SHARK NEWS

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The economics of shark and ray watching in the Maldives

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Introduction

The Republic of Maldives is a country composed entirely of coral atolls. Located in the central Indian Ocean, its two major economic activities in the Maldives are fishing and tourism. Fishing has traditionally concentrated on oceanic tunas, but over the last two decades the fisheries sector has diversified to include exploitation of other resources, including sharks. Tourism started in 1972, and has grown steadily since then, with some 350,000 tourist arrivals expected in 1998. The main attractions for visitors are the tropical beaches and coral reefs. The reefs are rich in marine life, which makes diving and snorkelling particularly popular. Perhaps as many as 50% of tourists go diving during their stay.

Feeding wild stingrays is a tourist attraction on some islands. Photo: Charles

Shark watching

One of the greatest attractions for recreational divers is observing large marine animals underwater in their natural habitats. Sharks in particular are always a major attraction. The main shark species involved in the Maldives are listed in Table 1, in approximate order of abundance.

Table 1. Sharks regularly encountered by divers in the Maldives

English name	Scientific name	Maldivian name
Whitetip reef shark	*Triaenodon obesus*	Faana miyaru
Grey reef shark	*Carcharhinus amblyrhynchos*	Thila miyaru
Blacktip reef shark	*Carcharhinus melanopterus*	Falhu miyaru
Scalloped hammerhead	*Sphyrna lewini*	Kalhigandu miyaru
Tawny nurse shark	*Nebrius ferrugineus*	Nidhan miyaru
Silvertip shark	*Carcharhinus albimarginatus*	Kattafulhi miyaru
Whale shark	*Rhincodon typus*	Fehurihi
Variegated shark	*Stegostoma fasciatum*	Hitha miyaru

Divers might see sharks on almost any dive, but there are certain sites that offer a much higher chance of seeing sharks than others. During a survey in 1992, the number of dives taking place annually at 35 specific shark-watching dive sites was estimated at 76,850. At an average cost of US$30 per dive, that amounted to an annual expenditure by divers of about US$2.3 million on shark-watching dives (Anderson and Ahmed 1993).

Anderson and Ahmed (1993) further estimated that in 1992 a single grey reef shark was worth about US$33,500 per year at what was then the most popular shark watching site, 'Fish Head'. For all shark watching dive sites, the average value of a live grey reef shark was estimated at about US$3,300 per year. Since grey reef sharks can live for at least 18 years, and in the Maldives recognisable individuals have been seen at dive sites for many years in a row, the total value of each shark is several times higher. In contrast, a dead grey reef shark was calculated to have a one-time value of about US$32 to a local fisherman. Thus, grey reef sharks were worth at least 100 times more alive at a dive site than dead on a fishing boat.

With such large sums of money involved in shark watching, there was (and is) considerable interest among diving operators in preserving 'their' reef sharks. In view of the economic importance of diving tourism, and in particular shark watching, fifteen top dive sites (9 of which were, or had been shark watching sites) were declared marine protected areas in June 1995. This included 'Fish Head'. In addition, the catching of whale sharks was banned (see Table 3).

Despite these measures, and increased awareness of the importance of sharks as tourist attractions, fishing of reef sharks continued, even within the central tourism zone. As a result, shark numbers at what was the most popular site (Fish Head) have decreased to such a low level (an average of only one shark seen per dive in 1997, from a high of 20+ ten years earlier) that many dive operators no longer visit. The loss of diving revenue from this one site has been roughly estimated at US$500,000 per year (Anderson 1998). A survey of departing divers carried out in late 1997 revealed that 58% saw

fewer sharks than expected during their visit, and 83% of repeat visitors thought that there had been a decrease in shark numbers since their last visit (Waheed 1998).

Recognising the great economic importance of shark watching in the country, the Ministry of Fisheries and Agriculture recently introduced a new regulation, banning all types of shark fishing within the main tourism zone (defined as Baa, Lhaviyani, Kaafu, Alifu, Vaavu and Seenu Atolls, and the waters within 12 miles of the atolls).

Some shark watching dive sites still have significant number of sharks in residence. Tourist arrivals have increased substantially (from 212,000 in 1992 to about 350,000 in 1998), as has the average cost per dive (to about US$35 each). Current expenditure by divers on shark watching in the Maldives is therefore likely to be in excess of the US$2.3 million per year calculated in 1992. In addition, with fewer sharks, and at least as much money being spent on seeing them, the value of each shark for diving tourism must have increased significantly. On the basis of willingness to pay, Waheed (1998) estimated that reef sharks had a nominal value of US$6.6 million as attractions for tourist divers in 1997. These estimates are of direct diving revenue only; indirect revenues (including food, accommodation and transport) are several times higher.

Ray watching

In addition to sharks, other large marine animals are also major attractions to tourist divers. Rays are especially popular. A total of 14 species of ray have been recorded from the Maldives so far. The main species involved in tourist activities are listed in Table 2.

Manta rays migrate from side to side of the atoll chain in phase with the monsoons, in order to take advantage of seasonal plankton blooms. They are common on the west side of the atolls during the northeast monsoon, and on the east side during the southwest monsoon. Mantas are most frequently watched by divers when they visit 'cleaning stations' on the reefs. In contrast, stingrays tend to be seen at particular locations year-round. Some dive operators feed stingrays in order to guarantee close encounters. In addition, a few resorts feed stingrays in their lagoons, thereby providing an attraction for all their guests, not just the divers.

Table 2. Ray species regularly encountered by tourists in the Maldives

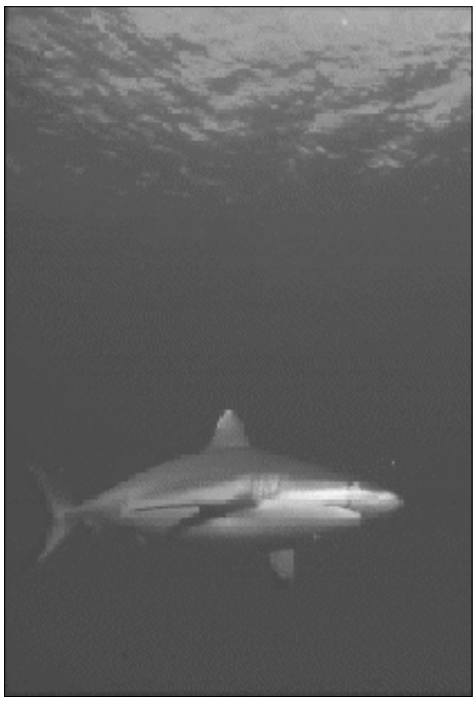
English name	Scientific name	Maldivian name
Manta ray	*Manta birostris*	En madi
Black spotted stingray	*Taeniura meyeni*	Naru nagoo madi
Brown stingray	*Himantura fai*	Naru nagoo madi

Anderson and Hafiz (1997) suggested that the economic value of ray watching in the Maldives 'must run into many hundreds thousand dollars per year'. This is likely to be an underestimate. From a survey of departing tourists, and on the basis of willingness to pay, Waheed (1998) estimated that manta rays alone had a nominal value of US$7.8 million as attractions for tourist divers in 1997.

The value of rays as attractions for divers has been recognised by the Government of Maldives. At present, few fishermen catch rays and there is minimal local demand for ray products. A fishery is only likely to develop in response overseas demand. To forestall the development of an export-oriented fishery the export of rays was banned from June 1995. The export of ray skins was specifically banned from January 1996.

Resolution of conflicting interests

There appear to be few problems afflicting ray resources in the Maldives. However, the reef shark resources are seriously threatened by over-fishing. Related to this, there is a major conflict of interest between reef shark fishermen and diving tourism operators.



The ultimate prize for diving tourists. Photo Charles

The problem for fishermen is that tourism does not necessarily bring them any direct benefits. They are therefore inclined to continue fishing for sharks, whatever the costs to diving operators. There is little demand for any shark products within the Maldives. The fisheries are driven by the high price of fins in the east Asian market. As long as the demand for fins is high, there will be a strong incentive to continue shark fishing, even though stocks are overfished, and despite the value of sharks for tourism. However, fishermen do benefit from tourism. Tourism is the Maldives' greatest source of income, and thus contributes enormously to social development from which all Maldivians benefit, even though fishermen do not normally recognise this indirect benefit to them. In addition, as new resorts are developed, more and more fishermen are finding employment in tourism. As one example, there were 19 shark fishing boats on the island of Dhangethi in south Ari Atoll in July 1991, just before the development of several resorts in that area. By August 1992 seven boats had left shark fishing to take employment at newly opened resorts nearby (Anderson and Ahmed, 1993). By August 1998, there were 22 boats involved in tourism, and only four engaged in shark fishing.

The problem for divers and diving tour operators is that reef sharks numbers have declined significantly in recent years, as a direct result of fishing. Divers are leaving the Maldives disappointed because they have seen so few sharks. As a direct result, some of these divers will not come back to the Maldives, thus reducing future revenues. Dive operators cannot offer special shark diving excursions to sites such as Fish Head (and thereby increase their revenue) now that shark sightings cannot be guaranteed.

The problem for the Government of Maldives is how to balance the demands of the tourism industry with the rights and needs of the fishermen. Recognising the great economic importance of shark watching in the country, it has introduced regulations aimed at promoting shark and ray conservation. This culminated in the ban on all types of shark fishing within the main tourism zone. This ban should go a long way towards conserving reef shark resources, although it may not be entirely effective, given the limited ability to police and enforce it.

The various regulations (*iulaan*) relating to the conservation of reef sharks and rays are listed in Table 3. These regulations have been gazetted under the Environment Law (Law 4/93) by the Ministry of Planning, Human Resources and Environment; the Fisheries Law (5/87) by the Ministry of Fisheries and Agriculture; and the Import-Export Law (31/79) by the Ministry of Trade, Industries and Labour.

There is no doubt that reef shark resources have been overfished in recent years. There is also no doubt that the revenue from shark watching far outweighs that from the export of reef shark products.

Table 3. Summary of regulations relevant to the conservation of reef sharks and rays in the Maldives

Regulation No.	Effective	Details
E-95/32	5 June 95	Creation of 15 marine protected areas (dive sites)
FA-A1/29/95/39	24 June 95	Whale shark fishing prohibited
A-23/95	25 June 95	Export of rays prohibited
A-26/95 (of 15.7.95)	1 Jan 96	Export of ray skins prohibited
FA-A1/29/98/39	8 Sept 98	All shark fishing in tourism zone prohibited

From a macroeconomic point of view it would make sense to ban all shark fishing and all shark product exports. Since reef shark stocks appear to have been reduced to relatively low levels, such complete bans would have little financial impact on reef shark fishermen, many of whom have already switched to other occupations. However, such bans would have a major impact on the large and completely separate oceanic shark fishery. It remains to be seen whether reef shark populations can recover to their former abundance under the current regulation regime, or if a total ban on shark fishing and exports will be required.

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Editorial

We apologise for this much overdue issue of *Shark News* which has been so greatly delayed due to the time constraints of our voluntary editors. Now that we have employed a Programme Officer (see opposite), *Shark News* will return to circulation on a regular basis of at least two issues per year. As so much time has passed since the last, we decided to make this one a 'bumper' issue: there are so many books and publications to review, several meetings have taken place, and many changes that have occurred since we last produced a newsletter in late 1998. For those of you who have been unable to attend any of the Shark Specialist Group meetings that have been held, we would like to take this opportunity now to update you on the recent activities and progress of our Group.

Coordination of the IUCN Red List assessments

Red List assessments were prepared by numerous SSG experts for over 100 elasmobranch species during 1999 and early 2000 (see p.8 for details). Details of those assessed as threatened were published in the 2000 IUCN Red List, <www.redlist.org> and provide a sobering perspective on their status. The IUCN has requested that the SSG completes assessments for all chondrichthyan fish species by 2003, in order to provide a full overview of our knowledge of the group.

FAO International Plan of Action (IPOA) Sharks

SSG members have provided advice on the implementation of the FAO IPOA-Sharks, and on the development of national plans by shark fishing States, including USA, Australia and New Zealand. Progress was reviewed by FAO at the 2001 Committee on Fisheries (COFI) meeting, attended by Co-Chair Sarah Fowler on the IUCN Delegation. (See p.13 for more information on the FAO IPOA–Sharks.)

CITES

SSG experts appraised proposals for listing three species of shark on Appendices I and II of the Convention on International Trade in Endangered Species, prior to the Conference of Parties in 2000, where the SSG was represented by Co-Chair Sarah Fowler on the IUCN delegation (see page 9). SSG experts have also contributed to the review of the CITES listing criteria and to the FAO review of these criteria with specific reference to aquatic species.

Programme Officer Appointed

The SSG has received a grant of £70,000 over three years from the Global Wildlife Division of the UK's Department of the Environment, Transport and Regions towards the cost of employing a full-time SSG Programme Officer. In March 2001, Rachel Cavanagh was appointed to this post, on an initial one-year contract based in the Nature Bureau in the UK with SSG Co-Chair Sarah Fowler. Her role will be to coordinate the work of the SSG under the management and guidance of the Co- and Deputy Chairs and the other voluntary officers of the SSG's Executive Committee.

Over the past few years, the SSG's activities in many areas has been hampered by our reliance on volunteer members alone. An array of conservation objectives for elasmobranchs can now be more effectively pursued and the SSG should become far more active and effective a group. The SSG's and Programme Officer's work programme has been discussed at two SSG meetings in 2001: during the IPFC in Durban, South Africa, and at the American Elasmobranch Society meeting in the USA.

Rachel Cavanagh, SSG Programme Officer. Photo: Jack Musick.

Some of you will know Rachel already as a result of her past involvement in elasmobranch research and conservation. In 1996 she spent some months working for Dr. Sonny Gruber on lemon sharks in Bimini, the Bahamas. Later, she became an SSG volunteer with the Darwin Project on Elasmobranch Biodiversity, Conservation and Management in Sabah, Malaysia, and played a key role in the rediscovery of the Borneo River Shark. Rachel later organised an elasmobranch research expedition to Sarawak with SSG volunteer Scott Mycock, and was one of the first members of the UK Shark Trust. For the past three years Rachel has been working on her PhD in wildlife disease ecology and is now delighted to have returned to the field of elasmobranchs, where her main interests and enthusiasm lie.

Status Report for the Chondrichthyan fishes

Editing of the final draft is underway, and we aim to publish later this year. We urgently need to include updated information on management and conservation legislation being implemented for shark fisheries and protected species around the world. The kind of information we are seeking appears in the tables on pp.19 and 20 of the IUCN Occasional Paper *Sharks and their Relatives* (Camhi *et al.* 1998 – see p.18 to obtain a copy). The tables can also be viewed on the SSG website: <www.flmnh.ufl.edu/fish/Organizations/SSG/SSGDefault.html>. Please contact Rachel Cavanagh <rachel@naturebureau.co.uk> if you have relevant information; you will be gratefully acknowledged.

Sarah Fowler & Jack Musick, SSG Co-Chairs.

Western Australia's dusky shark fishery:

an example of a sustainable fishery for a long-lived, late maturing, slow growing, low reproductive rate species?

Colin Simpfendorfer, Western Australian Marine Research Laboratories

The dusky shark *Carcharhinus obscurus* is a species of shark with a strongly K-selected life history. The young are born at 80 to 105 cm total length (TL) and on average grow less than 10 cm TL per year. Individuals mature at approximately 20 years and may live to over 45 years. The average litter size for mature females is ten, with litters produced every third, or possibly second year. The life history of the dusky shark is therefore one that makes it particularly susceptible to overfishing by commercial fisheries. For example, in the western North Atlantic, the abundance of dusky sharks has been estimated to have declined by 60–80% between 1974 and 1991 because of heavy commercial and recreational fishing (Musick *et al*. 1993).

New-born dusky shark. Photo: Colin Simpfendorfer

A commercial fishery exists in southwestern Australia for dusky sharks. Annual catches of this fishery peaked at 600–700 mt during the early 1980s, and are currently around 450–500 mt. This fishery is unlike any other for a large, long-lived species in that recently pupped juveniles are targeted using demersal gillnets with a mesh size of 16.5–17.8 cm.

The Fisheries Department of Western Australia undertakes assessment of the fishery using a combination of exploitation rates and demographic analysis. Exploitation rates are estimated from a tagging study of recently pupped dusky sharks. Age-specific exploitation rates are used in the assessment based on releases during the 1994 and 1995 pupping seasons. It was assumed that the size selectivity of the gillnets used in the fishery meant that no sharks over six years of age were caught in the fishery. The exploitation rate data are used in the demographic analysis along with life history information such as age at maturity, maximum age, litter size, reproductive periodicity, and natural mortality. For the purposes of the assessment, and the examination of uncertainty in the outcomes, a total of 17 scenarios were used (one base case and 16 sensitivity tests for variations in life history and exploitation rate data), each examining three levels of fishing: no fishing, exploitation rates experienced by the 1994 cohort, and exploitation rates experienced by the 1995 cohort.

Results of the assessment indicated that the population was sustainable at the current levels of exploitation. The annual rate of population increase without fishing was 4.3%, while with the current level of exploitation is 2.3–2.7%. Sensitivity tests indicated that only if natural mortality was above expected levels would there be a possibility that the current levels of exploitation could not be sustained.

The results of this assessment are interesting in that they indicate a possible strategy for commercially exploiting long-lived, late maturing, slow growing, low reproductive rate species. This strategy is to target fishing at the youngest age class. In the case of the Western Australian dusky shark population, only one in six individuals survive to maturity (due to the late age at maturity) so most of the neonates caught would have died anyway.

The application of this fishing strategy to other populations of long-lived, late maturing, species is probably limited. The strategy works well with dusky sharks because of their large size at birth, which provides fishermen with a product large enough to be commercially viable. In other species, individuals in the youngest age class may be too small to be economically viable as a target. It is also a strategy that applies to meat fisheries, since fin-based fisheries are most commonly driven by the desire for the largest fins.

It is important that when a fishing strategy such as this is applied that only the desired age classes are caught. There are two approaches that can be used to do this. One is the use of size-selective fishing gear (e.g. gillnets), and the other is to fish in nursery areas.

In situations where there is also capture of other age classes, the advantages of this fishing strategy quickly diminish. Exploitation rates of older age classes need only be in the order of 1% to 2% to result in over-exploitation of the stock. In any fishery that employs this fishing strategy it is important that there is an ongoing monitoring programme to estimate exploitation rates of both the target, as well as the non-target age classes. The results of the sensitivity tests also indicate that if possible an accurate estimate of the level of natural mortality will provide a decrease in the uncertainty of the assessment.

The results of the assessment of the Western Australian dusky shark fishery indicates the accepted paradigm that strongly K-selected shark species cannot withstand targeted commercial fishing pressure does not always hold true.

However, it is only an extreme fishing strategy, where the youngest age classes are caught, that may be sustainable. Such a fishing strategy has limited applicability to most strongly K-selected shark species and should be carefully examined before being implemented.

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Shark Fisheries in Central America

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In order to determine the status of shark fisheries in Central America a cooperative project was launched. ProAmbiente and INRECOSMAR (local NGOs) had the leading role under a cooperative agreement with PRADESPESCA, a project for fisheries development in the region funded by the European Community. Efforts concentrated on identifying available biological data, local publications on shark fisheries, formal studies and publications, catch data on marketing and trade routes.

According to Ruiz (1999), *Carcharhinus falciformis*, *Nasolamia velox*, and *Sphyrna lewini* represent the largest catch in Guatemala. *C. falciformis* and *S. lewini* are species commonly captured in Honduras, El Salvador and Panama (Salinas 1999, Villatoro 1999 and Ramírez and Medina 1999). In Costa Rica and Nicaragua the shark species more frequently captured are *Prionace glauca*, *C. falciformis*, *Mustelus* sp., *S. lewini* and *Alopias superciliosus* (Hernández and Maradiaga 1999).

Use of the resource

Guatemala is the country that best utilises sharks since, except for viscera, the whole animal is used (Ruiz 1997). Honduras, Nicaragua and Costa Rica are the extreme cases where market exists only for meat and fins (ProAmbiente 1999).

Sharks: Target fishery or incidental catch?

Shark landings in Central America come from two activities. One is coastal fishing, where sharks are incidental or complementary catches of the shrimp (Penaeidae), lobster (Palinuridae), snapper (Lutjanidae), drum (Sciaenidae) and grouper (Serranidae) fisheries. The other one is the pelagic fisheries (long-lines), where sharks are incidental catch of mahi mahi *Coriphaena hippurus*, marlin *Tretrapterus audax* and *Makaira indica*, sailfish *Istiophorus platypterus*, swordfish *Xiphias gladius* and tuna *Thunnus albacares* and *T. obesus* (ProAmbiente, 1999).

Regional economic importance of shark trade

In Honduras, the economic importance of sharks in the fishery is unknown. Reports from Salinas (1998) show that a portion of the shark catch is sold in local markets, mainly in Choluteca and Tegucigalpa, and some is exported to Guatemala and El Salvador. In El Salvador, sharks represent an important source of income for fishermen. In fact, between 1993 and 1997, 4,178,780 kg were landed, 12.3% of it was exported at a value of $8,987,368 (CENDEPESCA, 1998). The main export markets were the United States, Mexico and Asian countries (Villatoro 1997). In Nicaragua there is no historic data on prices or shark products marketed. Costa Rica and the United States have become Nicaragua's main export markets for shark fins and meat, respectively (Hernández and Maradiaga 1998). In Costa Rica, shark meat and fins contribute up to 25% of the income generated by the fishery. Between 1987 and 1997, the volume of shark fin trade was around 140,000 kg (INCOPESCA 1998), the price varied between $40 and $70 per kilogram. Main export markets are Taiwan, Hong Kong, Japan and United States. In 1999 in Panama, shark fin exports reached 67,582 kg with a value of $ 4,511,042. Principal markets were Hong Kong (67% of shark fins) and the United States (25.7% of shark fin trade and more that 50% of shark meat) (Ramírez and Medina 1999).

Management measures recommended

1) Identification of the most important fishing banks and seasonality of shark populations present at those fishing grounds.
2) Research into basic fishery data such as growth, mortality, abundance, distribution, reproduction, recruitment sizes, weight, sex size and age at sexual maturity and age structure of the populations, particularly for species that are of economic importance in Central America.
3) Estimation of catch per unit of effort (CPUE) for shark species landed by national and international fleets that fish Central American waters.
4) Identification of breeding and nursery areas in order to provide means for protection of those areas from fishing or other environmental pressures.
5) Establishment of a monitoring program to assess the mortality of sharks due to incidental fishing, as well as the fraction of sharks species that are subject to incidental capture.
6) Design of management measures to continuously advise Central American fishing authorities and companies on the sustainable use of this resource.
7) Integration of the FAO Code of Conduct for Responsible Fisheries and the United Nations Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks to a regional fishery management scheme.
8) Design and implementation of a communication campaign to educate the public and interested groups at national, regional and international levels about the threatened status of shark fisheries.

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Challenges of Atlantic shark management for a viable and sustainable shark fishery

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Atlantic shark management has been, and continues to be, a challenge. Since the National Marine Fisheries Service* (NMFS) established management measures in 1993 for 39 shark species along the Atlantic and Gulf of Mexico coasts, the management atmosphere has grown increasingly focused on stopping overfishing and rebuilding shark stocks. The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the primary domestic fisheries law, was amended in 1996 with 3 new national standards, or requirements, as well as significant revisions of existing national standards. These new national standards focused on reducing bycatch, identifying and protecting essential fish habitat, and protecting human safety at sea. Management measures must comply with numerous laws, such as the Endangered Species Act, the Marine Mammal Protection Act, and the Regulatory Flexibility Act, in addition to the Magnuson-Stevens Act.

One factor contributing to the difficulties in shark management is the availability and reliability of data on shark populations. In fact, lack of sufficient data time series (both in number and length) hampered the establishment of the original fishery management plan (FMP). Since that time, improved data collection has continued and has indicated the need for additional restrictions on harvest levels.

For instance, based on the results of a 1996 stock assessment, NMFS decreased the 1997 commercial fishery quota for large coastal sharks by 50 percent. After this quota cut, commercial fishermen sued NMFS. In 1998, NMFS conducted a new stock assessment that, again, indicated the need for additional harvest restrictions. As a result of the Magnuson-Stevens Act requirements, and equipped with this new stock assessment, NMFS promulgated new management measures to rebuild Atlantic shark populations (see summary table) as part of a new Highly Migratory Species FMP for Atlantic tunas, swordfish, and sharks (HMS FMP). The final HMS FMP contains substantial analyses of socio-economic impacts, habitat requirements, non-target catches and discards, and the adoption of the precautionary approach. For species for which no new information is available, NMFS implemented several precautionary measures to ensure that these species do not become depleted and that directed fisheries and/or markets do not develop. NMFS estimates that the new shark management measures may have considerable negative social and economic impacts on commercial and recreational fishermen. Commercial and recreational fishermen sued NMFS on the new shark measures contained in the final HMS FMP. The lawsuit with recreational fishermen is ongoing. The lawsuit with the commercial fishermen was consolidated with the 1997 lawsuit.

Summary Table: What the Final HMS FMP means to Atlantic shark fishermen

PROHIBITED SPECIES

The following sharks cannot be kept commercially or recreationally: Whale, basking, sand tiger, bigeye sand tiger, white, dusky, night, bignose, Galapagos, Caribbean reef, narrowtooth, longfin mako, bigeye thresher, sevengill, sixgill, bigeye sixgill, Caribbean sharpnose, smalltail, and Atlantic angel sharks.

COMMERCIAL REGULATIONS

Management Unit	Species that can be retained	Quota (mt dw)	Size Limit	Authorized Gears
Large Coastal Sharks - directed commercial retention limit of 4,000 lb dw per trip - incidental retention limit	Ridgeback: Sandbar, silky, tiger	622	4.5 feet (137 cm) fork length	Longline; Gillnet; Rod and reel; handline; bandit gear
	Non-ridgeback: Blacktip, bull, spinner lemon, nurse, smooth hammerhead, scalloped hammerhead, great hammerhead	196	None	
Pelagic Sharks - no directed retention limit - incidental retention limit	Shortfin mako, thresher, oceanic whitetip	488	None	
	Porbeagle	92		
	Blue	273		
Small Coastal Sharks - no directed retention limit - incidental retention limit	Atlantic sharpnose, blacknose, finetooth, bonnethead	359	None	
Deepwater and Other Sharks	Catsharks, dogfish sharks, sawsharks, smoothhound sharks	None	None	

Additional remarks:
All sharks not retained must be released in a manner that ensures the maximum probability of survival.
No finning any sharks no matter what species.
Fishing seasons January 1 to June 30; July 1 to December 31.
Season-specific quota overharvest and underharvest adjustments; no reopening that year.
Limited access; Exempted Fishing Permit (EFP) requirements.
Count dead discards against federal quotas; Count state landing after federal closure against federal quota.
For incidental limited access permit holders: 5 large coastal sharks per trip; a total of 16 pelagic or small coastal sharks (all species combined) per vessel per trip.

RECREATIONAL REGULATIONS

Management Unit	Species that can be kept	Retention Limit	Authorized Gear
Large Coastal, Pelagic, and Small Coastal Sharks	LCS: Sandbar, silky, tiger, blacktip, bull, spinner, lemon, nurse, smooth hammerhead, scalloped hammerhead, great hammerhead Pelagic: shortfin mako, thresher, oceanic whitetip, porbeagle, blue SCS: Atlantic sharpnose, blacknose, finetooth, bonnethead	1 shark per vessel per trip (all species) with a 4.5 feet fork length minimum size; allowance for 1 Atlantic sharpnose per person per trip (no minimum size)	Rod and reel; handline; bandit gear

Additional remarks:
Harvested sharks must have fins, head, and tail attached (can be bled and gutted if tail is still attached). No recreational limits on deepwater and other sharks.

This table summarizes existing regulations. Please refer to the implementing regulations for details of current requirements.

On June 30, 1999, NMFS received a Court Order from Judge Steven D. Merryday relative to the 1997 and 1999 lawsuits challenging the commercial harvest quotas for Atlantic sharks. This order put many of the new shark management measures that were to go into effect July 1, 1999, on hold except for certain non-quota related measures and all recreational shark measures. In December 2000, this lawsuit was settled. NMFS determined that the settlement agreement was appropriate because it will conserve Atlantic sharks while maintaining a sustainable fishery in the long-term; move the management process for Atlantic sharks forward through quality-controlled scientific assessment and appropriate rulemaking; and promote confidence in the management process and its underlying science.

In addition to other things, the settlement agreement calls for NMFS to maintain the 1997 commercial quotas until the 1998 stock assessment is peer-reviewed (completion was expected in late spring 2001). If the peer-review is negative, NMFS must maintain the 1997 commercial quotas until a new stock assessment is peer-reviewed. Regardless of the results of the peer-review, the settlement agreement also calls for new stock assessments for large and small coastal sharks.

In December 2000, the President signed the Shark Finning Prohibition Act (Public law 106-557). This Act prohibits any person subject to U.S. jurisdiction from engaging in shark finning at sea, possessing fins aboard a fishing vessels without the corresponding carcass, and landing shark fins without a corresponding carcass. NMFS is currently working on implementing the regulations in this Act. Additionally, the Magnuson-Stevens Act is currently undergoing the re-authorization process which may result in additional requirements.

Other factors that continue to hamper Atlantic shark management are the lack of an international forum for scientific evaluation and management of pelagic species, widespread problems with species-specific identification and the subsequent problems confounding species-specific management, and overcapitalization and severe derby fishing conditions in commercial fisheries. However, recent progress has been made on the international front through the Food and Agriculture Organization's (FAO) International Plan of Action for Shark Conservation and Management (IPOA) and the assessment of pelagic shark catch rates at the International Commission for the Conservation of Atlantic Tunas (ICCAT) Standing Committee on Research and Statistics meeting in May, 1999. In February 2001, NMFS complied voluntarily with the IPOA by finalising its National Plan of Action for the Conservation and Management of Sharks (NPOA). This relies on the current Magnuson-Stevens Act and calls for improved data collection, stock assessments, and outreach for sharks across the United States.

NMFS continues to work toward improvements in data collection and scientific assessments. These actions will assist management, both internationally and domestically, to take the steps necessary to ensure adequate protection for all Atlantic sharks.

For copies of the final HMS FMP and implementing regulations, contact the authors. More information is available on-line at http://www.nmfs.noaa.gov/sfa/hmspg.html

*NMFS is the branch of the U.S. Federal government responsible for conservation and management of Atlantic sharks.

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Editor's note: Shortly before press time, NMFS announced their intention to reopen the Atlantic fishery for large coastal sharks on July 1 to allow the second half of the annual quota to be taken. This fishery was to remain closed if the 1998 large coastal shark assessment (the basis for the 1999 50% quota cut and subsequent lawsuit) was upheld. The scientific peer review of the assessment, anticipated in the spring, was significantly delayed and will not be

Fishery for US Atlantic spiny dogfish temporarily halted

Sonja Fordham, The Ocean Conservancy

In accordance with a federal management plan, the commercial fishery for spiny dogfish *Squalus acanthias* off the NE coast of the United States was closed in June as the first half of the annual quota was reached. The Commonwealth of Massachusetts also announced that their state waters (shore out to three miles) would be closed to dogfish fishing, in line with the federal closure and recent emergency action by the Atlantic States Marine Fisheries Commission (ASMFC).

Such closures are key to the rebuilding of the overfished spiny dogfish population in the NW Atlantic, yet somewhat surprising considering Massachusetts' opposition to the federal plan's low quotas; last year Massachusetts imposed a state dogfish quota that was nearly twice that for federal waters, leading to a 67% quota overage in the first year of the plan. This overage was not deducted from the 2001 spiny dogfish quota, the second half of which will be available to the fishery in the fall.

The US Atlantic spiny dogfish fishery began about a decade ago. In 1990, landings increased to 32 million pounds, more than triple 1989 levels, then peaked in 1996 at over 60 million pounds. Landings in 1999 exceeded 32 million pounds. Massachusetts vessels have been responsible for more than half the US Atlantic dogfish landings; North Carolina has ranked second. The majority of U.S. Atlantic spiny dogfish are exported to Europe. Mature females are targeted to meet market demand for large fish.

The federal fishery management councils for the Mid-Atlantic and New England regions began developing a fishery management plan for the Exclusive Economic Zone (EEZ) in the mid 1990s. Controversy over the catch cuts needed to rebuild the population, coupled with the low priority of the species led to significant management delays. In early 2000, pressure from fishermen and Massachusetts congressmen led to further postponements and a quota increase from the scientifically advised 2.9 million pounds to 4 million pounds. The first U.S. Atlantic dogfish regulations were not implemented until April 2000.

The unregulated, directed take of mature females and years of management delays have taken their toll. Mature female dogfish are now depleted and the number of pups is at record low levels. The pulse of intermediate age females that once offered hope for timely rebuilding has now also been significantly reduced. Before the 2000 quota was grossly exceeded, population rebuilding was already expected to take nearly two decades.

Although Massachusetts waters are temporarily closed to dogfish fishing, the state continues to argue for a "constant harvest" approach that would allow nearly double the federal dogfish quota and continued directed fishing on mature females. Massachusetts, supported by states such as New Hampshire and Maine, is expected to continue to push for quota increases. The ASMFC could change their dogfish management strategy as early as July, while the federal plan may take a year or more to amend.

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The 2000 IUCN Red List of Threatened Species:
Elasmobranch Update

Rachel Cavanagh and Sarah Fowler, Shark Specialist Group

What is the Red List?

The IUCN Red List is widely recognised as the most comprehensive, global approach for evaluating the conservation status of plant and animal species. It has no statutory force, but occupies a prominent role in guiding the conservation activities of governments, NGOs and scientific institutions. The current Red List Programme began when the Species Survival Commission launched an initiative to revise the listing system, in recognition of the need for a consistent and objective process to describe threatened species. A quantitative system of criteria for assigning species to Red List categories of threat was adopted by the IUCN in 1994.

Elasmobranchs and the Red List

One of the recent introductions to the Red List Programme was a call to improve the coverage of elasmobranchs, few of which had been assessed in the past (the 1996 Red List included just 32 species). In 1999, numerous members of the SSG prepared assessments for over 100 species. Co-Chair Sarah Fowler coordinated a consultation of the entire SSG membership in July 2000, during which assessments were finalised by consensus in preparation for publication of the 2000 Red List in October. The result is summarised below.

Elasmobranch assessments, 2000 Red List

The Red List Categories		2000 Red List Assessments
EX	Extinct	0
EW	Extinct in the Wild	0
CR	Critically Endangered	3
EN	Endangered	17
VU	Vulnerable	19
LR/cd	Lower Risk/conservation dependent	4
LR/nt	Lower Risk/near threatened	35
DD	Data Deficient	17
LR/lc	Lower Risk/least concern	10

It is too early to attempt to draw any significant trends from the limited data available, although it is clear that long-lived species with low fecundity are especially at risk, and groups such as the sawfish (*Pristis* spp., see below) give particular cause for concern. There is an urgent need to review all chondrichthyan species to give a balanced overview of the state of knowledge of the whole group.

Endangered Elasmobranchs

Elasmobranchs identified as Critically Endangered, the most severe 'at risk' category, indicating that a species is "facing an extremely high risk of extinction in the wild in the immediate future" were:

1) The largetooth sawfish *Pristis perottetii*: taken in (former) directed fisheries and extremely vulnerable to bycatch in virtually all fisheries throughout its Atlantic and Eastern Pacific range. Its status is known to be especially serious in parts of Central America, including Lake Nicaragua.

2) The common sawfish *Pristis pristis*: it is thought that this species will become extinct without timely intervention.

3) The Brazilian guitarfish *Rhinobatus horkelii*: its abundance has decreased by 96% over the ten years from 1984, when landings peaked, to 1994. The inshore nursery grounds of this species are heavily fished and it is quite likely that this endemic guitarfish could be driven to extinction in the foreseeable future.

Three other species are identified as Endangered globally, but Critically Endangered in parts of their range, these are the great-tooth (or freshwater) sawfish *Pristis microdon* (CR in SE Asia), the smalltooth (or wide) sawfish *Pristis pectinata* (CR in the North and Southwest Atlantic – see page 15) and the common skate *Raja (Dipturus) batis* (CR in shelf seas). In addition, the giant freshwater whipray *Himantura chaophraya* is classed as Vulnerable globally, but Critically Endangered in Thailand and probably other localities.

Seventeen species of elasmobranchs have been listed as Endangered, meaning the taxon is "facing a very high risk of extinction in the near future". These include the Ganges shark *Glyphis gangeticus* and the speartooth shark *Glyphis glyphis,* both of which seem to be confined to rivers, estuaries and coastal waters under significant development and exploitation pressures. This category also encompasses four other sawfish species. Another 19 are Vulnerable.

Seventeen of the species assessed so far are Data Deficient, meaning that appropriate data on their distribution and/or abundance is lacking. Indeed, a very large proportion of all chondrichthyan fish species is likely to fall within this category.

It is most sobering, however, to note that less than 10% of the species assessed were considered to be Lower Risk/least concern – the only category of assessment not listed on the Red List database and website because these species are considered not to be threatened or likely to become threatened in the foreseeable future.

Current and Future Red List Assessments

You can search for all current threatened and Data Deficient elasmobranch Red Listings on <**www.redlist.org**>.

To suggest changes to any of the current listings, please contact Rachel Cavanagh <rachel@naturebureau.co.uk> who will be coordinating the SSG consultation and discussions on future changes and additions. In addition, the IUCN has now requested that the SSG complete assessments of all chondrichthyan species by the end of 2003. If you are interested in undertaking assessments, please contact Rachel with details of the species you would be prepared to review.

The SSC Red List Programme Office has issued the timetable for submissions to the Red List. The CD-ROM and website will be updated annually, and an analysis of the data produced in hard copy every four to five years. Unless otherwise notified, the following schedule will apply every year:

30th April: deadline for any petitions against listings appearing in the previous edition of the IUCN Red List. Petitions may only be based on the Red List Criteria and accompanying documentation.

31st August: deadline for the submission of new assessments, corrections, new documentation, etc.

31st August: deadline for the submission of justifications from the parties in petitions cases, if the matter has not been resolved.

Mid-November: The Red List Standards Working Group and Petitions Subcommittee will meet by mid-November to discuss and decide on the outcome of any petitions. This decision will appear in the next issue of the Red List.

Early January: public launch of the Red List.

Further Information

The 2000 IUCN Red List is not available in printed format because of the very large number of species covered. It may, however, be consulted on the internet at <http://www.redlist.org>. Full details of the Red List Categories and Criteria are also provided at this site. For general Red List enquiries email <redlist@ssc-uk.org>.

A publication and CD of *The IUCN SSC 2000 Red List of Threatened Species*, compiled by Craig Hilton-Taylor, ISBN 2-8317-0564-9, is available from IUCN publications, fax +44 1223 277175, or email <info@books.iucn.org>.

CITES Update

Sarah Fowler and Rachel Cavanagh, Shark Specialist Group

Introduction

The Convention on International Trade in Endangered Species (CITES) came into force in 1975 in response to concerns about the potential detrimental effects on species' survival of high levels of international trade in wild animals and plants. CITES establishes the international legal framework for the prevention of trade in endangered species of wild fauna and flora, and for effective regulation of international trade in other listed species which may become threatened in the absence of such regulation. Over 150 countries are Party to CITES, which is one of the most effective of the international wildlife conventions.

Sharks first appeared on the CITES agenda during the 9th COP (Conference of Parties) in 1994, when Resolution 9.17 on 'The Status of International Trade in Shark Species' was passed. This called for the Animals Committee of CITES to review all information concerning the biological status of sharks and effects of international trade and to submit a report to the 10th COP in 1997, and called for FAO and other international fisheries organisations to improve their research programmes and to submit new information to the 11th COP in 1999.

The CITES Appendices

Appendix I lists about 820 species threatened with extinction and for which no international trade is allowed (except under exceptional circumstances).

Appendix II lists about 29,000 species. International trade is strictly regulated and monitored to ensure that it is not detrimental to their status, but Parties control the volumes of products they export.

Appendix III lists about 230 species identified by any Party as subject to regulation within its jurisdiction in order to prevent or restrict exploitation, and as needing the cooperation of other Parties in the control of trade.

Appendix IV governs the issue of the permits required before international trade in the species listed on Appendices I-III can occur.

Amendments to the Appendices (addition or removal of species, or transfers between Appendices) may only be proposed by States. Amendments to Appendix I & II listings are made at least every two years at the COP and require a two-thirds majority vote to suceed.

Elasmobranch listing proposals

The first Chondrichthyan fish listing proposal was submitted to the 10th COP in Zimbabwe in 1997: the USA's Appendix I proposal for all species of sawfishes. Both the saws and fins of these Endangered or Critically Endangered species enter international trade. Regardless, this proposal was rejected on votes (see *Shark News* 10, 1998).

Following this, three species were proposed for listing at the 11th COP in Kenya, 2000: the white shark (Australia – Appendix I), whale shark (USA – Appendix II) and basking shark (UK – Appendix II). Several SSG members provided comments to IUCN during the preparation of the IUCN *Analyses of Proposals* provided to Parties prior to the Conference, and Co-Chair Sarah Fowler attended as a member of the IUCN Delegation.

The white shark proposal (amended to Appendix II during the meeting) and whale shark proposal failed to receive the necessary majority for adoption. The basking shark proposal, considered to present a very strong case for listing, narrowly failed to reach the necessary two-thirds majority vote in favour. Basking sharks have since been listed on Appendix III by the European Union, but reservations by Japan and Norway mean that these countries will not declare their international trade in this species.

Future developments?

While this article was being written, there were unconfirmed reports that Australia might shortly be consulting other states on a proposal to list the white shark on Appendix III. This would support Australia's domestic legislation protecting this species by ensuring that illegally exported jaws, teeth and fins are not imported by other CITES Parties. A few states which have protected their whale shark populations may also be considering Appendix III proposals for this species.

The UK government has already announced that it will be resubmitting its Appendix II proposal for the basking shark at the 12th COP in 2002. No other Appendix I or II proposals have yet been made, but white and whale sharks could well be put forward again before the deadline for proposals in May 2002 prior to next year's COP.

White shark

There is evidence from protective beach-netting, game fishing and commercial fishery catch per unit effort that populations are declining. The species is not targeted by large commercial fisheries, but is taken as bycatch, as a sport fish, and to supply the curio trade with teeth and jaws. The high price for the latter are thought to stimulate directed take of this shark in coastal fisheries and by trophy anglers. An Appendix III listing will require Australia to issue CITES permits to allow trade, and require all other parties trading in this species to issue a Certificate of Origin. The requirement for permits will assist Australia to regulate trade in specimens and enable all parties to gain a greater understanding of trade in the species and any derivatives of the species.

Whale shark

Catches of this shark, which is of great ecotourism value, have apparently declined during short-term target fisheries in several countries. It is classified as Vulnerable on the IUCN Red List. Earlier this year India followed the example of the Philippines by closing its whale shark fishery and strictly protecting the species. They are also protected in Australia, the Maldives, Honduras, Malaysia and USA. The meat is popular and expensive in some countries, particularly Taiwan, which appears to have been the main export market for the Philippines and Indian fisheries. The fins are also highly prized in parts of China, where prices of $15,000 each were reported in 1999/2000.

Basking shark

The basking shark is Red Listed as 'Vulnerable' globally, and 'Endangered' where fisheries have seriously depleted populations. The high current value of the huge fins (and formerly liver oil) has stimulated targeted fisheries and is an incentive for sharks taken in bycatch to be utilised rather than released alive. The species is protected in only part of its range and none of its fisheries managed. The UK Appendix II listing proposal is intended to ensure that its exploitation is regulated and monitored, and that fisheries driven by international trade are not detrimental to its survival.

FAO's remit

One reason for not accepting the listing proposals in 2000 made during sometimes heated debates at the COP was that CITES was not the appropriate forum for managing sharks – this is FAO's task through the IPOA-Sharks (see p.13). Certainly, the IPOA notes that national Shark Plans should aim to facilitate the identification and reporting of species-specific biological and trade data, and pay special attention to vulnerable or threatened stocks, but does not specify how this should be undertaken.

There are two main schools of thought in this respect: those who feel that CITES has no place in the management of aquatic species, and those who consider that CITES has a complementary role to fisheries management as the only body capable of monitoring and regulating international trade in threatened species.

Bayesian methods in shark fishery management

Elizabeth A. Babcock and Ellen K. Pikitch,
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Introduction

Compared to classical statistics, Bayesian statistics are a fundamentally different way of approaching parameter estimation, model fitting, and hypothesis testing. In the last decade, Bayesian statistics have gone from an obscure method advocated by a minority of statisticians, to a standard method in fisheries stock assessment. There are two main reasons for the increasing popularity of Bayesian statistics.

(1) Bayesian methods allow the inclusion of information from diverse sources through the use of prior probabilities.

(2) Bayesian methods provide results in terms of probability distributions, which can be used in the decision analyses that assessments must supply for fisheries management.

These advantages are particularly relevant to shark fisheries, where data are generally poor, and many stocks are badly depleted. To demonstrate these points, we will describe the Bayesian surplus production model for large coastal sharks in the U.S. Atlantic and Gulf of Mexico from the 1998 Shark Evaluation Workshop (NMFS 1998).

Surplus production models in the large coastal shark fishery

The U.S. Atlantic and Gulf of Mexico large coastal shark fishery is dominated by sandbar *Carcharhinus plumbeus* and blacktip *Carcharhinus limbatus* sharks. The fishery is managed by a quota on commercial shark landings, and bag limits in the recreational fishery. Previous assessments of large coastal sharks (NMFS 1998, 1996) used a simple surplus production model.

Surplus production models are based on the following equation (paraphrased from Hilborn and Walters 1992).

Population next year = population this year + surplus production - catch

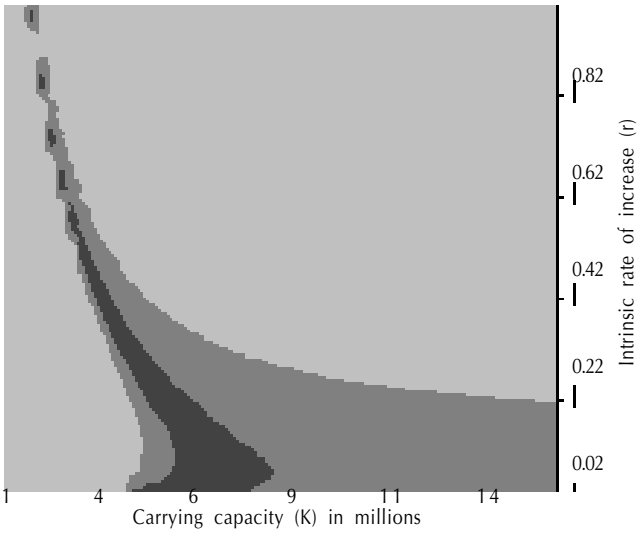
Assuming logistic population growth, the population's per capita growth rate will be highest at low population levels, approaching the intrinsic rate of growth (r). However, the total surplus production is highest when the population is at half of the carrying capacity (K). At K/2, the surplus production is rK/4, so the maximum sustainable yield (or catch) is also rK/4.

The data required to estimate the parameters of this model are the total catch in each year, and at least one time series of estimates of relative abundance, such as a catch per unit effort (CPUE) series.

A standard method of estimating r and K is to assume a population level at the beginning of the CPUE time series and use the logistic model to predict the whole time series, with an assumed value for r and for K. The best estimates of r and K are those that cause the predicted time series and the observed time series of CPUE to be the most similar (Hilborn and Walters 1992). There are several ways of finding these best fit values, including minimizing the sum of the squared differences between the observed and predicted CPUE values (sum of squares estimation), and finding the estimates that maximize the likelihood of having observed the data given the parameters (maximum likelihood estimation).

This method works well if the data are informative, meaning that only a small range of parameter values provide a good fit between the observed data and the predictions of the model. Unfortunately, for large coastal sharks in the U.S Atlantic and Gulf of Mexico, the catch per effort data are not informative with respect to the critical parameters, r and K. The population began in the 1970s at an unknown level and declined through the 1980s and 1990s. This so-called "one-way-trip trajectory" is a textbook example of uninformative data (Hilborn and Walters 1992). These CPUE data could be from a relatively unproductive population with a high starting biomass (low r and high K), or from a productive population with a low starting biomass (high r and low K). A joint likelihood profile of r and K (Figure 1) shows this. The darker regions in the graph represent combinations of r and K that provide a better fit between the model and the data.

Figure 1. Joint likelihood profile of r and K for combined large coastal sharks, from McAllister and Pikitch 1998a.



In the 1996 assessment of large coastal sharks (NMFS 1996) the surplus production model's maximum likelihood estimate of r was 0.26. However, demographic analyses of sandbar and blacktip sharks presented at the same meeting indicated that r was probably less than 0.10, based on age-at-maturity, litter size, and other life history characteristics. The discrepancy between the demographic and surplus production estimates of r are easily explained by the uninformative CPUE data-while an r of 0.26 was the best fit estimate, the fit for r=0.1 or even r=0.05 was not significantly worse (Figure 1). Clearly, the demographic information about r should be incorporated into the stock production analysis, and this is precisely what a Bayesian prior will allow.

Bayesian statistics

Bayesian statistics are not just another statistical model; they represent a fundamentally different approach to parameter estimation (Dennis 1996). Classical or "frequentist" statistics consider a parameter, such as r in the surplus production model, to be an unknown constant, while the data are considered to be realizations of a random variable. Frequentist statistics can calculate the probability of a certain set of data being collected given a certain set of parameters, but cannot assign probabilities to parameter values (McAllister and Kirkwood 1998). Thus, a classical 95% confidence interval (CI) does not imply that there is a 95% chance that the interval contains the true parameter value. Rather, it implies that, if data were collected and the analysis performed many times, 95% of the calculated CI's would contain the actual parameter value. Bayesian statistics, on the other hand, consider a parameter to be a random variable with a distribution that reflects the uncertainty about the parameter (McAllister and Kirkwood 1998). So, unlike a frequentist confidence interval, a Bayesian 95% CI can be interpreted as having a 95% chance of containing the true parameter value. For more information on the theoretical differences between Bayesian and frequentist statistics, see McAllister and Kirkwood (1998) and Punt and Hilborn (1997) for the Bayesian perspective; see Dennis (1996) for the frequentist perspective.

Bayesian estimation calculates a joint probability density function (pdf) of the parameters given the data, called the posterior distribution because it is the pdf after the analysis. The pdf of the parameters before the analysis is called the prior distribution. The posterior is calculated with Bayes' rule, which states that:

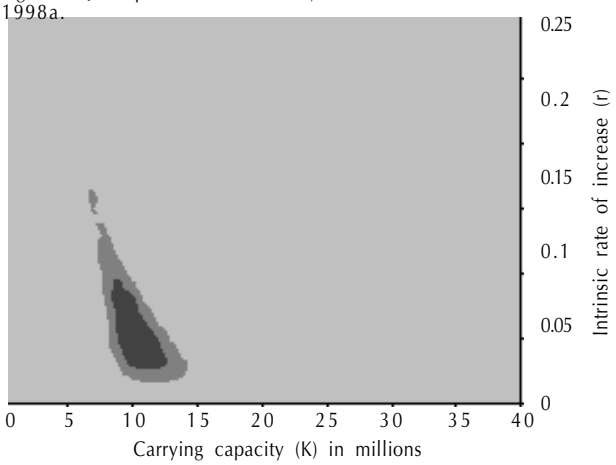
The posterior probability of the parameters is proportional to the likelihood of the data times the prior probability of the parameters.

The likelihood of the data given the parameters is a probability density function that provides a measure of the fit between the data and the model, given an assumed set of parameters. More formally, this likelihood function represents the probability of obtaining the observed data if the assumed set of parameters happened to be the true ones. Thus, the posterior pdf of the parameters is a function of both the fit between the data and the model, and the prior information about the parameters. If the data are very informative, then the posterior pdf will be determined by the data, and the prior will have little effect. Conversely, if the data are uninformative, the posterior pdf will resemble the prior (McAllister and Kirkwood 1998). In some cases, the posterior can be calculated analytically, however, for most fisheries models, the posterior must be calculated with a numerical integration method, such as the Markov Chain Monte Carlo (MCMC) or the Sampling Importance Resampling (SIR) algorithm (McAllister and Kirkwood 1998).

Much of the work of Bayesian estimation is in choosing appropriate prior distributions (McAllister and Kirkwood 1998, Punt and Hilborn 1997). If information is available regarding the potential value of a parameter, an informative prior can be developed. Expert knowledge and information from related species can be used, so long as the information used to develop the prior is completely independent from the data used in the analysis. For example, an assessment of a fish species could develop a prior for the intrinsic rate of increase r from the distribution of r values for all the known species in the same genus. If there is no available information about a parameter, an uninformative prior can be used. An uninformative prior conveys ignorance about the value of the parameter, so that only the likelihood function provides information about the parameter.

For the large coastal shark assessment, the demographic analyses were used to develop an informative prior for r in a Bayesian surplus production model (McAllister and Pikitch 1998a, 1998b; NMFS 1998). The demographic analysis was completely independent of the catch data, so it was a legitimate source of prior information.

Figure 2. Joint posterior of r and K, from McAllister and Pikitch 1998a.



A Bayesian stock production model for large coastal sharks, using an informative prior on r generated the joint posterior on r and K shown in Figure 2, analogous to the joint likelihood surface in the classical assessment (Figure 1). Note that the range of most likely values of r and K is much more restricted.

The Bayesian method allowed the unrelated information from a demographic model and a stock production model to be combined, to increase the accuracy and precision of the estimates of r and K. The ability to incorporate prior information about demographics into the production model was probably the main reason why the Bayesian method was adopted for the most recent large coastal shark assessment (NMFS 1998).

Bayesian decision analysis

Estimating r and K is only part of the function of an assessment. Fisheries managers are required to decide on a management action, such as the total allowable catch (TAC) for large coastal sharks, when there is uncertainty about the state of nature (stock size relative to K and the value of r). An assessment must therefore calculate the probability of each competing hypothesis about the state of nature. Also, the consequences of each proposed management action must be calculated under each state of nature, and integrated across states of nature. The consequences of the management actions include such indicators of policy performance as the probability of stock recovery to K/2 within 10 years or the probability of the stock decreasing in the next 10 years (McAllister and Pikitch 1998b).

In Bayesian decision analysis, the posterior expected values and distributions of the indicators of policy performance are calculated through Monte Carlo simulation as follows (McAllister and Pikitch 1998b). A state of nature is drawn from the posterior pdf of the parameters from the assessment. These parameter values are used to calculate the stock size trajectory throughout the time series, with the catch in the future determined by the TAC being considered. This procedure is followed many times to determine the probability of the population increasing in the next ten years and other indicators. These results can be integrated across all the possible values of a parameter such as r, or calculated for several possible ranges of the parameter (McAllister and Pikitch 1998b). Because Bayesian decision analysis presents managers with decision tables and probability distributions instead of point estimates, management decisions can be made with an awareness of uncertainty.

Bayesian methods allow uncertainty to be formally incorporated into an assessment, and allow all available biological data to be included in the model. For many shark species there is little available fisheries data, so that including biological information in the form of priors will greatly improve the accuracy (and hence the usefulness) of the assessment models.

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United States Bans Shark Finning

Sonja Fordham, The Ocean Conservancy

Congress Takes Action

In late 2000, the United States Congress adopted legislation to prohibit shark finning – the practice of slicing off a shark's fins and discarding its carcass at sea – in all US waters. Former US President Bill Clinton signed the "Shark Finning Prohibition Act" into law last December. Prior to this overall ban, finning was permitted in the US Pacific, yet prohibited since 1993 in the US Atlantic, Gulf of Mexico and the Caribbean Sea. In addition to banning finning, the new legislation provides for initiation of related international negotiations and authorizes shark fishery and population research.

Wasteful Practice

Shark fins are the principal ingredients in shark fin soup, an Asian delicacy that can sell for as much as $100 a bowl. By the late 1990s, tens of thousands of sharks caught as bycatch were being killed just for their fins in tuna and swordfish fisheries of the US Pacific. In 1998, the number of sharks finned in the waters surrounding Hawaii topped 60,000. Because fins comprise only a small percentage of a shark's bodyweight, finning wastes 95% or more of each shark. In addition, observer surveys from Honolulu based longline vessels revealed that 86% of the sharks finned were brought to the boat alive.

The waste associated with finning prompted a call to ban the practice from conservationists, scientists, local fishermen and the general public. Allowing finning in the US Pacific was also inconsistent with a number of US fisheries policies and ran counter to the recommendations of several international fishery agreements, including the United Nations Food and Agricultural Organization (FAO) International Plan of Action (IPOA) for Sharks.

The New Legislation

Under the new law, it is illegal to remove shark fins and discard the carcass at sea and land or have fins on board without the corresponding carcass. In addition, the US Departments of Commerce and State are directed to seek an international ban on finning and initiate amendment and development of bilateral and multilateral shark agreements to protect sharks. The legislation calls for government investigation of the nature and extent of finning and the transshipment of fins while the US is to urge other governments to collect data regarding shark stock abundance, bycatch and trade, and submit National Plans of Action for Sharks to FAO. The new law also authorizes a Department of Commerce shark research program in order to collect data for assessments and to research fishing gear and practices that safeguard fishermen, minimize incidental catch of sharks and maximize shark utilization. The government agencies are to submit a report to Congress that sets forth a plan of action for international shark conservation and evaluates the progress of existing efforts. Regulations to implement the new finning legislation were released for public comment in June 2001.

International Finning Bans

Recognizing that cooperation among fishing nations is key to achieving effective management of migratory fish stocks, the United States has been a leading proponent of international shark conservation initiatives. In a statement released at the bill's signing, President Clinton reinforced US commitment to the

Fins drying at Cape Town docks, South Africa. Photo: Bruce McCoubrey/

FAO IPOA for Sharks and pledged that the US would intensify efforts to achieve finning bans and related measures by other nations and within international management bodies.

Other national legislation

Countries which have already banned shark finning are Brazil, Costa Rica, Oman, South Africa and Australia.

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Review of Non-food Fisheries

Project Seahorse is seeking information on the ecological and economic impacts of non-food fisheries. Trade of marine fish destined for any of the following uses will be covered by the project: Bait, aquarium display, medicines, curiosities and art, household objects and fabrics, education and research, chemicals, food for cultured species and mariculture seed. Please send ideas, references, data, advice and contacts to Dr Amanda Vincent, c/o Anne-Marie Blais, Project Seahorse. Email: <ablais@po-box.mcgill.ca>

International shark conservation and management initiatives

Mike Pawson, CEFAS, Lowestoft, UK and Sarah Fowler, SSG

We are well aware that modern fishing technology and improved access to distant markets have together caused an increase in fishing effort and catches of sharks, skates and rays, and there is concern of the consequences for the populations of some species in several areas of the world's oceans. Because the elasmobranchs' close stock-recruitment relationships denies them the variability which enables most teleost fish populations to be boosted by better-than-average year classes, they have long recovery times in response to over-fishing. At present, there are few international management mechanisms effectively addressing this, and management and conservation of elasmobranchs are held back by a lack of knowledge of their biological parameters and of the statistics and practices employed in fisheries taking them.

FAO International Plan of Action for Sharks

FAO has concluded that "it is necessary to better manage directed shark (*for which read 'all chondrichthyan fish'*) catches and certain multispecies fisheries in which sharks constitute a significant bycatch", and has recognised the importance of having international co-operation and co-ordination of shark management plans. The International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks) has therefore been developed, endorsed by the FAO Committee on Fisheries (COFI) in February 1999, and was formally adopted by the FAO Conference in November 1999. Its objective is to ensure the conservation and management of sharks and their long-term sustainable use, and encompasses both target and non-target catches. For more information see *Shark News* no. 12 (p.5) or the FAO Fisheries website (http://www.fao.org/waicent/faoinfo/fishery).

The IPOA encouraged States to adopt (by the COFI session in 2001) a National Plan of Action (*NPOA or Shark-plan*) and to carry out regular assessments of the status of shark stocks subject to fishing. This would necessitate consistent collection of commercial data and improved species identification, and would ultimately lead to the establishment of abundance indices and biological reference levels. International collaboration on data collection and data sharing systems for stock assessment is particularly important in relation to straddling, highly migratory and high seas stocks.

Committee on Fisheries (COFI) 2001

COFI is the only global inter-governmental forum examining major international fisheries and aquaculture problems and issues. It addresses recommendations to governments, regional fishery bodies, NGOs, fishworkers, FAO and the international community, and has also been used as a forum for the negotiation of global agreements and non-binding instruments. The 24th COFI meeting took place in Rome on 26 February to 2 March 2001.

Shark management plans reviewed

The UN States present reviewed their progress with implementing the Code of Conduct on Responsible Fisheries, including the IPOA–Sharks. The level of progress announced at the meeting was disappointing. At least 125 nations are known to import shark fin into Hong Kong and are therefore assumed to have active shark fisheries. Despite this, however, only 17 member states had reported that they were preparing NPOAs prior to COFI, about 15 were considering doing so and 47 had stated that were not doing so. It was far from clear precisely how well advanced most of these plans were.

The USA's Shark Plan, the only national plan completed and available, may be downloaded from <www.nmfs.noaa.gov>. This plan benefits from being able to build on a long history of shark fisheries assessment and management in the USA, particularly on the Atlantic coast. The USA urged other states at COFI to complete their shark plans, emphasising that this should only be the first step towards comprehensive shark fisheries management at national, regional and global levels.

Australia presented a comprehensive shark fishery assessment, which will provide a sound basis for their national plan, which is currently being developed.

The European Union tabled a 'preliminary draft assessment' which provided minimal information on shark fisheries and existing and potential shark management activity in the EU.

No other shark assessments or National Shark Plans reported by other delegations to COFI as underway or completed are available for study.

ICES Elasmobranch Study Group

In parallel with the development of the FAO IPOA–Sharks, the ICES Elasmobranch Study Group took the initiative to develop a European proposal for elasmobranch stock assessments. Eighteen scientists from eleven countries met in Santander in March 1999 assisted by an EC funded Concerted Action Project entitled 'Preparation of a Proposal for Stock Assessment of some elasmobranch fishes in European waters'. This was submitted successfully under the 1999 call for studies in support of the Common Fisheries Policy (CFP), commenced in 1 January 2000 and is due for completion by 31st December 2002.

Development of Elasmobranch Assessments

The objective of this 3-year research programme, DELAS (Development of Elasmobranch Assessments), is to improve the scientific basis for the management of fisheries taking elasmobranch species. This project aims to collate existing data, to instigate the collection of new data and to develop standard assessment methods for one or two representative species of each of four groups: pelagic sharks (blue shark *Prionace glauca)*, skates and rays *(*thornback ray *Raja clavata* and cuckoo ray *Raja naevus*), coastal dogfish and catsharks (spurdog *Squalus acanthias*, and lesser spotted dogfish *Scyliorhinus canicula*), and deep-water sharks *(*Portuguese dogfish *Centroscymnus coelolepis*, leaf-scale gulper shark *Centrophorus squamosus*, kitefin shark *Dalatias licha* and blackmouth catshark *Galeus melastomus*).

For this purpose, survey and fisheries data will be used to describe population distribution that, together with genetic, tagging and biometric data, will be used to investigate stock separation. Commercial and survey catch and effort series will be used to indicate abundance trends, and length (and possibly age) distributions will be used to estimate historic and contemporary stock mortality rates. A key element of the research is the development of life history models and the compilation of appropriate biological data, which will be used to indicate whether current exploitation is sustainable.

This study will provide a dedicated database and preliminary assessments for some important elasmobranch stocks, and will furnish ICES with a knowledge of data requirements and assessment methods which can be applied to elasmobranch species in order to provide management advice for both targeted fisheries and where elasmobranchs are taken as by-catch.

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Environmental Hero Award

Sonja Fordham, Fisheries Project Manager for The Ocean Conservancy (formerly the Center for Marine Conservation, CMC) has been named an Environmental Hero by the National Oceanic and Atmospheric Administration (NOAA) in recognition of nearly a decade of defending depleted ocean fish. Sonja has worked as a CMC fish advocate since 1991. She is a regular participant in the deliberations of NMFS, the regional fishery management councils, the Atlantic States Marine Fisheries Commission, the US Congress and several international fisheries bodies. Sonja is especially active in New England and Mid-Atlantic fish issues, as well as in shark conservation, both in the USA and internationally. Her advocacy often focuses on under-appreciated yet imperilled fish such as the spiny dogfish (cape shark), skates, groundfish and tilefish.

During her nine years at CMC, Sonja has authored numerous reports and articles, become a resource for the media and appealed to countless like-minded as well as opposing groups in the interest of fish conservation. Her most rewarding activities involve encouraging concerned citizens to "speak for the fish".

Sonja Fordham receives her award from Andy Rosenberg, NOAA. Photo: The Ocean Conservancy.

"I am deeply honored to receive this award as well as privileged to have worked with so many dedicated and talented NOAA staff members over the years", remarked Sonja. "This honor also signals the government's recognition of non-fishing interests as important stakeholders in the conservation of our ocean fish".

"*The fish could not ask for a better advocate*", stated Roger Rufe, CMC president.

Sonja is a long-term, active member of the IUCN Shark Specialist Group and the American Elasmobranch Society and maintains appointments to Mid-Atlantic Advisory Committees for dogfish and tilefish, the NMFS Highly Migratory Species Advisory Panel and the Northwest Atlantic Fisheries Organization (NAFO) Consultative Committee. In recent years, she has served on several U.S. delegations to NAFO Annual Meetings as well as those related to development and implementation of the 1999 United Nations Food and Agriculture Organization (FAO) International Plan of Action for the Conservation and Management of Sharks, and the Convention on International Trade in Endangered Species (CITES). Currently, Sonja has been spending much of her time working to end the wasteful practice of shark finning and to close shark conservation loopholes in Atlantic state waters.

SSC Specialist Group Grants

The Chicago Zoological Society makes annual grants to IUCN Species Survival Commission Specialist Groups from its Chicago Board of Trade Endangered Species Fund 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 (subject to change on the latter date). The deadline for the October 2001 awards will be announced later in the year, but will likely be sometime in August 2001.

The Fund will support projects up to $5,000 (smaller requests will fare better). The Fund will consider proposals that are on a specific threatened (or nearly threatened) species or a specific habitat that is of high value or also threatened. Priority will be given to projects that are clearly of critical need for the species or habitat, 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.

Projects that have been specifically identified in published or nearly published Action Plans take priority. The Specialist Group Executive Committee must endorse any proposal submitted on the Group's behalf. It is important that projects are considered important and of high quality by the group.

Proposals should be no more than two pages long, and preferably one page, including budget. The budget should be very general, with categories of expenses, and a brief justification. The proposal should stress the significance of and the general approach to the work, not a detailed methodology. The emphasis on the written proposal should be on describing the outcomes and importance of the project. If a project is included in an Action Plan, please provide a reference. Other references are not necessary.

All applications must be made through the SSG Executive Committee. Please send them to Rachel Cavanagh, SSG Programme Officer (address with Editorial Details on p.20).

Proposal To List Smalltooth Sawfish As Endangered

Rachel Cavanagh, SSG Programme Officer

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA) has been seeking public comment on its proposal to list as endangered the US population of smalltooth sawfish *Pristis pectinata*. An extensive review has concluded that the US population, currently restricted to South Florida, is in danger of extinction.

This large, widely distributed sawfish is listed as Endangered globally and Critically Endangered in the North and Southwest Atlantic on the IUCN 2000 Red List (p. 8). It has been wholly or nearly extirpated from large areas of its former range in the North Atlantic (Mediterranean, US Atlantic and Gulf of Mexico) and the Southwest Atlantic coast by fishing and habitat modification. Its status elsewhere is uncertain but likely to be similarly reduced.

NOAA Fisheries will make the final decision on whether to list the population of smalltooth sawfish as endangered. The public had until July 15th, 2001 to comment on the proposal to: Chief, Protected Resources Division, NMFS Southeast Regional Office, 9721 Executive Center Drive North, St.Petersburg FL 33702, USA. A copy of the proposal may be obtained by contacting this office at (+1) 727-570-5312 or on-line at <http://www.nmfs.noaa.gov/prot_res/species/fish/Smalltooth_sawfish.html> This site contains additional information, links to the status review for smalltooth sawfish, and the federal register notice.

Meetings

Tagging and tracking marine fish with electronic devices

7-11 February 2000, East-West Center, Honolulu, Hawaii.

Marine fishes are tagged and tracked with a suite of different electronic devices of varying degrees of sophistication. In the past 5 years, these devices have yielded an impressive amount of information. This symposium reviewed this information and identify future research challenges.

There were sessions on the results of tagging and tracking work to date, tracking with acoustic tags, automated monitors, geo-locating archival tags, pop-off devices, 'cross-over' studies, unresolved problems, remote recovery of data, geolocation algorithms, data management and GIS, integration of results, fish mortality vs. tag mortality, future developments, applications from other fields, new sensors, fish tracking data archive, and applications to fishery management, including behavior in stock assessment.

Papers will be published in the forthcoming 2001 special issue of *Reviews in Fish and Fisheries Biology*.

International Pelagic Shark Workshop

February 14-17, 2000, Asilomar Conference Center, Pacific Grove, California, USA. Presented by the Ocean Wildlife Campaign.

Pelagic sharks are targeted by commercial and recreational fisheries worldwide and are taken in large numbers in the bycatch of other fisheries. However, little information exists about trends in abundance or their ability to withstand fishing pressure. Because of their highly migratory nature, data on catches, indices of abundance, and life history parameters from all major pelagic shark fishing countries are required in order to effectively manage these fisheries.

This workshop began to compile the information and expertise needed for pelagic shark management in the Atlantic and Pacific.

Its objectives were:

- to collate all available biological and fishery data for pelagic sharks that are subject to fisheries;
- to evaluate the potential for assessing various pelagic shark populations;
- to identify additional data and analyses required for assessment and for the purposes of fishery management; and
- to publish the proceedings in a peer-reviewed volume.

Working group papers and posters were presented on the following:

Trends in Abundance of Pelagic Sharks and History of their Fisheries. Case studies of pelagic shark fisheries, focusing on the data that are necessary to prepare a fishery management plan.

Life History, Stock Structure and Movement. Life history, intrinsic rates of increase, and genetics and tagging as indicators of stock structure and migration.

Assessment Methods and Management Strategies for Pelagic Sharks. Assessment and management methods appropriate to the particular needs of pelagic sharks.

The bibliography prepared for this meeting is available on the SSG website (see address on p. 1). Proceedings are in preparation.

Shark Conference 2000

21-24 February 2000, Honolulu, Hawaii.

Organised by WildAid, the Hawaiian Audubon Society and the Western Pacific Fisheries Coalition, to bring together some of the world's experts on sharks in order to compile the current knowledge of shark populations worldwide and the effects of over-fishing, excessive by-catch, environmental factors and the finning industry. To read the full report and find out more about WildAid's campaign, please visit <http://www.wildaid.org>.

Sustainable Management of Sharks and Rays in West Africa

26-28 April 2000, Saint-Louis, Senegal.

This workshop was organised by FIBA (International Foundation of "Banc d'Arguin') in collaboration with WWF and IUCN. The aims were to promote a regional policy for shark and ray fisheries, to identify priorities for research and to define recommendations for the sustainable exploitation of sharks and rays in West Africa. The critical situation of shark fisheries in the region and the drastic depletion in shark populations was discussed, and a number of recommendations proposed. Among these, the principle of full utilisation of shark catches and the constraint of landing sharks intact with their fins were unanimously adopted.

These recommendations will form the basis for a regional Plan of Action for Sharks. SSG member Bernard Seret attended the workshop and new SSG member (now appointed Regional Vice-Chair) Mathieu Ducrocq was recruited and will be taking the lead in West Africa on behalf of the SSG. We look forward to working with him on the Plan of Action and other elasmobranch conservation and management issues.

4th Annual Meeting of the European Elasmobranch Society

28-30 September 2000, Livorno, Italy.

This EEA meeting helped turn the spotlight on Mediterranean sharks and rays – very little is known about these species, yet it is likely many are endangered. ICRAM (the Italian Central Institute for Applied Marine Research) presented their National Shark Assessment – in fact the first such in Europe. The EEA participants endorsed the aims of the FAO IPOA for all shark species, congratulated the initiative of ICRAM and offered the support and expertise of the EEA to other Member States of the European Commission for the development and implementation of national and European Shark-plans.

Brazilian Elasmobranch Society/Sociedade Brasileira Para o Estudo dos Elasmobrânquios (SBEEL)

City of Santos-SP, November 2000.

The SBEEL meeting offered a great opportunity for discussions on the diversity of elasmobranch species along the Brazilian coast; distribution, reproduction and growth; freshwater stingrays; fisheries and conservation strategies. Ninety-four oral and poster presentations, small conferences and special topics of discussion were presented by 200 researchers and students from Brazil, Uruguay, Argentina, USA, UK and Chile. The abstracts are available (mostly in Portuguese). Please contact Getulio Rincon: <rincon@brazilmail.com> or <zazan143@bsb.zaz.com.br>.

6th Indo-Pacific Fish Conference

Durban, South Africa, 20-25 May 2001

Symposia were held with themes including pelagic, chondrichthyan, coastal, and reef fishes. Secretariat, 6th IPFC, Oceanographic Research Institute, PO Box 10712, Marine Parade, 4056 Durban, South Africa. Fax: +27 31 337 2132. Email: <seaworld@dbn.lia.net> The SSG held a meeting during the conference, the minutes of which will be posted on the SSG website in due course.

IFAW African Shark Conservation Workshop

Cape Town, South Africa, 30 May - 3 June 2001

The workshop was attended by delegates from many African nations as well as SSG and IFAW representatives. Themes included shark management and threats, research priorities and legislation. Please contact Ntombentsha Nkwentsha, IFAW South Africa office for details. Fax: +27 21 465 6838. Email: <nnkwentsha@ifaw.org>

Recent Books & Publications

Sharks, Skates, and Rays: The Biology of Elasmobranch Fishes

William C. Hamlett (Editor). 1999. 544 pp., 228 illus., hardcover. The Johns Hopkins University Press, Baltimore, MD, USA. US$115.00. ISBN 0-8018-6048-2.

In 1922, Dr Frank Daniel published the first edition of the now-classic book, *The Elasmobranch Fishes* (first published 1922, revised 1928 and 1934). It represented the ultimate compilation of information on elasmobranch morphology of its time. *Sharks, Skates, and Rays* is a successor to this classic work, providing a comprehensive and up-to-date overview of elasmobranch morphology. Daniel's work has been built upon by keeping a systems approach, although the coverage has been expanded from anatomy to include modern information on physiology and biochemistry. The new volume also provides equal treatment for skates and rays.

The chapters take us through the many intriguing aspects of elasmobranch form and function that capture the biologist's imagination today as they have for hundreds of years. The detail helps us understand elasmobranchs as we know them to behave in the wild. For example, the chapter on special senses describes the major senses, such as the eyes and olfactory systems, and the special receptors that, all combined, make them powerful and effective predators. If you want a comprehensive review of the different modes of reproduction, there is a chapter on both female and male systems, discussed from an evolutionary perspective. The chapter on the urinary system synthesizes a disparate literature on elasmobranch renal architecture, illustrating how the structure of this system reflects its function, depending on whether the particular system is marine, euryhaline, or restricted to freshwater bodies. No book on these fish would be complete without mention of the variety of tooth form, and all are included here, fossils and recent, the incredible diversity showing that not all sharks are the typical 'Jaws'!

Overall the authors present a wide coverage of general introductory material for the relative novice to the biology of these fish, but also review the latest technical citations, making the book a valuable primary reference resource to all researchers in the field. All the authors are leading authorities in their respective fields in elasmobranch biology. An annotated checklist compiled by Leonard J. V. Compagno is included as an appendix, and includes all described species with a generalized listing of geographic distribution and habitat for each genus. More than 200 illustrations supplement the text.

William C. Hamlett is an associate professor of anatomy at Indiana University School of Medicine and an adjunct associate professor of biological sciences at the University of Notre Dame.

Contents and contributors:

Foreword, William C. Hamlett.
Systematics and Body form, Leonard J.V. Compagno.
Integumentary System and Teeth, Norman E. Kemp.
Endoskeleton, Leonard J.V. Compagno.
Muscular System, Karel F. Liem, Adam P. Summers, & Quentin Bone.
Digestive System, Suzanne Holmgren & Stephan Nilsson.
Respiratory System, P.J. Butler.
Circulatory System, Ramon Munoz-Chapuli & Geoffrey H. Satchell.
The Heart, Bruno Tota.
Nervous System, Michael R. Hoffman.
Special Senses, Horst Bleckmann & Michael H. Hoffman.
The Rectal Gland and Volume Homeostasis, Kenneth R. Olson.
Urinary System, Enrico Reale & Eric Lacy
Female Reproductive System, William C. Hamlett & Thomas J. Koob.
Male Reproductive System, William C. Hamlett.

The Conservation Handbook: Research, Management and Policy

William J Sutherland. 2000. 278 pp., paperback. Blackwell Science. £24.95 ISBN 0-632-05344-5.

There are many books outlining the main concepts of conservation biology, but how does one put this theoretical knowledge into practice? The aim of *The Conservation Handbook* is to provide clear guidance on the implementation of conservation techniques, concentrating on what individuals can actually do to tackle some of the problems. Although not a book specifically concerned with the conservation of aquatic species and habitats, there are sections on fisheries monitoring and management. The author (Professor of Biological Sciences at the University of East Anglia, Norwich, UK), emphasises, however, that many conservation problems and solutions are similar everywhere. The wide range of methods described include those for ecological research, monitoring, planning, education, fund-raising, habitat management and combining conservation with development. Nineteen case studies illustrate how the methods have been applied.

The Handbook will be of interest to conservation biology students and practising conservationists worldwide, and will be especially useful for conservation workers in developing countries.

For every copy sold, another copy will be sent free to a practising conservationist outside Western Europe, North America, Australia, New Zealand and Japan. If you know of someone outside these areas who will benefit from this book, please send your name and address, and the name of the suggested recipient, their address and a sentence or two explaining why they should be sent this book to: <gratis@nhbs.co.uk>.

Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals

American Fisheries Society Symposium 23. John A. Musick (Editor). 1999. 265 pp. American Fisheries Society, Bethesda, Maryland, USA. ISBN 1-888569-15-8.

Long-lived marine animals, such as chondrichthyan fish, whales and sea turtles may not be able to respond as strongly or as rapidly to compensate for reductions in population densities. These groups are also particularly vulnerable to anthropogenic mortality and prone to population collapse. This book presents the papers from the Symposium convened to enable scientists working with many different long-lived marine taxa to discuss the ecological similarities and differences among the groups they study and to examine management strategies that might lead to improved conservation of these vulnerable species.

John A. Musick is Co-Chair of the SSG and is Head of Vertebrate Biology at the Virginia Institute of Marine Science, USA.

The End of the Line?

WildAid Report, 2001

The report documents over two year's research in 12 countries, including many of the main consuming markets and major shark fisheries. The report highlights the problems facing shark populations around the world, including increases in shark catches and the globalization of the fin trade. There are specific country studies, detailing how, in many parts of the developing world, artisanal fishermen are losing their catches to modern technology; and how World Heritage Sites and Marine Reserves such as the Galapagos Islands are being increasingly encroached upon by illegal fisheries for shark fins. The report concludes with WildAids recommendations for improved shark fisheries management and conservation, including a request for reduced consumption of shark fin soup worldwide.

For more information and details on how to obtain a copy of the report, please visit <http://www.wildaid.org>.

Shark Fisheries Management and Biology.

Marine and Freshwater Research, 49/7, 1998. 220 pp.

The collection of 23 papers in this special issue of *Marine and Freshwater Research* grew out of the Sharks and Man Workshop held during the Second World Fisheries Congress in 1996. It makes a valuable contribution towards redressing the lack of information on shark harvesting and biology, particularly in terms of describing shark fisheries and their assessment, monitoring and management. Some papers were presented at the workshop and others solicited to address gaps in the scientific literature. All but two papers are sourced from the Southern Hemisphere, all are relevant to the conservation of sharks and management of shark fisheries, and all were peer-reviewed.

The 'Shark Fisheries and Management' section reviews the broad issues confronting shark fisheries management and shark conservation and describes some national or regional shark fisheries and their management. 'Catch Monitoring and By-catch' papers describe at-sea-monitoring programmes for coastal and offshore fisheries, raising issues such as discarding, by-catch, market grading, shark fishery interactions with mammals, sea birds and turtles and the management of risk associated with interactions between sharks and humans. The 'Life History and Stock Assessment' section includes a paper comparing the productivities of 26 species of shark based on life history parameters. Others address important components of shark biology required for stock assessment (reproduction, age and growth, and gillnet selectivity). One paper applies a stock assessment with risk analysis based on demographic parameters combined with fishing gear selectivity parameters and time series data of catch and catch per unit effort. 'General Biology' includes papers on taxonomy and genetic studies relevant to stock delineation, feeding and liver oils.

Order your copy from CSIRO Publishing, PO Box 1139, Collingwood, Vic. 3066, Australia. Cost is $60 ($A in Australia/NZ, $US elsewhere) plus $8 postage per order. Cheques or Money Orders should be made payable to CSIRO Publishing, or pay by credit card. International tel: +61 3 9662 7666, Fax: +61 3 9662 7555, Email: <sales@publish.csiro.au> Website: <http://www.publish.csiro.au/journals/mfr>.

Quaderni della Civica Stazione Idrobiologica di Milano. No. 22, Dicembre 1997.

Atti del Primo Convegno italiano sugli Elasmobranchi.

This special issue of *Quaderni* contains papers presented at a one day meeting of Italian elasmobranch enthusiasts in 1995. They include studies of blue shark *Prionace glauca*, white shark *Carcharodon carcharias*, and thresher shark *Alopias vulpinus* in the Adriatic Sea, and descriptions of tagging projects and the Large Elasmobranchs Monitoring Programme (LEM) in the Mediterranean. Papers are presented in English and Italian, with colour and black and white plates. Contact Aquario, Viale Gadio, 2 I-20121 Milano MI, Italy.

Cetacea Informa, Anno Vii no.13, 1998: Speciale squali, Speciale scuole.

Produced (in Italian) by Fondazione Cetacea, Viale Milano 63, 47838 Riccione (RN) Italia. Fax + 39 541 691557. Email: <cetacea@iper.net>.

Tiburones del Mar de Alborán

F.J. Pinto de la Rosa. Servicio de Publicaciones, Centro de Ediciones de la Diputación de Málaga, Spain. 115pp + glossary and index. Black and white plates. In Spanish.

Introduces sharks, their anatomy, classification, and describes those species most commonly reported from the Alboran Sea (western Mediterranean).

The Basking Shark in Scotland

Denis Fairfax, 1998. 206 pp, hardback, black and white illustrations. £16.99. Tuckwell Press, East Linton, Scotland. ISBN 1-86232-094-2.

This book presents a detailed illustrated history of the fishery for this species in Scotland, based on archival sources, early historical works and interviews with surviving shark hunters. The biology and history of scientific and taxonomic studies are also described.

Proceedings of the 5th Indo-Pacific Fish Conference

The Proceedings of the 5th Indo-Pacific Fish Conference (Noumea, 3-8 November 1997), including papers from the Symposium on Chondrichthyan Fishes, are now available.

The volume contains 79 papers (866 pages). Copies are available for 400 F (French francs) each, plus postage (67 F per copy within Europe, 75 F to Africa, and 110 F for other countries). Orders and payment should be sent to the Societe Française d'Ichtyologie, 43 rue Cuvier, 75231 Paris cedex 05, France. Payment may also be made by bank transfer to Banque Nationale de Paris, N°: 30004 - 00042 - 00000801019 - 27, or by credit card (Visa or Master). Send credit card details by fax (for the attention of Bernard Seret, (33) 01.40.79.37.71) or by postal mail with your signature.

Report of the Consultation on the management of fishing capacity, shark fisheries and incidental catch of seabirds in longline fisheries

FAO Fisheries Report No. 593. FAO, Rome, Italy, 26-30 October 1998. ISBN 92-5-004266-3.

The meeting, attended by delegations from 80 Members of FAO and by observers, approved draft International Plans of Action for the above three subjects. The report publishes these drafts in English, French and Spanish. The Consultation also discussed at length the need to take urgent action to curb the growing problems of flags of convenience and pirate fishing. It recommended that priority be given by FAO Members to consider accepting the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement).

Biology of the Megamouth Shark

K. Yano, J.F. Morrisssey, Y. Yabumoto and K. Nakaya (Eds), 1997. xv+203 pp. Tokai University Press, Tokyo, Japan. ISBN 4-486-03111-3.

This volume represents the product of a unique international scientific collaboration arising from the stranding of a 4.7m female megamouth shark *Megachasma pelagios* (only the seventh specimen known to science) in Fukuoka, Japan, in 1994. The dissection (by 30 scientists) of the shark in 1995 was followed by a symposium in March 1996, and the publication of 21 refereed papers (with colour and black and white plates) in these proceedings. The preserved specimen is now on public display at Marine World umino-nakamichi, Japan.

Copies of the publication are available from Tokai University Press, 2-28-4 Tomigaya, Shibuya-ku, 151 Japan. Fax. 81-3-5478-0870. Payment (5000 yen, equivalent to about US$45) can be made by VISA or Master Card.

Fish bycatch in New Zealand tuna longline fisheries

M.P. Francis, L.H. Griggs, S.J.Baird, T.E. Murray and H.A. Dean. 1999. NIWA Technical Report 55. NIWA, P.O.Box 14-901, Wellington, New Zealand. ISSN 1174-2631. 18 pp plus numerous tables and appendices.

The number of hooks set by tuna longline vessels in the New Zealand EEZ declined by about 90% from a maximum of 24–27 million hooks per year in 1980–82, to 2–4 million hooks in 1994–1997. This report uses scientific observer data to determine the fish

species caught on tuna longlines and to estimate the amount of fish taken on observed vessels, scaling up these estimates to provide estimates of total fish bycatch. Analysis covers the period 1988/89 to 1996/97, when observer coverage was considered sufficiently representative for analysis.

Blue shark (32%) and albacore (29%) dominated the catch, with southern bluefin tuna, Ray's bream, porbeagle shark and mako shark the next abundant species, contributing 6–8% each.

In recent years (1994–1997), changes in fleet composition from mainly foreign and charter vessels to mainly domestic vessels has resulted in a shift in species composition: the proportion of albacore has increased (42%) and the proportion of blue shark decreased (23%).

REDUCED PRICE!

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 only £7 or $10 plus postage and packing (20% surface, 40% overseas airmail) from the SSG (see addresses on p. 16).

This introduction to the ecology, status and conservation of sharks and their relatives is aimed at a general audience. It draws attention to the unique biology of this group of fishes and makes the case for expanded political and financial investment in research, monitoring, and precautionary management for all fisheries taking sharks, skates, rays and chimaeras as part of their catch.

This publication is an invaluable source of information for the interested naturalist, students and managers. A particularly useful feature is the extensive use of tables to present the comparative life-history traits of sharks compared with other long-lived taxa, IUCN Red List assessments, management tools for domestic shark fisheries currently implemented by shark fishing nations, legally protected species, and life history traits for over 40 species of elasmobranch. There is also a list of over 200 key references, all of which are cited in the text.

Order your copy *NOW!*

Red Sea Sharks

Jeremy Stafford-Deitsch, 1999. 96 pp. Trident Press, London, UK. ISBN 1-900724-28-6.

This beautifully illustrated book is the latest in the IN DEPTH Divers' Guide series. It features wonderful colour photographs by the author and excellent pen and ink drawings by Ian Fergusson. The first part of the book contains information on sharks and divers, sensory mechanisms, reproduction and development, conservation, shark attacks and safety tips. The second part is dedicated to shark identification, with double page spreads on the identification, distribution, size, habitat and diet of the fifteen species of shark most likely to be encountered by divers in the Red Sea.

Available in hard back (£14.95) and soft back (£9.99). Postage within the UK is £3.00 per book, airmail within Europe £4.00, and airmail outside Europe £9.50 per book. Contact Biblios Publishers' Distribution Service, fax + 44 (0)1403 711143, or tel. + 44 (0)1403 710851.

Australian Seafood Handbook: an identification guide to domestic species

Yearsley, Last and Ward (eds.), 1999. 470 pp. CSIRO, Australia.

This full-colour identification guide is intended to be a reference for all Australian professional and recreational fishers, fishmongers, processors, biologists and seafood consumers. It contains everything you need to know about recognising and identifying the rich variety of seafood species found in Australian waters. A chapter on cartilaginous fishes is included. There are colour photographs of 350 seafood species and photographs of fish fillets. Protein fingerprints are included for 380 species and oil (fatty acid) composition analyses are included for 200 species.

The Handbook is available in hardcover and waterproof versions. Prices (in US $ overseas, and Australian dollars in Australia and NZ) are $39.95 + P&P for the hardcover and $75 + P&P for the waterproof.

Order copies from CSIRO Publishing, PO Box 1139, Collingwood, Vic 3066, Australia. Tel. (+61) (0)3 9662 7500, or fax. (+61) (0)3 9662 7555. http://www.publish.csiro.au/books, Email <info@publish.csiro.au>

Sharks on the Line II: An Analysis of Pacific State Shark Fisheries

Merry Camhi, 1999. 116pp. National Audubon Society.

This report is the second in a series that looks at sharks and their fisheries on a state-by-state basis. The first report (reviewed in *Shark News* 12) addressed the Atlantic and Gulf Coast States (Camhi, 1998), and a 1999 Atlantic update is also now available (Camhi, 1999).

Sharks on the Line II focuses on fisheries and management for sharks, skates and rays in the five Pacific states of Alaska, California, Hawaii, Oregon and Washington. Bycatch is probably the greatest and most insidious threat to sharks and skates in both US and international Pacific waters. Only a small number of fisheries actually target elasmobranchs, and more than 75% of the reported shark landings and almost 100% of the skate landings from the Pacific states are from bycatch. Less is known about the regionwide status of shark species in US Pacific waters than in the Atlantic, and one of the main goals of this report was to evaluate what each Pacific state is doing to manage its elasmobranch fisheries.

For a copy of this report and/or the first volume, contact Merry Camhi, Living Oceans Program, National Audubon Society, 550 South Bay Avenue, Islip, NY, 11751, USA. Email: <mcamhi@audubon.org>.

Case Studies of the Management of Elasmobranch Fisheries

FAO Fisheries Technical Paper No.378. FAO, Rome, Italy, 1999. 920pp. (in two volumes). ISBN 92-5-104291-8.

The first volume of this publication contains analyses of elasmobranch fisheries in the Atlantic and Indian Oceans, Malaysia and northern Australia. The second volume contains the case studies for Southern Australia, the regional accounts and descriptions of the activities of NGOs and quality of reported landings data. In general, the case studies cover the topics of the resource (species composition of fishery and associated species either as bycatch or discards) and development and current status of the means of prosecuting the fishery and the harvesting process. Fisheries management objectives and national fisheries policies are described, and the authors provide a critical review of the policy setting process in relation to elasmobranch fisheries, its successes, ongoing and unresolved problems and the nature of their weaknesses.

A Preliminary Evaluation of the Status of Shark Species

FAO Fisheries Technical Paper No.380. FAO, Rome, Italy, 1999. 72pp. ISBN 92-5-104299.

A preliminary evaluation of the status of shark species is made on the basis of available data, the reproductive potential of each species, and the level of exploitation of the species. Exploited shark species are classified numerically according to their vulnerability.

Shark Utilisation, Marketing and Trade

S. Vannuccini. 1999. FAO Fisheries Technical Paper No.389. FAO, Rome, Italy. 470pp. ISBN 92-5-104361-2.

Though sharks make up only a small part of the world's recorded fish landings, they are an extremely valuable resource. The are exploited for their meat, fins, skin, liver, cartilage and other internal organs. Shark skin is used to make leather and sandpaper, liver oil is used in the textile and leather industries, as a medicine and health supplement, as an ingredient of cosmetics and as a lubricant. Shark fin is one of the costliest marine commodities, and is used as a soup ingredient in Chinese communities all over the world.

This report brings together information from those parts of the world where sharks are important economically, with the latest statistics available. The species used and the methods of preparation for the various purposes are detailed.

Fisheries Management. 1. Conservation and Management of Sharks.

FAO Technical Guidelines for Responsible Fisheries. No.4, Suppl. 1. FAO, Rome, Italy, 2000. 37pp. ISBN 92-5-105514-3

These guidelines have been produced by SSG member Terry Walker to support implementation of the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks). They are addressed primarily to decision-makers and policy-makers associated with conserving shark and other chondrichthyan fish, and with managing these resources, but will also be of interest to fishing industries and other parties.

The guidelines provide general advice and a framework for development and implementation of Shark Plans and Assessment Reports prepared at national and regional levels. They are also intended for joint Shark Plans for transboundary species of shark. They cover the four elements of the FAO Sustainable Development Reference Scheme, which are:

- Species conservation
- Biodiversity Maintenance
- Habitat Protection
- Management for Sustainable Use

Science and Management of Shark Fisheries

Fisheries Research Vol. 39 No. 2. December 1998. Elsevier Science Ltd. ISSN 0165-7836.

Papers in this collection include:

A review of the fishery for pelagic sharks in Atlantic Canada.

Pelagic shark fisheries along the west coast of the US and Baja California.

Shark bycatch in the Japanese high seas squid driftnet fishery in the North Pacific Ocean.

The phenomenon of apparent change of growth rate in gummy shark (*Mustelus antarcticus*) harvested off southern Australia.

Implications of recent increases in catches on the dynamics of Northwest Atlantic spiny dogfish (*Squalus acanthias*).

Fishery biology and the demography of the Atlantic sharpnose shark, (*Rhizoprionodon terraenovae*) in the southern Gulf of Mexico.

Demographic analysis as an aid in shark stock assessment and management.

Habitat management and closure of a nurse shark breeding and nursery ground.

Federal management of US Atlantic shark fisheries.

US and international mechanisms for protecting and managing shark resources.

Due to the late publication of this issue of *Shark News* the above collection of papers in the *Fisheries Research* journal is somewhat outdated: resulting from a Symposium held in Florida, USA in 1995. However, there is much useful information on shark fisheries and management to be found in this issue, particularly as a background to the current situation. It serves as a good overview to the strengths and limitations of available protective and management mechanisms for sharks. A combination of these mechanisms will likely provide the best chance for sustainable management of sharks and prevent over-utilization in the future.

The final message is clear: all countries need to give the highest priority to collection and sharing of data on the population status and life-history parameters of elasmobranchs, and data by species on the level of take in fisheries.

Subscribers to *Shark News*

New readers wishing to continue to receive *Shark News* should return the slip below, with their name and address clearly printed.

We greatly welcome all personal contributions towards the cost of printing, mailing, and other Shark 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). Invoices for subscriptions (£5.00 per issue) can be sent to organisations or libraries unable to contribute without a formal request for payment.

Donations may be made as follows:

1. by cheque or Bankers Order in US$ to Sonja Fordham at the Center for Marine Conservation (marked payable to "CMC – 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.

All addresses are given below.

Finally, please send any comments on the newsletter and suggestions for articles for future issues to Programme Officer Rachel Cavanagh, email: <rachel@naturebureau.co.uk>

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or (with donations in US$) to: Sonja Fordham, Ocean Conservancy, 1725 DeSales Street NW, Washington, DC 20036, USA.

This issue of *Shark News* is sponsored by the US State Department

The United States Government (USG) recognizes and supports IUCN's important scientific work, and is a major donor to IUCN. The U.S. State Department makes annual voluntary financial contributions to the IUCN Species Survival Commission (SSC), assisting the IUCN Secretariat to support the major activities and programme priorities of the SSC. The State Department also contributes to a wide range of other international organizations, including the United Nations Development Program, the United Nations Environment Program, and the UN Convention to Combat Desertification.

The Departments of State, Commerce (NOAA), Interior (FWS), and IUCN work closely each year to determine funding priorities. Species conservation, including marine species, has long been and continues to be one of the highest USG environmental priorities. Some of the funds to IUCN have, therefore, been used to support activities of the Shark Specialist Group, the Seabird Group, and the Marine Turtle Specialist Group. In total, the State Department contributed $110,000 in 2000/2001 to marine species activities directed by the Executive Committees of these SSC Specialist Groups. These U.S. State funds have supported much of the recent work of the Shark Specialist Group, including coordination of the preparation of the 2000 Red List assessments, participation in meetings associated with implementation of the FAO International Plan of Action for Sharks and FAO's review of the CITES listing criteria, preparation of the Chondrichthyan Fish Status Report, and for the printing of this issue of *Shark News*. We are extremely grateful for this support.

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 of almost 2,000 recipients, *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 National Audubon Society's Living Ocean Program, Columbus Zoo, WWF's Endangered Seas Campaign, the Center for Marine Conservation, and the Ocean Wildlife Campaign.

Please contact Rachel Cavanagh for details on sponsoring part or all of an issue of *Shark News*. rachel@naturebureau.co.uk

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Forthcoming meetings

1st International Elasmobranch Husbandry Symposium

Orlando, Florida, USA, 3-7 October 2001

A forum for the presentation, discussion and dissemination of information detailing captive maintenance and husbandry practices for elasmobranchs in public aquaria. For more details, please visit http://www.colszoo.org/internal/elasmo_confer/elasmo.html

5th European Elasmobranch Association Annual Meeting

German Elasmobranch Society, Kiel, Germany, 19-21 October 2001

The organizing committee encourages interested people, NGO representatives and especially scientists on all educational academic levels from all European countries and beyond to participate and contribute to the communication of current scientific research and conservation measures of chondrichthyes. For more details, please visit http://www.elasmo.de

FAO Technical Consultation on CITES Criteria for aquatic species

Namibia, 22-26 October 2001

18th American Elasmobranch Society Meeting

Kansas City, Missouri, USA, July 2002

12th Conference of Parties to CITES

Santiago de Chile, 4-15th November 2002

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.

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 the editor 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 sub-headings, 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.

This newsletter is produced with the kind assistance of the Natural Resources Institute, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK.

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