Monster subdued

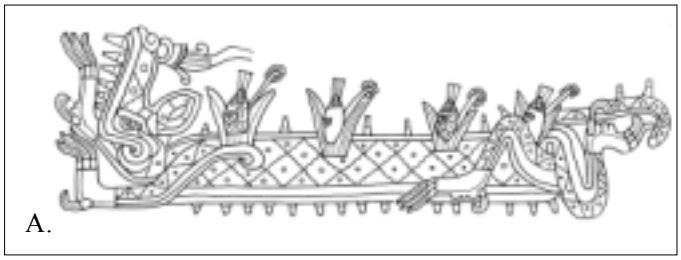
When the gods were forming the world, they gazed into the primal sea, wondering how to create land for their people. They noticed a titanic monster called *Cipactli* surging through the darkened depths. Baiting the beast from the abyss, four gods wrestled the raging creature to the surface. The deities succeeded in subduing *Cipactli*, eventually ripping her in half. The earth was formed from her lower body; the heavens from her upper half. Dismembered but alive, the paralyzed *Cipactli* became known as *Tlaltecuhtli*, the "Earth-Lord".

## Cipactli as crocodile, shark and sawfish

Little is known about *Cipactli*; she is rarely mentioned in the mythological texts or pictured in the Aztec codices. However, careful examination of the iconography of this earth-monster reveals much about her role in Aztec religious thought. Historically, interpretations of *Cipactli* have been confused by zoological imprecision; various commentators have identified *Cipactli* as either a serpent, lizard, alligator, crocodile, caiman, shark, swordfish, sawfish, gar, iguana, or dragon... This confusion is eliminated once the iconography is scrutinized.

The primary form of *Cipactli* is undeniably crocodilian. *Cipactli* is often depicted with a reptilian scale design I have termed "*Cipactli* pattern" (McDavitt 1993). Composed of wavy diagonal lines intersecting to form diamonds with a black dot in the center, this design is a faithful rendering of the skin of true crocodiles which have sensory pits on each of their body scales (as opposed to alligators and caimans). "*Cipactli* pattern" can be used to identify other symbols linked to her. Drawings of mountains, caves, and the ground itself are often filled with "*Cipactli* pattern", revealing that the earth was formed from the body of this mighty crocodile.

Other depictions of *Cipactli* feature a finned fish body and heterocercal tail. Beyer (1965) interprets this tail as belonging to the sawfish, but the tail is too strongly heterocercal to represent this

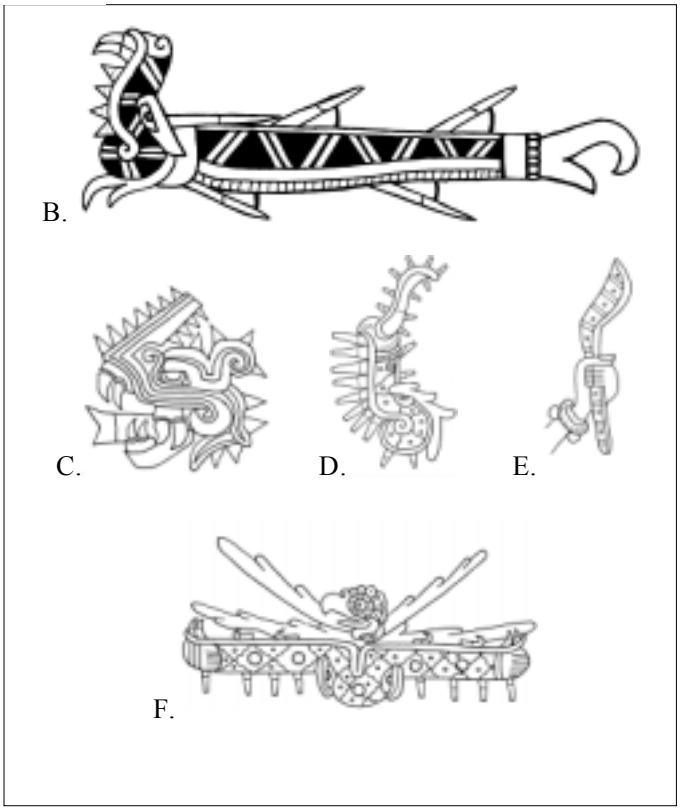



A. *Cipactli* as crocodile growing corn on her back—note the "*Cipactli* pattern" skin. (Codex Borgia)

ray. In some depictions, the finned *Cipactli* bites the leg off a male deity. The strong upper tail lobe combined with this propensity for man-eating suggest the carcharhiniform sharks; stripes on one example may specifically denote the tiger shark, though most examples are not striped. And there is a final, more enigmatic form of *Cipactli*…

At times, the crocodile head of *Cipactli* bears a strange, toothy appendage. Though often very stylized, several naturalistic representations clearly identify this feature as the rostrum of a sawfish (*Pristis* sp.). Called *acipaquitli* by the Aztecs, this creature is even linguistically linked to the earth-monster. Rarely discussed in Aztec texts and seemingly absent from the codices, sawfish rostra have received little mention in interpretations of the Great Temple offerings.

However, these toothy snouts represent the most abundant large animal remains interred beneath the center of the Aztec universe. Sawfish rostra were undeniably important in Aztec religious thought, but are there any clues to their significance?

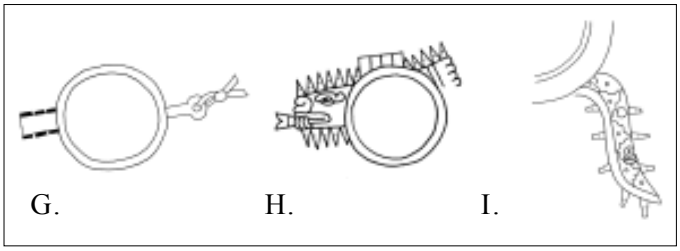



B. *Cipactli* as shark—note heterocercal tail. (Codex Fejervary-Mayer)
C. *Cipactli* head with sawfish rostrum (petroglyph, Acalpixcan)
D. *Cipactli* head with sawfish snout—note S-curve resembling the *xonecuilli* staff (Codex Borgia)
E. *Xonecuilli* staff, symbolizing lightning and fertility (Codex Borgia)
F. Devouring maw of *Tlaltecuhtli* as surface of the earth, accepting offering of quail blood—the head of this "Earth Lord" is formed from two inverted *Cipactli* heads joined at the base (Codex Borgia)

## Sword of the Earth-Monster

In reality, sawfish rostra appear commonly in the Aztec codices, often independent of *Cipactli*. They sometimes bear the characteristic "*Cipactli* pattern", firmly establishing their association with the earth-monster. However, these rostra are often so stylized that they are rarely recognized. In the codices, sawfish rostra often curl with a graceful S-curve. This modification in shape suggests that when depicted, sawfish rostra were sometimes merged with another implement, the *xonecuilli*, an S-curved staff associated with lightning and agricultural fertility.

In Aztec language, the sawfish rostrum was known as *imacuauh* "its sword" (Sahagun 11: 1963), linking *Cipactli* to warfare and the sword combat which fed her, or *itlahuitequia* "its striker" (Sahagun 2: 1981), a term using the same root as *tlahuitequiliztli* "lightning". There is pictorial evidence of these associations, as well. Sawfish rostra are most often depicted as symbolic 'swords' in the shield / spear bundles which symbolize warfare in Aztec iconography. There is even a structural similarity between the Aztec glass-edged swords and the sawfishes' toothy appendage. Similarly, sawfish rostra occasionally appear as lightning hurled by gods.




G. Aztec sword & shield, symbolizing warfare (Lienzo de Tlaxcala)
H. Sawfish rostrum as symbolic sword behind shield (Codex Borbonicus)
I. Detail of *xonecuilli*-shaped sawfish snout behind shield—note "*Cipactli* pattern" (Codex Borgia)

Sawfish rostra are then common both archaeologically and iconographically. In Aztec religion, they were powerful symbols representing the connection between the fecundity of the landscape and warfare. *Cipactli / Tlaltecuhtli*, enraged at being dismembered to form the earth, demanded to be "irrigated with blood" in order to nurture crops on her fertile back (Garibay 1973). As the 'sword' of the earth-monster, the sawfish rostrum represented the necessity of bloodshed through combat and sacrifice for agricultural production. In the Aztec world, there was no life without death.

The use of sawfish snouts in ritual is detailed in a text written soon after the conquest of the Aztecs (Sahagun 2: 1981). In certain heart extraction sacrifices, the neck of the victim was crushed with the snout of a sawfish, preventing any inauspicious cries. Presumably, this action also allowed *Cipactli* to symbolically 'bite' the offering before the heart and blood were offered to the sun.

## Remains re-examined

So, what do the plentiful sawfish and shark remains entombed beneath the Aztec Great Temple mean? Based on iconographic analysis, sawfishes, sharks, and crocodiles clearly represent *Cipactli / Tlaltecuhtli*, the personified earth, at once fertile and destructive. The detached sawfish rostra may be actual ritual implements used to pierce the necks of sacrificial victims when the hungry earth required food. They were probably offered, as were other tools of sacrifice, as palpable proof that the Aztecs were fulfilling their duty to feed the gods. Based on their associations with warfare, these 'swords' of *Cipactli* were potent symbols of the Aztecs' obligation to fertilize the predatory, devouring earth with blood and bodies, so that she could in turn nourish mankind. And there are other possibilities…

Many ancient cultures believed that the earth had been formed from a titanic monster or dragon. These societies regularly re-enacted the battle between the gods and the earth-monster, celebrating the founding of the world. Civilizations from Ancient Babylonia to Edo-Period Japan performed these rituals to prevent the captive earth from moving, a terrifying possibility which threatened to destroy the world.

Planted at the very center of the Aztec cosmos, these *Cipactli* remains may represent such a foundation sacrifice. We can imagine that these crocodile, shark, and sawfish offerings were utilized in ceremonies where *Cipactli* was symbolically slain to prevent her from sinking below the waves, forever destroying the parasitic civilization resting on her back. By cyclically defeating *Cipactli* and entombing her beneath the Great Temple, perhaps the Aztecs hoped to ensure that their living, hostile earth never again found the strength to submerge.

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# Coastal shark fishery off Pernambuco – Brazil: is there any possibility of management?

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Since the 1970's it has been questioned if a sustainable fishery for elasmobranchs is possible. It is now generally accepted that economic and biological sustainability can be reached through the exploitation of relatively more fecund species, under careful management.

The intention of this article is to highlight the importance of small coastal sharks stocks in poor regions with social, economic and technological difficulties, making it extremely difficult to implement conservation and management measures. However, there are no conclusive studies on the subject, and many questions still concern researchers and policy and decision makers.

The first problem that we face when considering shark fisheries is with the term itself. Can we say that there is a small coastal shark fishery in Pernambuco, Brazil? Not as such, although the pressures on this resource as highlighted throughout this article, lead us to believe that these resources are in serious danger.

Small sharks play an important role in the economy of developing countries, because they form part of the diet of the poorest communities. Studies aimed at improved exploitation, which take into account conservation of the resource, are thus of great importance.

In the past, high value commercial fish species occurring off Pernambuco, Brazil, such as snappers, groupers, and mackerel, were targeted in preference to less valuable fish, such as small coastal sharks. However, the sharp decline of many valuable commercial stocks has resulted in an increased and directed fishing effort to make use of less valuable species such as sharks.

The contribution of sharks to the fishing production of the State of Pernambuco has always been very low. In the late 1970's the average contribution was 1.38% (SUDENE 1983), during the 1980's the average was 1%, (SUDEPE 1988), reaching the lowest contribution in 1995, with 0.12% (4.6t) (IBAMA 1996) and fluctuating around 0.25% since then. In 2000 the total catch of sharks was 13.91t (0.24%) (IBAMA 2001). The catch of coastal sharks around Pernambuco comprises 4 species: *Rhizoprionodon porosus*, the most abundant species (60%), *Rhizoprionodon lalandii*, *Carcharhinus porosus* and *Carcharhinus acronotus*.

In 2000, motor boats caught 91.6% of the total shark production (12.74t), rafts 6.8% (0.95t) , and canoes 1.6% (0.21t). Gillnets are the most common fishing gear used for the capture of coastal sharks, although gillnets were second in the State total production responsible for 19% (1,046.77t), being surpassed by fish traps (*covos*), which were responsible for 20%. Handlines were responsible for 17% of the catch. The relative contribution of sharks to the total catch (by gillnets only), was 1.33% (IBAMA 2001).

## Management difficulties

Some of the difficulties for the management of small coastal sharks off Pernambuco are as follows:

1. **Non-target species.**
   Small coastal sharks are considered of low value and importance commercially, thus few studies have been conducted, and historical data are scarce. Generally, these species are important among low-income communities, due to low prices, ease of processing and the comparatively low size/volume of the catches.
2. **High fishing effort and low abundance index;**
   The relative abundance was estimated through the catch per unit effort (CPUE) in terms of total weight and number of individuals caught per 1000m$^2$ of net per day of fishing. This allowed the estimation of a fishing effort of approximately 320,000m$^2$, with a CPUE of 0.12-kg/1000m$^2$ of net/day or 0.09 ind./1000m$^2$ of net/day.
3. **Lack of trustworthy baseline data;**
   The lack of baseline data hinders an in-depth analysis on the occurrence and frequency of sharks off Pernambuco coast.
4. **Restricted area fishing**
   The fishing fleet operates near shore in depths between 10- 30m due to unsophisticated equipment. Wooden hull man-made boats of 6-10 m length are used, usually with 30-hp engine. It is therefore highly likely that shark nursery areas are under heavy fishing pressure.
5. **Low selectivity of fishing gears**
   Amongst the variety of fishing gears used for the artisanal fishery off Pernambuco State coast, fixed gillnets are one of the most abundant, as stated above, and catch small sharks as bycatch. Average mesh size is 50 mm from knot to knot, nylon monofilament of 0.6 mm, an enrolment coefficient between 50%-60%, 24 meshes in height and 100 m in length.
6. **No options of diversification of fishing activities**
   Attempts to diversify traditional fishing activities is always considered when development plans for the artisanal fishery sector are discussed, but resistance to this is common among fishermen who generally oppose changes to their way of fishing, and among official government agencies considering economic aspects and not the social and ecological aspects.
7. **Social and economic conditions of fishing communities**
   Generally very poor social and economic conditions of coastal fishing communities impede the introduction of new technologies, and, sometimes prevent their development. Local sustainable development is necessary to change this situation.
8. **Vocation strengthening**
   The local fishing sector is known for intra- and interregional inequalities. Fishing is the natural vocation for these communities, supplying immediate necessities, consolidating societies and developing other local advantages.
9. **High divergence and competition among fishermen and low associative organisation**
   Much needs to be done to reach an adequate level of organisation in the fishing communities of Pernambuco in order for them to participate in the planning to achieve the desired sustainable development. In fact, the social structure of these communities currently hinders awareness and faith in the planning and development process.
10. **Migration, distribution and abundance of stocks**
    There is little information on the stocks, and currently no seasonal or spatial pattern can be drawn.
11. **Environmental impacts**
    Coastal and estuarine areas off Pernambuco State are suffering intense habitat degradation, due to high levels of anthropogenic activities. It is these nearshore habitats most under threat that provide nursery grounds for many shark species.

## Plan of Action

The environmental impacts, unsustainable fishery, and poor socio-economic conditions of these fishing communities all seem to be contributing to the reduction of the coastal shark stocks. These conditions, together with the slow growth, high longevity, late maturation and low fecundity of these sharks, mean that any management measures introduced for the artisanal fishing sector are likely to face problems. Following the guidelines developed by FAO (FAO 2000), a specific plan of action for small coastal sharks stocks off Pernambuco should include and prioritise studies on:

**Fisheries:** fishing technique evaluation, gathering of fisheries data, and fisheries-independent abundance information;

**Ecology:** temporal and spatial distribution and abundance, habitats characteristics, oceanographic conditions, and location of nursery grounds;

**Demography:** incorporating biological data on reproduction, age at maturity, fecundity, maximum age, sex ratio, and natural mortality at specific ages (Márquez-Farias and Castillo-Geniz 1998);

**Anthropogenic impacts:** aquatic sports, bathers, industrial and domestic waste, and harbour developments; and

**Socio-economics:** technological and economic dependencies of fishing communities on production variability, strategy of harvest, processing and commercialisation. Emphasis must be give to the management credibility and the integration between management and evaluation.


## Acknowledgements

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# Sawfish Trade in the North of Brazil


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In the North of Brazil, one of the regions' most famous fish markets is the "Ver-O-Peso" in the city of Belém (State of Pará). Sawfish are routinely captured and their meat, fins and rostral expansion (saw) are sold in local markets. Two species of sawfish (*Pristis perotteti* and *P. pectinata*) have been observed to be landed at the "Ver-O-Peso".

The flesh of sawfish is white and tender, especially that of the juveniles, and is one of the most valuable and preferred of the other elasmobranchs sold locally. Fins, usually removed on board as soon as a sawfish is caught, are obviously far more valuable than the meat, but are considered to be of intermediate quality by local fin buyers.

Saws going through the last part of the drying process before they are sold.
Photo: Patricia Charvet-Almeida

The saws are also removed on board and dried on the boat deck along with the fins. Large saws (1.5 m or more) are sold immediately upon arrival of the fishing boats. Fishermen usually sell these saws to specific buyers who order them prior to the departure of the boats. These large saws are worth up to US$ 300 depending on their size, are used as curios, and are probably taken to other regions of the country or exported. Small sized saws, from newborn and juvenile sawfish, are sold as curios to tourists, and to locals as part of a regional folklore treatment of asthma. This treatment consists of grinding the saw to a powder and mixing it with hot water to make a tea. This tea is considered very effective by many, although there is no medical evidence on the possible beneficial effects. Pieces of the rostral expansion are often sold since a whole saw is not required for this treatment. Small saws also have another, rather unfortunate use: the saw teeth are removed and tied to rooster legs as sharp "weapons" to be used in illegal cockfights.

Sawfish are extremely vulnerable to most fisheries since their saw becomes easily entangled in almost any kind of fishing net. When brought aboard, sawfish thrash around, and depending on how entangled the animal is, the only way to free it from the net (without destroying the fishing gear) is to kill and cut up the animal. Older fishermen have commented that regionally the number of catches has reduced significantly over the last 10-15 years.

All seven species of sawfish are listed as either Endangered or Critically Endangered on the Red List of Threatened Species (www.redlist.org) and the listing of sawfish under CITES should be reconsidered, in addition to the implementation of urgently needed management and protection measures, in order to prevent further population declines taking place.


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# Molecular Genetics of some Brazilian Sharks

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Sharks are excellent organisms for the study of molecular evolution in vertebrates because there is an abundant stratigraphic record based on fossil teeth which permits accurate calibration of rates of DNA and protein sequence evolution. Literature on molecular genetics of sharks from South America is rare. A study on the evolution of Squatinidae sharks based on DNA sequences is presented here.

The family Squatinidae, (angel sharks), comprises a single genus that includes fifteen extant species. Three species of the genus *Squatina,* commonly known as 'cações-anjos' in Brazil, are endemic to the continental shelf of southeastern South America, between latitudes 24°00'S and 42°00'S: *Squatina argentina*, *S. guggenheim* and *S. occulta*. Fisheries for angel sharks are of great economic importance in Rio Grande do Sul State, Brazil.

Vooren and Silva (1991) described the species *Squatina occulta* which differs from *S. argentina* by the shape and relative size of the pectoral fin, from *S. guggenheim* by the lack of a dorsal row of spines, and from both species by the tooth formula and colour of the dorsal body surface. Before their description of *S. occulta* and re-description of *S. guggenheim*, only one species of *Squatina* was thought to occur along the southern coast of South America. *S. occulta* and *S. guggenheim* were misidentified as *S. argentina* in some studies.

In our study, PCR (polymerase chain reaction) was used to amplify 401-base pair sequences of the mitochondrial DNA cytochrome b gene from each species. DNA sequences of this gene from the three species of *Squatina* from southern Brazil were analysed. Phylogenetic analyses were performed with the Phylogenetic Analysis Using Parsimony (PAUP) program. The maximum parsimony tree was obtained with the heuristic search algorithm (Swofford 1993).

The phylogenetic analyses performed indicate that the *Squatina* species from southern Brazil constitute a monophyletic group, with the newly described *S. occulta* being more closely related to *S. guggenheim* than to *S. argentina* in all analyses, although *S. occulta* and *S. guggenheim* differ in morphological aspects (e.g. presence or absence of dorsal spines, tooth formula), in growth parameters (maximum total length and total weight, total length and total weight at birth), and in reproductive parameters (fecundity, total length at maturity, diameter and mass of the mature follicle) (Vooren and Silva 1991).

The molecular phylogeny obtained here suggests that the similarities between *S. occulta* and *S. argentina* are shared ancestral characteristics. *S. occulta* and *S. argentina* have many similarities in growth and reproductive parameters. Furthermore, the spatial distributions of these two species overlap partially in the continental shelf of southern Brazil in depths of 60-200 m, whereas *S. guggenheim* is rarely found in depths greater than 80 m (Vooren and Silva 1991). The close relationship between *S. occulta* and *S. guggenheim* observed in this molecular study is supported by the number of functional ovaries. The present phylogeny suggests that a single functional ovary is a synapomorphy between *S. occulta* and *S. guggenheim*. *S. argentina* is the only one of the three angel sharks species from southern Brazil that maintains the "ancient character" (Vooren and Silva 1991) of paired functional ovaries in the female, while *S. occulta* and *S. guggenheim* have a single functional ovary on the left-hand side of the body cavity. In other species of *Squatina*, such as *S. japonica, S. dumeril*, and most specimens observed of *S. californica,* only the left ovary is functional, whereas *S. oculata* and *S. squatina* have two functional ovaries (Natanson and Caillet 1986). Ovaries are paired structures in most elasmobranchs, but it was observed that they can be asymmetrical in adult sharks of the orders Carcharhiniformes, Pristiophoriformes and Squatiniformes. Phylogenetic analyses of mitochondrial DNA sequences has shown that the angel sharks (Squatiniformes) and saw sharks (Pristiophoriformes) are sister groups (Kitamura *et al*. 1996).

Vooren and Silva (1991) suggested that speciation in angel sharks may occur with minor changes in body form, and major changes in growth and reproductive parameters. The results of the present study suggested that *S. occulta* and *S. guggenheim*, the two species that share the reproductive characteristic of a single functional ovary, are the most closely related pair of species among the three species from southern Brazil. *S. argentina*, which has two functional ovaries and has the highest fecundity (7-11 embryos), is the only species that lives in depths below 200 m (up to 500m). *S. occulta* is found in depths between 60-200m and has an intermediate fecundity between the three species (4-10 embryos). *S. guggenheim* occurs from 0-60m and has the lowest fecundity (3-8 embryos) (Vooren and Silva 1991).

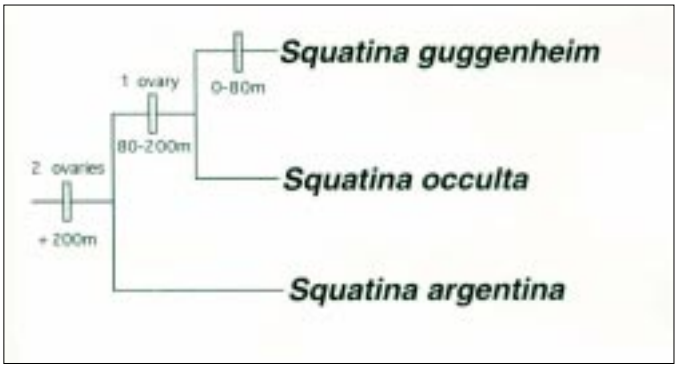


Figure1. Hypothesis of evolution of three species of angel sharks (*S. argentina, S. guggenheim, and S. occulta*) from southern Brazil as predicted by mitochondrial

The present phylogenetic analysis suggests that evolution of the genus *Squatina* in southeastern South America waters may have occurred from deeper to shallower waters (Figure 1). The results indicate that *S. argentina* was the first species of *Squatina* to occupy the continental shelf in depths of 200m or more. Fossil records suggest that the genus *Squatina* has existed since the Upper Jurassic (Capetta 1987). *S. occulta* and *S. guggenheim* have evolved more recently, and speciation probably occurred as an adaptation to life in shallower waters on different types of substrata. The different colour patterns observed in the three species have also been cited as evidence of adaptation to different types of ocean bottom (Vooren and Silva 1991). If this hypothesis is true, *S. guggenheim*, the species that lives between 0-80m, is the most recent species among the three *Squatina* from southern Brazil.

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# Projeto Cação: a study of sharks caught by artisanal fisheries in Sao Paulo, Southern Brazil

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## Introduction

There have been few long-term studies on Brazilian coastal sharks (Lessa 1987, Stride *et al*. 1992, Hazin 1995). None has been undertaken in São Paulo State since Sadowsky (1967) examined sharks from Cananéia.

Studies on the biology and fisheries of coastal sharks caught by the artisanal fleet in São Paulo, Brazil, commenced in July 1996. This work, known as Projeto Cação (Cação is a Portuguese name for shark, widely utilised in Brazil, mainly by fishermen), aims to understand the biological and ecological aspects of the species occurring in the study area. The study is underway in Praia dos Pescadores (fishermen's beach), Itanhaém County, where weekly samples are taken. The fishing fleet comprises about ten motorised small boats (5-6 m long), which utilise gill nets within 5-19 nautical miles from the shore.

Sharks landed are examined and dissected by the researchers on the beach, before processing takes place. Biological material obtained is taken to the laboratory for later analysis. To date, up to 11,000 sharks belonging to 14 species have been studied.

## Summarised species composition data

***Rhizoprionodon lalandei* - Brazilian sharpnose**

Probably the most abundant coastal shark in Southern Brazil (Figueiredo 1977). This is the most heavily commercially exploited shark in the present study, representing more than 50% of total shark catches. The species is present year-round in the area, in different sizes classes. Adult females give birth between June-August.

***Rhizoprionodon porosus* - Atlantic sharpnose**

Observations from this study indicate that it is caught all year round. Birth apparently occurs during the Southern Brazil spring (September-November). Individuals from all size classes have been examined.

***Sphyrna lewini* - scalloped hammerhead**

One of the most common shark species caught by artisanal fisheries during the summer months in São Paulo State, when adult females arrive to give birth. The catches are composed almost exclusively of newborns and juveniles.

***Sphyrna zygaena* - smooth hammerhead**

This species appears to be more common in coastal waters during the winter period. Only juveniles (70-140 cm) were studied.

***Carcharhinus* species - requiem sharks**

Six species have been examined. *Carcharhinus brevipinna* (spinner shark) is the most frequently caught, occurring in summer. *C. limbatus* (blacktip shark) shows a similar distribution pattern to *C. brevipinna*, regarding the seasonal occurrence of newborns, but is less abundant than the former. Juvenile *C. obscurus* (dusky shark) occur in winter. *C. plumbeus* (sandbar shark) and *C. porosus* (smalltail shark) are uncommon, and juveniles occur during spring-summer periods. Only one specimen of *C. acronotus* (blacknose shark) was caught. This was a juvenile male and the southernmost known record of this species, which is most common in Northern Brazil (Gadig 1994, Hazin 1995).

***Squatina guggenheim* - angel shark**

A few samples of adults were obtained in winter. Some juveniles were collected in spring. This species is more frequently caught by bigger vessels in the deeper waters of South Brazil (Vooren and da Silva 1991).

**Other Sharks**

Three juvenile *Galeocerdo cuvier* (tiger shark) were caught in summer. Three adult male sandtiger sharks, *Carcharias taurus*, were observed in the same season, showing developed and haemorragic claspers, suggesting mating activity. A juvenile specimen of *Alopias vulpinus* (thresher shark) measuring about 135cm TL was caught during winter. The former is more abundant in Northern Brazil (Gadig 1994, Hazin 1995), while the thresher is usually associated with oceanic areas (Amorim and Arfelli 1992).

## Future strategies and goals

Having now gained adequate information on the biology and fisheries of shark species inhabiting this area, future strategies to be undertaken will consider the following topics:

1) the establishment of educational programmes to inform the fishermen about sharks;
2) the development of a document presenting the results of the project for submission to scientific and government authorities;
3) the implementation of measures to reduce fishing pressures on small coastal sharks.

## The importance of researcher - fishermen interactions

Two Masters theses are in development, utilising data from this project. The Projeto Cação does not receive any direct financial support from government or private agencies. The monthly costs of travelling, sampling and other expenses, (about US $300), are obtained through sales of Project T-Shirts.

This sum would not be enough if it were not for the collaboration and friendship of the local fishermen who have been helping the Project staff. These fishermen frequently donate whole specimens for research and allow all sharks to be made available for study before processing, as well as putting their boats at the disposal of the Project. Without such help this work would not be possible.

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# The artisanal ray fishery in the Gulf of California: development, fisheries research and management issues

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## Introduction

Fishing for rays in the Mexican Pacific developed with the introduction of bottom gillnets in the Upper Gulf of California, where local fishers target flounder, grouper, and many other finfish resources. The boats used for fishing rays are typical "pangas" 22-25ft in length, using outboard motors and operated by 1-3 fishers. Fishing trips are from 1-3 days in duration, and the operation depth varies with the target group of species. The number of boats used in the ray fishery is currently unknown but is assumed to be high. Fishers tend to switch to ray fisheries depending on the availability of other resources, for example during seasons when more valued resources such as blue crab, shrimps and sierra are restricted due to regulatory regimes. The catch is processed on the beach and stored in ice trucks.

The distribution is mostly regional and includes fresh fillets or salt dried meat. The quality is judged primarily on the colour of the meat (i.e. darker colour = less value). In general, as with other artisanal fisheries in México, the ray fishery is characterized by limited infrastructure for processing, low technology, limited fishing ratio, income supplies and marketing controlled by few companies or middlemen, and an unarticulated role with respect to regional economies.

The fishery for rays extends along the Gulf of California on both sides of Peninsula de Baja California to the Southern Mexican Pacific Coast. The importance of the ray fishery in terms of production decreases from North to South (Figure 1).

Compared to the shark fishery that dates back to the late 1930's, the catch of rays in México is a fairly new activity. The documentation of production began officially in 1986, assuming previously unregistered catches. The peak catch of rays was 1996 with 6,666t, and in 2000 the catch had decreased to 4,944t. The average catch for all Mexican Pacific states during the period from 1990 to 2000 was 5,514t, showing a relative stable trend. Catch production of the Gulf of California surrounding states represented 93% of the Pacific Coast total production during the same period (Figure 2).

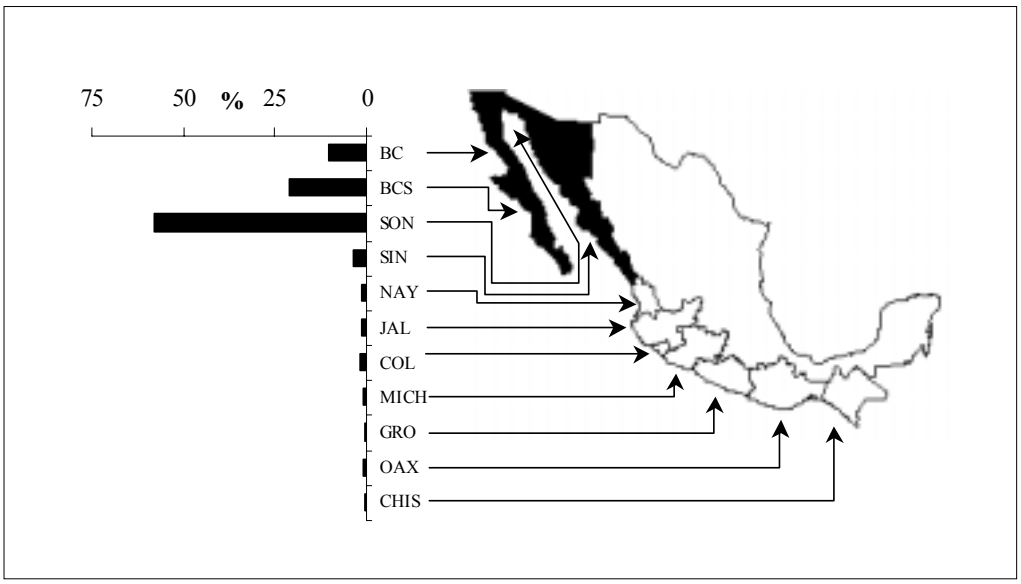


Figure 1. Average proportion of rays production by Mexican Pacific states. Dark shaded states represent the Gulf of California region.

## Species composition

Despite the development of the ray fishery, very few specific studies have been conducted in the Gulf of California region. Most have been carried out along the South West Coast of Baja California, Bahía Almejas and provide limited information. This, however, represents the only information produced regarding some commercially important rays in the region (*R. productus, R. steindachneri, G. marmorata, N. entemedor,* among others), which, unfortunately is mostly published in low impact journals. Undoubtedly the most valuable survey on rays and sharks in the Gulf of California was carried out in a two-year multi institutional research project conducted during 1998-99, lead by Dr. Robert Hueter from CSR/MML (Status of the shark and ray fishery resources in the Gulf of California: Applied Research to Improve Management and Conservation. Email: rhueter@mote.org).

A multispecies complex structure and a wide spectrum of life history strategies of the elasmobranchs studied were elucidated as a result of the biological examination of the catch in this survey. Species registered in Sonora state alone show the high diversity and relative importance in the catches (Table 1). The first five species

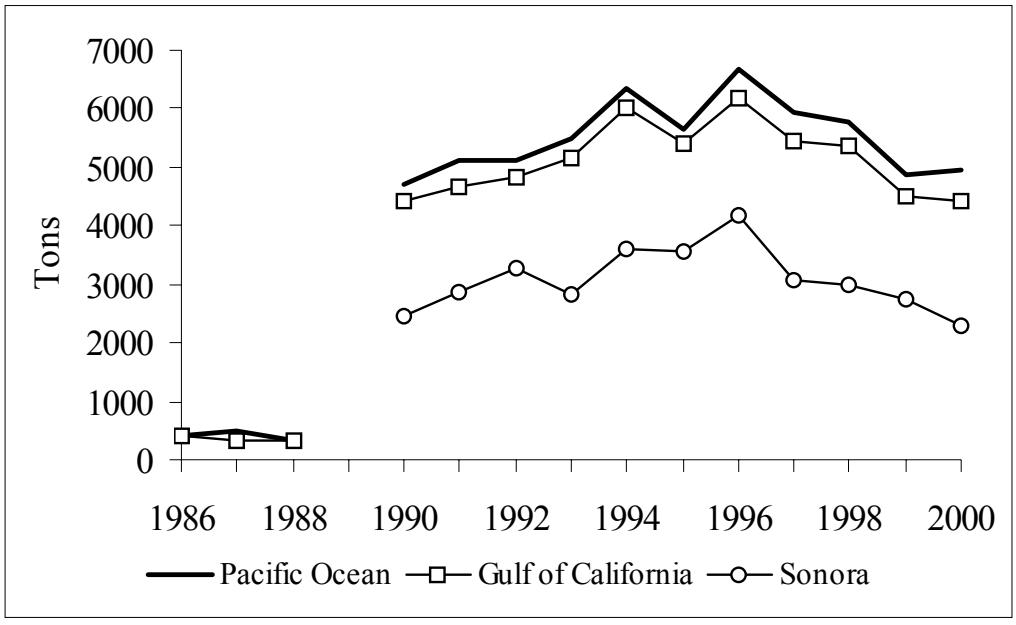


Figure 2. Annual catches of rays in the Pacific Ocean

Table. 1 Relative proportion of rays in Sonora

| Species | % |
|---|---|
| *Rhinobatus productus* | 37.98 |
| *Dasyatis brevis* | 18.95 |
| *Rhinoptera steindachneri* | 14.45 |
| *Gymnura marmorata* | 10.94 |
| *Narcine entemedor* | 5.00 |
| *Rhinobatus glaucostigma* | 4.40 |
| *Gymnura crebripunctata* | 2.74 |
| *Myliobatus californica* | 2.21 |
| *Zapterix exasperata* | 1.61 |
| *Raja velezi* | 1.24 |
| *Urubatis maculatus* | 0.18 |
| *Dasyatis longus* | 0.07 |
| *Mobula munkiana* | 0.06 |
| *Urotrygon chilensis* | 0.05 |
| *Mobula japanica* | 0.04 |
| *Myliobatis longirostris* | 0.03 |
| *Urotrygon rogersi* | 0.02 |
| *Urobatis halleri* | 0.01 |

represent almost 90% of the catches. Species composition varied depending mainly on the gillnet mesh size used and the season.

## Bycatch

Rays have been caught traditionally as bycatch in well-developed fisheries such as: blue crab (*Callinectes bellicosus*), sierra (*Scomberomorus sierra* and *S. concolor*), and shrimp (*Litopenaeus* spp., and *Farfantepenaeus* spp.). A gross calculation of the level of bycatch in the shrimp fishery using a 1:10 bycatch ratio (1 kg/ shrimp:10 kg/bycatch biomass) (Garcia-Caudillo *et al*. 2000), indicated the excessive biomass of rays that have been caught in the Gulf of California during the last 60 years. This prompted us to speculate that ray mortality level from bycatch exceeds the mortality level from the directed ray fishery in the Gulf of California. Parallel commercial activity has developed as a consequence of the large amounts of rays caught in the shrimp trawlers. This informal activity, consisting of middlemen buying the bycatch from the shrimp trawlers, is resulting in disadvantageous competition for the authentic fishermen, mainly because the price of the product from the trawlers is low due to the low operational costs. In addition, rays are frequently caught in traps used in the blue crab fishery and in gillnets used for sierra.

## The research

From almost no knowledge about the ray catches in the Gulf of California in 1998, basic information on the fishery, biology and life history styles of several commercially important rays is now recognized. Specifically, the research priorities of Instituto Nacional de la Pesca (INP) and preliminary results are:

**Fishing gear selectivity**. Because the fishing gears are constructed based on the fishers' experience, their characteristics and dimensions inevitably vary. Panels of different mesh size can be used and various types of net. Catch performance of gillnets in terms of selectivity is currently being examined. As expected, preliminary results have indicated different impacts on the population depending on the size selectivity properties of gillnets.

**Embryonic growth**. Monitoring pregnant females in the catch is used to estimate the season of parturition and the relative area of pupping grounds in Sonora state. Synchronization between embryonic growth of several species of rays and average surface temperature of the Gulf of California has been found.

**Fecundity**. The number of pups produced by species demonstrates the wide range of litter sizes. Some species are recognized as highly productive such as *Rhinobatos* spp. (3-10 pups), and *Gymnura marmorata* (2-15 pups). Contrarily, species such as *Rhinoptera steindachneri* (1 pup) and *Mobula* (1 pup) have an extraordinary low fecundity.

**Maturity**. Macroscopic sexual organs and histological surveys of shell glands and testes for several species are examined from specimens to investigate the possibility of sperm storage as a reproductive strategy, and for validation of the size at maturity. The maturity stages of the species are being compared to the selectivity of gillnets in order to estimate the trend of the gear to retain juveniles.

## Regulation and management issues

Shark management in México is still in the process of implementation due to radical opposition by the recreational sector demanding the inclusion of allowable proportions of billfishes as bycatch by longliners and drift gillnet vessels. A summary of regulation guidelines for the shark fishery was described by Castillo *et al*. (1998). Regulation of the shark fishery also includes measures for rays. Unfortunately, the main causes retarding the implementation of the regulations for sharks are of political order going beyond the facilities of the INP, and currently, the commercial ray fishery is not regulated.

However, through the INP, a new instrument for fisheries management has been developed, the Carta Nacional Pesquera, CNP (National Fisheries Chart). The CNP has legal and obligatory status and brings encouraging possibilities to incorporate the scientific findings of a particular fishery resource (either a single species or a group of species) identified as a Fishing Management Unit (FMU). This management tool will allow INP to build a record summarizing the state of knowledge of a specific FMU which could be implemented and updated annually. Anyone who is able to contribute to the knowledge of a certain resource can incorporate information via the Internet (http://inp.semarnap.gob.mx/ convocatoria/). This information is then reviewed and refereed by a panel of experts. In this way, information on ray resources has already been submitted and is currently undergoing the review process. Ironically, regulation of rays in the Gulf of California could be implemented faster than the Federal Management Plan for sharks (which includes ray-like species), which has been in the planning and development stages for at least seven years.

## Legally protected elasmobranch species in Mexico

Manta rays *Manta birostris*, *Mobula japanica* and *Mobula lucasana* have been protected since March 25, 1994 in the 12 miles perimeter surrounding the Revillagigedo archipelago (Isla San Benedicto, I. Clarion, Roca partida, I. Socorro and I. Guadalupe) in the Mexican Pacific. Commercial fishing is legal in other areas (Camhi *et al*., in prep).

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# Historic Trends in Catches of the Brazilian Longline Fishery in the Southwestern Equatorial Atlantic Ocean

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## Introduction

The pelagic longline fishery off northeastern Brazil began in 1956 with several Japanese longliners (leased by a Brazilian company) primarily targeting tunas (*Thunnus* spp.). This fleet consisted of 12 boats in 1959 (Paiva and Le Gall 1975) and although the fishery was quite successful, fishing operations were suspended in 1964 due to economic and political reasons. Between 1976 and 1977, the fishery experienced a brief revival through the leasing of two Korean longliners. However, there was no significant effort until 1983, when a Brazilian company began to operate from Natal (northeast Brazil), using relatively small vessels to target tunas, billfishes and sharks (mainly the blue shark, *Prionace glauca* and other *Carcharhinus* species). The longline fleet expanded throughout the following 17 years and by 2000 it consisted of 18 boats, ranging in size from approximately 16 to 26 m.

Catch data from this fishery have routinely been collected and used in studies examining biological characteristics of the principle species caught, including their relative distributions and abundances (Hazin *et al*. 1990; 1994a, Travassos *et al*. 1999), reproductive biology (Hazin *et al*. 1994b), and feeding habits (Hazin *et al*. 1994c). More recently, Hazin *et al*. (1998), analysed catch data from some vessels and provided a brief overview of temporal and spatial variations in catch compositions. The identification of such factors has proved essential for the effective management of this fishery. In the present paper, we have expanded the overview presented by Hazin *et al*. (1998) and included yearly catch data until 2000.

## Material and Methods

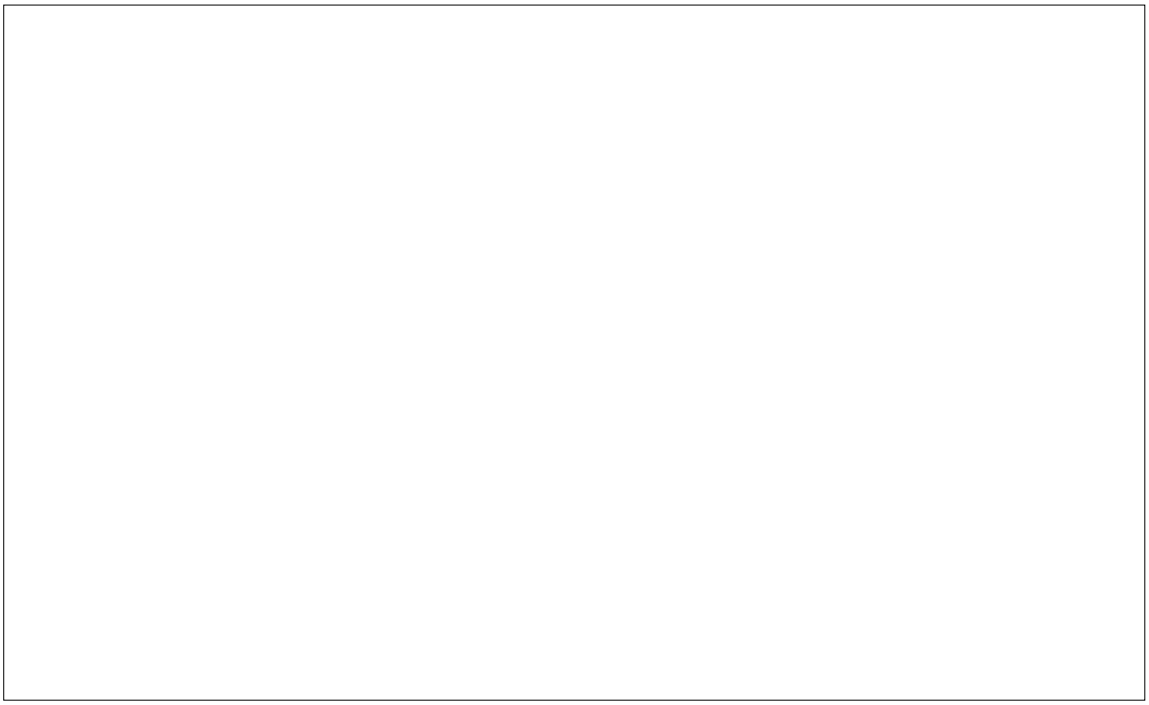
This study used data collected from the log-sheets of longliners operating off northeast Brazil, between 1983 to 2000. Prior to 1996, all vessels used Japanese-style multifilament longlines (for details see Shapiro 1950, Suzuki *et al*. 1977) baited with Brazilian sardine, *Sardinella brasiliensis*. In 1997, all vessels began using monofilament longlines rigged with light-sticks and baited with squid, *Illex argentinus*. Relative abundance of species was evaluated as nominal catch per unit of effort (CPUE), defined as the number of fish caught per 100 hooks per year. Catch records included identification of species, with the exception of sharks, which were collectively grouped up to 1986. After that year, sharks began to be recorded by species. However, because of difficulties in distinguishing some of the species of the genus *Carcharhinus*, for the purposes of this study, they were grouped under the category "gray sharks".

## Results and Discussion

The data presented in Figure 1 show quite large temporal fluctuations of total yearly CPUE of most groups of species examined. Many of these temporal variations can be explained by the changes in overall fishing strategy over the past 17 years, summarized in 5 distinct periods:

**Period 1** (July 1983 - June 1986): tunas (mainly yellowfin tuna) and billfish (swordfish *Xiphias gladius*, sailfish *Istiophorus albicans*, white marlin *Tetrapturus albidus*, and blue marlin *Makaira nigricans*) were the main target groups whilst sharks were avoided.
**Period 2** (July 1986 - December 1987): along with tunas and billfishes, sharks (mainly blue sharks) became a target group.
**Period 3** (January 1988 - June 1991): yellowfin tuna fishing grounds were discovered off the Archipelago of St. Peter and St. Paul, resulting in a shift of effort towards this species.
**Period 4** (July 1991 - June 1996): fishing effort was concentrated over shallow seamounts, where gray sharks species were abundant.
**Period 5** (July 1996 - Dec 2000): although gray sharks were still the dominant group, the CPUE of swordfish rose sharply owing to a concentrated effort involving the use of light sticks and squid as bait.

Figure 1. Location of fishing grounds of Brazilian longliners operating off northeast Brazil



The initial shift in effort towards sharks (period 2) occurred mainly because of an increased awareness of their abundance and availability. Unlike nearly all international longline fisheries, which tend to remove shark fins and discard the carcass at sea, all shark carcasses caught off northeastern Brazil were landed and sold locally. However, because of the low price of their meat, prior to June 1986, the return paid to fishers was half that for tunas and billfishes. In July 1986, the fishing company standardized the return for all species caught following the realization that although sharks were worth less than other species, their abundance meant that production could be more than doubled. The existence of an established local market for shark products (e.g. frozen fillets), which had developed from the steady production of shark meat during the first three years of the fishery, facilitated this shift in effort.

Figure 2 - Yearly mean CPUE of blue shark and gray shark caught by Brazilian longliners off northeast Brazil, from July 1983 to December 2000.

In January 1988, and during the first quarter of each consecutive year (period 3), vessels began to operate in the vicinity of the Archipelago of St. Peter and St. Paul to target yellowfin tuna that aggregate there in large numbers to feed on dense schools of spawning flying fish. As a result, the CPUE of this species more than tripled in the first two years after the new fishing grounds were discovered. This contributed to an overall rise in the CPUE of total tunas (Figure 1), and a slight drop in the CPUE of sharks (1988-90) due to a shift in effort away from areas of their maximum abundance (i.e. seamounts of the North Brazilian Chain and Fernando de Noronha Chain).

After 1992 (during period 4), vessels concentrated around the many seamounts, located mainly in Fernando de Noronha and North Brazilian Chains, to target gray sharks (Figures 1 and 2). The discovery of large abundances of this species in the vicinity of these seamounts, as well an increase in the international price of shark fins, contributed to this shift in effort.

During period 5, catches of billfishes increased as vessels began to adopt monofilament gear, rigged with lightsticks and squid as bait. The main species targeted was swordfish, although catches of other billfish also increased. The use of monofilament in areas not predominantly dominated by sharks meant that their CPUE subsequently dropped and is currently comparable to levels observed during period 3.

It is apparent that numerous factors have contributed to changes in fishing strategies during the past 17 years. Many of the shifts in effort are either market orientated, reflecting variation in consumer demand for various species, or as a result of the discovery of new fishing grounds and stocks. Very few of the changes observed in the first 13 years are gear related, however, given some of the more recent developments (e.g. use of monofilament), and that most of the fishing areas have been fully explored, these sorts of changes are likely to affect CPUE in the future. Ongoing monitoring of the fishing strategy and any changes in fishing gear are therefore essential for the effective management of this fishery.

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# IUCN SSC Specialist Group Grants

The Chicago Zoological Society makes annual grants to IUCN Species Survival Commission Specialist Groups for small projects identified in Action Plans or other group priority setting exercises. There are two grant cycles, one with awards in May and the other with awards in October. The Fund will support projects up to $5,000.

Priority will be given to projects that are clearly of critical need for species or habitats, that are likely to provide good, immediate results. Education /communications projects are welcome. Strict biological research projects are not a priority for this fund, unless there can be a direct application of the results.

Applications must be made through the SSG Executive Committee. Contact Rachel Cavanagh, SSG Programme Officer (address on p19) for details.

# Bycatch of Sharks and Rays in the Deep Sea Crustacean Fishery off the Chilean Coast

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The crustacean fishery for the red squat lobster *Pleuroncodes monodon,* the yellow squat lobster *Cervimunida johni* and deep sea shrimp *Heterocarpus reedi*, is a very important commercial fishing activity off northern Chile. This is a bottom trawl fishery that occurs close to the shelf break and into the upper slope, between 180-500 m depth, with each of the three crustacean species being more abundant from shallower to deeper waters in the following order: the red squat lobster, the yellow squat lobster and deep sea shrimp. The bycatch of this fishery includes several teleost and chondrichthyan fish species. Fifty one species of sharks and thirty seven species of rays have been recorded for Chilean waters by Pequeño (1989, 1997).

The most abundant bycatch species in this fishery is the common hake *Merluccius gayi,* which contributes 40-50% of the relative abundance by weight of the bycatch. The chondrichthyan species are far less abundant with sharks, rays and chimaeras accounting for less than 10% of the total relative abundance by weight (Table 1).

A monitoring program of this fishery began in mid 1997, in the area between 26° and 36°S off Chile, and since then ten shark species, four ray species and one chimaerid have been recorded. The greatest diversity of bycatch has been found in the deep sea shrimp catches, which is usually deeper than the two squat lobster species. (Table 1).

The percentage by weight of chondrichthyan species increases with depth, with only two shark and one ray species present in the red squat lobster fishing grounds and four shark and three ray species in the yellow squat lobster fishing grounds, representing in both cases less than 1% by weight of the bycatch. In the deep sea shrimp fishing grounds ten shark, four ray and one chimaerid species are caught, comprising around 10% of the bycatch by weight. However, only two shark species are relatively important in the bycatch of the deep sea shrimp fishing grounds: the hooktooth dogfish *Aculeola nigra* and the dusky catshark *Halaelurus canescens,* each comprising less than 5% of the bycatch (Table 1). With respect to the rays, only one species is relatively important in the catches of the deep sea shrimp fishery: the yellownose skate *Dipturus chilensis* (McEachran and Dunn 1998), comprising less than 1% of the bycatch (Table 1).

This increase with depth seems to be a common trend, since a study in the bycatch of deep-water bottom trawl fishery for orange roughy between 800-1200m (Koslow *et al.* 1994) and orange roughy and smooth oreo between 740-1503m (Wetherbee 2000) off New Zealand and Australia, show more species and a larger percentage of deep sea sharks in the bottom trawl captures at depths deeper than those of the Northern Chilean crustacean fishery. A similar pattern was described for rays by McEachran and Miyake (1990) which is consistent with our findings.

The biological information available for these deep sea shark species is scarce and has only recently been increasing due to this study. Only a few papers regarding their trophic ecology are published in the Chilean literature (Arancibia & Meléndez 1987). Recently, Catalán (unpublished data) has begun studying the reproductive biology of the two most important chondrichthyan bycatch species, *Aculeola nigra* and *Halaelurus canescens* for his marine biology thesis from specimens caught during this research program.

We would like to thank all who collaborated in the sampling during the past four years, and the Crustacean Fishing Companies: Agua Fría, Amancay, Isladamas, Pesca Marina and Socovel that financed the Monitoring Program.

Table 1. Relative importance by weight (%) of teleost and chondrichthyan fish bycatch in the crustacean trawling fisheries from northern Chile. (Larger percentages are in bold).

| | FISHERY | | |
|---|---|---|---|
| *Species* | Red Squat Lobster | Yellow Squat Lobster | Deep-sea Shrimp |
| AGNATA | < 0.01 | < 0.01 | 0.1 |
| **CHONDRICHTHYES** | **0.12** | **0.74** | **9.28** |
| ELASMOBRANCHII | | | |
| SQUALOMORPHII | | | |
| HEXANCHIFORMES | | | |
| Hexanchidae | | | |
| *Hexanchus griseus* | - | - | < 0.01 |
| SQUALIFORMES | | | |
| Echinorhinidae | | | |
| *Echinorhinus cookei* | | | *< 0.01* |
| Squalidae | | | |
| ***Aculeola nigra*** | 0.1 | 0.37 | **4.55** |
| *Centroscyllium granulatum* | - | - | 0.15 |
| *Centroscyllium nigrum* | - | - | 0.60 |
| *Centroscymnus crepidater* | - | < 0.01 | 0.26 |
| *Deania calcea* | | *< 0.01* | *< 0.01* |
| *Etmopterus granulosus* | - | - | 0.01 |
| CARCHARHINIFORMES | | | |
| Scyliorhinidae | | | |
| *Apristurus nasutus* | - | - | *0.24* |
| ***Halaelurus canescens*** | 0.02 | 0.28 | **1.88** |
| TORPEDINIFORMES | | | |
| Torpedinidae | | | |
| *Torpedo tremens* | - | - | 0.09 |
| BATOIDEA | | | |
| RAJIFORMES | | | |
| Rajidae | | | |
| *Dipturus chilensis* | - | *0.08* | *0.89* |
| Pseudorajidae | | | |
| *Sympterygia brevicaudata* | < 0.01 | < 0.01 | 0.54 |
| *Psammobatis scobina* | - | < 0.01 | 0.07 |
| HOLOCEPHALII | | | |
| CHIMAERIFORMES | | | |
| Chimaeridae | | | |
| *Hydrolagus macrophthalmus* | | | *< 0.01* |
| OSTEICHTHYES | 99.87 | 99.25 | **90.62** |

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# Meetings

## African Shark Conservation and Management Workshop International Fund for Animal Welfare (IFAW)

IFAW organized this workshop in May 2001 in Cape Town, South Africa (*Shark News* 13). Scientists and conservationists from 23 countries, including 18 African countries convened to discuss the future of shark species in African waters, and how best to cooperate continent-wide to conserve them. Workshop participants created the African Shark Management Group (ASMG) and elected Dr. Malcolm Smale, Port Elizabeth Museum South Africa, and SSG member, as Chair of the ASMG. After several days of discussions on threats and conservation needs, international policies and agreements, population trends, research data reviews, and ecotourism, the workshop formulated the following resolutions. The first resolution was adopted amongst all participants, the second has a reservation from the representative of the South African Department of Environmental Affairs & Tourism.

### Recommendations in Relation to shark finning and FAO Shark Action Plans

**Recognising** that a number of African and other nations around the world, as well as international bodies such as the FAO, have begun to address the urgent need for conservation of shark species worldwide;
**Acknowledging** that sharks have exceptionally low reproductive potential and that the depletion of sharks will deprive people of an important resource for many decades;
**Concerned** that many developing nations lack the technical expertise and financial resources to develop and implement National Plans of Action for Sharks;
**Concerned** that the practice of "finning" – when the fins are cut off and the carcasses discarded - wastes up to 95% of the individual shark;
**Recognising** that wasteful fishing practices such as finning promote increased fishing pressure, thereby increasing the risk of depleting shark populations and even some entire species;
**Concerned** that widespread shark finning can contribute to the deprivation of a natural resource valuable to fishing communities;
**Acknowledging** the increasing need for animal protein in many communities in the developing world;
**Noting** that the majority of profits from shark finning rarely go to local communities or to producer countries;
**Convinced** that a finning prohibition would create an incentive to practice full utilisation of dead animals and to use more selective fishing methods;
**Recognising** the concerns of local fishermen about the decreased abundance and availability of fish as a result of the dumping of shark carcasses in the area;
The participants at the IFAW African Shark Conservation and Management Workshop recommend that:

- All fishing nations and nations with territorial waters implement the FAO Code of Conduct for Responsible Fisheries and the International Plan of Action for Sharks (IPOA-sharks); and that
- Besides all other necessary requirements and measures, particular attention should be paid to "the minimisation of waste and discards" by promoting more selective fishing methods and prohibiting shark finning;
- All sharks, whether caught in directed fisheries or as bycatch, should, wherever possible, be landed with their fins and tails still attached;
- Bycatch of sharks should be avoided by the development and use of appropriate fishing methods and gear, but if bycatch is unavoidable, the animals should be released alive;
- Landing of fins without the corresponding carcasses should be prohibited; and
- The FAO, and particularly the richer fishing nations and shark product-consuming countries, as well as others, should provide financial and technical assistance to developing countries to enforce these prohibitions and develop and implement the National Plan of Action for Sharks.

### Recommendations in Relation to CITES and Non-Consumptive Use

**Noting** that a number of African and other nations, around the world, as well as international bodies such as the FAO, regional fisheries management organisations and CITES, have begun to address the urgent need for conservation of shark species worldwide;
**Recognising** that the FAO does not have the mandate to regulate and control international trade in shark products and, therefore, calls in its International Plan of Action for Sharks on other relevant bodies to do so;
**Recognising** that the depletion of sharks will deprive local populations of this valuable resource for many generations, because many species of shark have exceptionally low reproductive rates and might require decades to recover once depleted;
**Recognising** the lack of awareness in many countries of the vulnerability of sharks, of their ecological and economic importance and of the numerous threats to their populations;
**Considering** the potential benefits that alternative, non-consumptive use of sharks can bring to local communities;
**Recognising** the global nature of CITES and its membership of more than 150 nations and the special mandate of the Convention to regulate and control international trade to avoid detrimental effects on wildlife species resulting from this trade;
**Acknowledging** that CITES can generate comprehensive reporting and valuable statistics on international trade in sharks and their products in order to enhance shark management;
**Recognising** the urgent need for improved data and knowledge about the international trade in sharks and their products as a means of facilitating the development and implementation of national and regional shark action plans and management plans;
The participants at the IFAW African Shark Conservation and Management Workshop recommend that, besides all other requirements and measures:

- Governments adopt policies to ensure the sustainable management of shark resources and help to identify alternative sources of food and income for local communities, including from the non-consumptive use of sharks;
- All countries support CITES listing proposals for shark species when these species qualify for listing under the CITES listing criteria;
- Governments assess whether shark species in waters under their jurisdiction qualify for CITES listing and, if so, consider proposing these for the appropriate CITES Appendix at the next Conference of the Parties;
- In order to generate cooperation amongst countries in whose waters these species occur, governments seek Appendix III listing for these species;
- Countries and organisations, in particular the richer fishing nations and shark-product consuming countries, provide financial and technical assistance to developing countries to facilitate the realisation of the above objectives.

For more details see <http://www.ifaw.org> and the SSG website.

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## 17th American Elasmobranch Society Meeting

**Penn State, USA, July 2001**

There were 61 oral presentations, 14 posters, 2 symposia and over 100 members attended. The symposia were 'Nonfisheries-Related Human Impact on Elasmobranchs' and 'From Icons to Art: The Cultural Significance of Sharks and Man'. A number of resolutions came out of the meeting regarding spiny dogfish limits and measures; the large coastal shark fishery; protection of the smalltooth sawfish and a management plan for skates. Visit <http://www.flmnh.ufl.edu/fish/Organizations/AES/aes.htm> for more information.

## International Elasmobranch Husbandry Symposium

**3-6th October 2001, Orlando, Florida, USA.**

Organised and convened by Doug Warmolts (Columbus Zoo) and Mark Smith (Oceanario de Lisboa), this meeting demonstrated remarkable cooperation and sharing of experiences (good and bad) by the international public aquarium industry. International experts met as part of the process of developing an elasmobranch husbandry manual, which is planned to be published in 2003. The meeting concluded with a discussion session, led by a panel of experts, focused on the participants' future collaborative efforts orientated toward conserving elasmobranchs. It covered: (1) legislation, permitting and collection; (2) husbandry and veterinary care; (3) captive breeding; (4) research; and (5) education, outreach and advocacy. Doug and Mark will facilitate a further discussion session at the Regional Aquatic Workshop (RAW) in Denver (March 24 - 27th 2002) to review the plan of action (POA) framework and advance its development. It is envisioned that the final document will be used as a guide for regional taxon advisory groups (TAGs), and individual aquaria and zoological institutions, when prioritising their respective objectives, formulating collections and seeking programme funding. For more information about the 1st International Elasmobranch Husbandry Symposium and manual initiative, please refer to the website (http://www.colszoo.org/internal/elasmo_2002/page 1.htm) *Sarah Fowler*

## 5th Annual General Assembly and Science Meeting of the European Elasmobranch Association (EEA)

**Kiel, Germany, 19th-21st October 2001**

The EEA Annual General Assembly of national member organisation representatives was again coupled with a science meeting. It was hosted by the German Elasmobranch Society (D.E.G.) together with the International Fund for Animal Welfare (IFAW). Over 50 participants attended, among them scientists and conservationists from countries all over Europe, the USA and Hong Kong. Two resolutions were agreed, one in relation to shark finning and the FAO International Plan of Action for Sharks, and one in relation to CITES and the non-consumptive use of elasmobranchs. These resolutions have been distributed at various political levels, including the EU Fisheries Commission. The Science Meeting covered a broad range of research fields in the sessions on Conservation and Management; Biology and Behaviour; Morphology, Molecular Biology and Genetics; Distribution and Abundance; and Basking Sharks. *Boris Frentzel-Beyme*

## 1st NUPEC Workshop on Chondrichthyes

**Santos, Brazil, 12 -16 December 2001**

Organized by the Instituto de Pesca and the Núcleo de Pesquisa e Estudo em Chondrichthyes (NUPEC) this event was attended by researchers from Brazil, Portugal and Uruguay. The agenda consisted of conferences, round tables (particularly enlightening) and short courses. Among the issues addressed were Sea Animals in Captivity (Joao Correia, Portugal Oceanario), Skates of Northern Brazil (Lucia Goes de Araujo, Amazonas University), and Identification of Brazilian Rajidae (Ulises Leites Gomes, State University of Rio de Janeiro). The last round table, regarding Endangered Chondrichthyes, agreed a statement to be sent to the Sociedade Brasileira de Elasmobrânquios (SBEEL). *Andres Domingo*

# Recent Publications

## *Sharks of Florida, The Bahamas, The Caribbean and The Gulf of Mexico*

**Jeremy Stafford-Deitsch, 2001.**

**96pp. Trident Press, London, UK. ISBN 1-900724-45-6.**

Few divers are as familiar with shark behaviour as Jeremy Stafford-Deitsch, and he brings invaluable first-hand experience to the subject. This beautifully illustrated book is the latest in the IN DEPTH Divers' Guide series. The book is the only comprehensive guide to sharks of the tropical western Atlantic in a single volume, and contains useful and easily accessible information on a wide range of topics concerning sharks and their interactions with divers. The first part of the book deals with frequently asked questions about sharks, and the second part deals with individual species, providing vital information on how to identify sharks underwater. It includes descriptive information on 17 different sharks that frequent the Caribbean and adjacent seas.

Available in soft back (£9.99). Contact Orca Book Services, Fax +44 (0) 1202 666219 or Tel +44 (0) 1202 665432.

## *The behavior and sensory biology of elasmobranch fishes: an anthology in memory of Donald Nelson*

**Timothy C. Tricas and Samuel H. Gruber, 2001. 319pp. Kluwer Academic Publishers, The Netherlands. ISBN 0-7923-6821-5**

This volume is dedicated to the scientific contributions and memory of Donald Nelson, a pioneer in the study of shark behaviour, sensory biology and remote instrumentation. The volume includes papers on elasmobranch sensory biology and behaviour, addressing issues such as hearing, the lateral line, electroreception, the brain, orientation behaviour, chemical irritants, feeding and reproduction. There are also papers on tagging techniques, ultrasonic telemetry, physiological telemetry, remote monitoring techniques, archival tagging and satellite tagging. The intent of the volume is to familiarise both new and established scientists with the sensory biology and behaviour of sharks and rays, and to encourage further research in these areas on elasmobranchs in their natural habitat.

## *The Red Book: the Extinction Crisis Face to Face*

**Amie Bräutigam and Martin Jenkins, 2001. 300pp., 256 colour photos £45, US$65. Published by CEMEX, in collaboration with IUCN's Species Survival Commission and Agrupación Sierra Madre.**

Drawing on the IUCN Red List of Threatened Species, the world's most objective and authoritative inventory of species at risk of extinction, this publication combines awe-inspiring imagery with solid science and factual accounts. The result of a collaboration between industry and science, this dramatic new work conveys to the general public the urgency and scale of the current extinction crisis. It describes the extinction process, its causes, and the measures needed to reverse it in terms accessible to everyone. More than simply raising awareness, this book is a call for action to all sectors of society from industry to governments to educators, to work together to save biological diversity.

Order no. B1122. Proceeds from the sale of this publication will be used to endow the Peter Scott Fund to further SSC's work in conservation. Order from <http://www.iucn.org> or email info@books.iucn.org

## *Sharks and their Relatives: Ecology and Conservation*

**M. Camhi, S. Fowler, J. Musick, A. Bräutigam and S. Fordham. 1998. *Occasional Paper of the IUCN Species Survival Commission* No. 20. iv + 39 pp. No illustrations.**

Now available at the discount price of £7 or $10 plus postage and packing (20% surface, 40% overseas airmail) from Rachel Cavanagh, SSG Programme Officer, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK. <rachel@naturebureau.co.uk>

# Pelagic fisheries in the Galapagos Marine Resources Reserve

The IUCN Shark Specialist Group (SSG) strongly urges the Ecuador government not to allow commercial fishing for tunas and other pelagic fishes in the Galapagos Marine Resources Reserve (GMRR). We believe that commercial fisheries are a serious threat to sharks, and the marine environment of the GMRR as a whole, and will have far-reaching negative consequences for this unique World Heritage Site. Marine reserves are not mere conservation tools to protect the odd threatened species or habitat. They are critical to ensuring that fisheries remain productive and marine ecosystems stay healthy.

## Bycatch

A major environmental problem associated with pelagic fleets (both drift net and longline) is the high level of indiscriminate bycatch of other species, including sharks, manta rays, marine mammals, turtles and seabirds. Shark and ray populations have been seriously depleted throughout the world as a result of overfishing, much of which is due to bycatch from fisheries targeting other species.

## Sharks are Vulnerable

Twenty-seven species of sharks and rays (chondrichthyan fish) have been recorded from the waters around the Galapagos. Most chondrichthyans are of low productivity relative to teleost fishes, due to their different life history strategies. Chondrichthyans are particularly vulnerable to fishing pressure because of their slow-growth, late maturity, long life spans, and low fecundity. The overfishing of sharks is of global concern and the focus of conservation efforts under the FAO International Plan of Action for Sharks and CITES, as well as other conservation and fishery treaties.

## Role of Marine Reserves

Many of the sharks and rays occurring around the Galapagos are migratory species. Whilst it is not possible to protect the whole habitat for such fish, the Galapagos Reserve, currently protects an area sufficiently large to provide significant protection to the majority of the far-ranging species. There is increasing recognition worldwide of the importance of marine reserves as a fisheries management tool to prevent overfishing and habitat destruction. Ecuador will be taking a step backwards if this protected area is opened to commercial pelagic fisheries.

There are several good reasons for prohibiting fishing for any pelagic species in the GGMR. These include: (1) Marine protected areas (MPAs) can offer important protection to migratory species at critical times and places during their life cycles, including spawning areas, nursery grounds or migration bottlenecks. (2) A primary objective for MPAs is to protect the ecological function and integrity of marine ecosystems. Pelagic and non- resident species are critical to the integrity of these ecosystems and interact with residents in important ways, for example as prey or predators, or sources of nutrients. (3) It is harder to enforce regulations where certain kinds of fishing are allowed. Full protection is more straightforward to implement. (4) Shark fishing is currently banned in the GMMR to protect this vulnerable resource; allowing pelagic fishing will result in unacceptably high mortality from bycatch.

## Ecotourism

Commercial fishing will have a negative effect on the tourism industry of the Galapagos. Healthy shark populations are a major draw for dive tourism around the world. In the Bahamas a single live reef shark is estimated to be worth $250,000 in terms of dive tourism, whereas a dead reef shark has a one-time value of $50-60 to a fisherman. Similarly, in the Maldives in 1993, a single reef shark had a renewable value of $35,500 per year from diving, the same shark dead brought only $32 to the fisherman. The Galapagos Islands offer some of the world's best diving. For example, few sites in the world support similarly sized schools of hammerhead sharks. It is vital for the GMRR to maintain the abundance of sharks to assure the future of this high value, fast-growing industry.

The ecosystems of the Galapagos Islands are one of the greatest biological treasures of the world: it is of international importance that it is retained in as near-natural a state as possible.

# Future Issues of *Shark News*

We greatly welcome all personal contributions towards the cost of printing, mailing, and other Shark Specialist Group work, although we cannot presently afford to manage a formal subscription for the newsletter (this would probably cost more to administer than we will receive, particularly when handling foreign currency). Currently, each issue costs around US$3,500. This figure covers all printing, distribution and editing. The mailing list is more than 900 worldwide, ranging from SSG scientists and government agencies to interested members of the general public.

Donations may be made as follows:

1. by cheque or Bankers Order in US$ to Sonja Fordham at the Ocean Conservancy (marked payable to "TOC – Shark Specialist Group, account number #3020"), or

2. by cheque or Bankers Order in £ sterling to Rachel Cavanagh (made payable to the "Shark Specialist Group"), or

3. by credit card. Send details to Rachel Cavanagh.

Invoices for subscriptions (£5.00 per issue) can be sent to organisations or libraries unable to contribute without a formal request for payment.

All addresses are given below.

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Any donations in US$ please send to Sonja Fordham, Ocean Conservancy, 1725 DeSales Street NW, Washington, DC 20036, USA.

## This issue is sponsored by the National Audubon Society Living Oceans Program

The Living Oceans Program is the marine conservation program of the National Audubon Society, a non-profit conservation organisation dedicated to protecting wildlife and wild places. A primary goal of Living Oceans is the conservation and restoration of the oceans' giant fishes, particularly sharks, tunas and billfishes. We believe that effective fisheries management and conservation action must be based on sound science. Living Oceans has been a major financial supporter of *Shark News* since its inception in 1994, and we are pleased to sponsor this 14th issue addressing elasmobranch research, conservation and management in South and Central America.

Living Oceans engages in shark conservation and management at many levels, from spearheading efforts to improve the US Atlantic shark management plan, to helping to address the conservation of sharks in Central America, to assisting in conservation initiatives at CITES regarding the trade in shark products and with the FAO International Plan of Action for Sharks.

For more information about Audubon's Living Oceans Program, please contact Merry Camhi, SSG Deputy Chair, National Audubon Society, Living Oceans Program, 550 South Bay Avenue, Islip, NY 11751, USA. Email: mcamhi@audubon.org

*Shark News* is fundamental to the work of the Shark Specialist Group, linking experts from around the world, publicising research and developments and confronts critical conservation issues. We urge other organisations and individuals to sponsor upcoming issues of *Shark News.* With a growing global distribution *Shark News* is becoming an increasingly important means of communication among shark scientists and other elasmobranch enthusiasts. Please support this newsletter by sending your contribution today, or even better, ask your institution to sponsor an issue. Former sponsors have included the Audubon's Living Ocean Program, Columbus Zoo, WWF's Endangered Seas Campaign, the Center for Marine Conservation, the Ocean Wildlife Campaign and the US State Department.

Please contact Rachel Cavanagh, SSG Programme Officer for details on sponsoring part or all of an issue of *Shark News*, or with articles for future issues: <rachel@naturebureau.co.uk>

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Fabrizio Serena, Michele Romanelli, ICRAM, Stuart Nicholls, Jennifer Zimmerman, Andrej Presern and the Karger Libri

# Forthcoming meetings

### Sustainable Utilization and Conservation of Sharks
Taipei, Taiwan, 13-16 May 2002
<http://www.shark.fd.ntou.edu.tw>

### 18th American Elasmobranch Society Meeting
Kansas City, Missouri, USA, 3-8 July 2002
<http://www.dce.ksu.edu/dce/cl/2002jointmeeting>

### AFS Deep-Sea Elasmobranch Symposium
Vancouver, Canada, 22-26 July 2002
<http://www-heb.pac.dfo-mpo.gc.ca/congress/>

### 6th European Elasmobranch Association Meeting
Cardiff, UK, 7-8 September 2002. Contact enquiries@sharktrust.org

### Elasmobranch Fisheries: Managing for Sustainable Use and Biodiversity Conservation
Spain (venue to be announced), 11-13 September 2002
<http://www.nafo.ca/events/elasmo.pdf>

### 12th Meeting of the Conference of the Parties to CITES
Santiago, Chile, 3rd-15th November 2002, <http://www.cites.org>

## Editorial details

*Shark News* aims to provide a forum for exchange of information on all aspects of chondrichthyan conservation matters for Shark Group members and other readers. It is not necessary to be a member of the Shark Specialist Group in order to receive this newsletter (see p.19).

We publish articles dealing with shark, skate, ray and chimaeroid fisheries, conservation and population status issues around the world; circulate information on other relevant journals, publications and scientific papers; alert our readers to current threats to chondrichthyans; and provide news of meetings. We do not usually publish original scientific data, but aim to complement scientific journals. Published material represents the authors' opinions only, and not those of IUCN or the Shark Specialist Group.

Publication dates are dependent upon sponsorship and receiving sufficient material for publication, formerly three issues per annum.

**Manuscripts should be sent to Rachel Cavanagh at the address given on p.19**. They should be composed in English, legibly typewritten and double-spaced. Word-processed material on IBM-compatible discs would be most gratefully received, or as email attachments. Tables and figures must include captions and graphics should be camera-ready.

**Length of features**: (word counts include titles and references): The lead article, with two good size illustrations, should be no more than 1,300-1,400 words. A single column article should be 550-600 words, (450-500 words leaves space for a small illustration). A full page (2 column) article with good-sized illustration should be 800-1000 words. Other main articles, for an inside two page spread with one large or two medium-sized illustrations, should be 1,800-2,000 words, depending on the number of illustrations. Short newsy communications and letters are also welcome.

**Writing style**: This newsletter goes to members of the general public and to managers and policy-makers, as well as to elasmobranch specialists, fisheries scientists and the conservation community. We need a clear and brief style of writing. It is also essential to break up the text with plenty of subheadings, and to provide one or two photographs or graphics. There is room for small tables, but nothing too long and complex. Author's name, affiliation and address must be provided, with their fax number and email address where available.

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