SHARK NEWS

SHARK NEWS 12 NEWSLETTER OF THE IUCN SHARK SPECIALIST GROUP **NOVEMBER 1998**

Philopatry, natal homing and localised stock depletion in sharks

Robert E. Hueter,
Center for Shark Research, Mote Marine Laboratory, USA

No one knows for sure what dictates the precise patterns of shark distribution in time and space, and our understanding of the motives and mechanisms underlying shark migratory patterns is crude at best. This essay is an attempt to tie together three scientific concepts – philopatry, natal homing and localised stock depletion – to promote a hypothesis about shark distribution and migration, and to issue a challenge to shark researchers and students around the world.

Adult blacknose shark *Carcharhinus acronotus* on a sport fisherman's line prior to release in Tampa Bay, Florida. Photo: N. Summers.

Philopatry

Philopatry is a term from animal behaviour and ecology derived from the Greek for 'home-loving'. In his 1963 book *Animal Species and Evolution*, Ernst Mayr defined philopatry as the drive or tendency of an individual to return to, or stay in, its home area, birthplace, or another adopted locality. The term is commonly used to describe the migratory habits of microorganisms, invertebrates, and many vertebrates including mammals and especially birds. It is less common in the fish literature and is almost non-existent in the elasmobranch literature. Shark biologists talk of migratory routes, home ranges, activity spaces, and sometimes territories, but these are all expressions of a simpler temporal-spatial pattern: that of an animal such as a migratory shark choosing to go to, or stay in, a specific geographic location. This is philopatry.

Natal homing

The next term, *natal homing*, is perhaps the extreme form of philopatry in which an animal migrates back to its specific birthplace, usually to reproduce. The term was applied in 1967 by the great sea turtle biologist Archie Carr to the migratory habits of adult female sea turtles, which Carr believed return to nest at their natal rookeries. Although long-term tag returns of sea turtles have yet to confirm Carr's natal homing hypothesis (not surprising given their 30-year maturity time and the only recent development of tools like PIT tags), genetic evidence supporting his hypothesis is accumulating. In fish, natal homing is well-known to occur in salmon, in which the primary mechanism for this behaviour is olfactory imprinting, based on the work of Hasler and his students dating back to the 1960s.

Localised stock depletion

The last term, *localised stock depletion*, is a fisheries concept that refers to the depletion of a species in a highly restricted part of its geographic range. Species density is "hole-punched" in a specific locality, typically through either localised intensive fishing or degradation of habitat. Certainly the effects of habitat changes on shark distribution are understandable in this regard. But it is less clear how migratory sharks could be easily fished out in a specific place when abundance and tagging data indicate their conspecifics are in good supply nearby, apparently passing by suitable, unclaimed habitat.

And yet, examples of this can be found. Data from recreational shark tournaments in Florida in the 1970s and 1980s indicate localised depletion through concentrated overfishing, as shark abundance and size in the recreational fishery dropped dramatically in one Florida coastal site after another – but not all at the same time (Hueter 1991). This started well before the region's commercial shark fishery expanded in the mid-1980s. Was this an indication that shark populations sorted themselves out on a much finer scale than was realised, such that stock structure is dictated to a great extent by philopatry?

Question

If salmon and sea turtles do it, why not sharks? Are individual sharks in non-insular environments philopatric for specific places in their ranges, such as feeding areas, mating areas, and in the case of adult females, specific nurseries? Or do migrating sharks simply 'aim at a moving target', a set of environmental conditions that does not always have the same earth coordinates (Cury 1994)? The latter process, which leads to individual dispersal, has been generally assumed to apply to coastal sharks in regions where suitable habitat is widespread.

Fisheries management issue also includes ...

Modelling the school shark fishery in southern Australia
Management of North Sea rays
Commercial shark landings in south-west England
Spiny dogfish management in Atlantic Canada
FAO Plan of Action for the conservation and management of sharks
Shark and skate fishery in the Algerian Basin

Next issue continues fishery management theme

Evidence

The evidence needed to answer this question includes long-term tagging and tracking data, catch and abundance studies looking for localised depletions, and population genetic data. The Florida case suggests evidence of philopatry from catch data, and others can be found, such as those described in the March 1996 issue of *Shark News* (Walker 1996). Genetic data have been slow in coming, as the field has gone from allozymes to mitochondrial DNA and now microsatellite DNA to find the right probe for shark population differences.

Tagging and tracking data will ultimately provide the most direct evidence of philopatry. To examine this and other questions about the life history of sharks, the Center for Shark Research of the Mote Marine Laboratory has operated a shark-tagging program over the past seven years. CSR biologists have tagged more than 5,700 small sharks of 16 species, and results from over 200 recaptures suggest philopatric tendencies in some coastal sharks of the Florida Gulf of Mexico.

Blacknose sharks

Among the species studied, we have tagged juvenile and adult blacknose sharks *Carcharhinus acronotus*, primarily in Tampa Bay along the central Gulf coast. Male and female blacknose sharks come into the lower Bay in late spring for mating and feeding, and they vacate the area entirely by late summer. So far, we have received 14 long-term recaptures of these sharks, and all came back in almost exactly one-year, two-year, three-year, or four-year cycles. Eight of these annual-cycle recaptures were found within 0–5 miles of the tagging site, two were found nine miles away, and only four were recaptured more than 10 miles from the tagging site. Longest time at liberty so far has been 1,452 days (4.0 years), and this shark was recaptured at exactly the same place where it was tagged four years earlier.

Although we don't know precisely where these sharks go in the winter, we do know they are well outside the Tampa Bay area, perhaps hundreds of miles away. Could they simply be lurking offshore, following a set of environmental conditions that will bring them back in the summer? Possibly, but why are they so close to the tagging site exactly one, two, three, or four years later? Are these individual sharks philopatric for these specific areas and returning on an annual basis?

Blacktip and other sharks

For juvenile blacktip sharks *Carcharhinus limbatus*, the data are more numerous but less clear, and yet a similar pattern is emerging. When we examine all of our blacktip recaptures and disregard the season when the sharks were tagged (although the vast majority of these were tagged in the spring and summer months of May, June, or July), temporal migratory patterns are mixed, except for one: the annual cycle. Even though some sharks were recaptured nearly 300 miles away during mid-years, at the end of each complete year at liberty they were usually right back at the tagging sites. In this case it is very unlikely that these sharks are simply lurking offshore during the winter, because our winter blacktip recaptures have all been at relatively distant locations from the tagging sites, about 100–300 miles away.

Data from these and from other species are accumulating. Similar patterns are appearing for the Atlantic sharpnose shark *Rhizoprionodon terraenovae* and the less well-travelled bonnethead *Sphyrna tiburo*. The jury is still out on juvenile bull sharks *Carcharhinus leucas* and other species because there have been relatively few recaptures thus far. Meanwhile, we are continually scrutinising our new recapture data. Could it be that our data are biased because, for some reason, only fishermen near the tagging sites recognise our tags and turn in the data? Probably not, because we have received off-cycle returns from distant locations, and we have also had success with recaptures of these same tags from throughout the Gulf, including in Mexican waters.

Hypothesis

Although these data are preliminary, a trend is emerging. I believe it is time to 'raise the bar' on this hypothesis and more formally state that which many shark biologists have thought about, talked about, and written about, to wit:

That many, if not most, shark species are philopatric for their natal nursery areas and other critical parts of their ranges, such as winter feeding grounds. This philopatry, furthermore, makes them even more susceptible to regional overfishing and habitat destruction.

The requirements for philopatric behaviour and natal homing in sharks would include:

- Defined nursery areas – sharks certainly have these;
- Migratory routes and patterns – also well documented;
- Neural and sensory equipment required for a homing mechanism.

After studying the senses and brains of sharks for nearly 25 years, it is clear to me that they are more than qualified for the job. Their large brains certainly surpass those of salmon and sea turtles, and their senses, including electroreception, are among the most well-developed in the animal kingdom.

Conclusions, and a challenge

I consider the issue of philopatry and natal homing in sharks to be the most important issue in shark biology today, and I challenge all shark researchers to test this hypothesis rigorously in their respective research areas. Nearly every type of shark research can play a role in this, for the ramifications of philopatry, if true for most shark species, would be profound. It certainly would affect our views of shark evolution and genetics, and it would shape new perspectives on the physiology and ecology of shark species. It would fundamentally affect studies of shark population dynamics, and perhaps most importantly, it would drastically change conventional views of shark fisheries science for the management and conservation of shark populations.

References

Carr, A. 1967. *So Excellent a Fishe: A Natural History of Sea Turtles.* Scribner, New York, NY. 280 pp.

Cury, P. 1994. Obstinate nature: an ecology of individuals. Thoughts on reproductive behavior and biodiversity. *Can. J. Fish. Aquat. Sci.* 51: 1664–1673.

Hasler, A.D. and A.T. Scholz. 1983. *Olfactory Imprinting and Homing in Salmon.* Springer-Verlag, New York, NY. 134 pp.

Hueter, R.E. 1991. Survey of the Florida recreational shark fishery utilizing shark tournament and selected longline data. Mote Marine Laboratory Tech. Rept. 232A: 94 pp.

Mayr, E. 1963. *Animal Species and Evolution.* Belknap Press of Harvard University Press, Cambridge, Mass. 797 pp.

Walker, T. 1996. Localised stock depletion in sharks: does it occur for sharks? *Shark News* 6: 1–2.

Robert E. Hueter, Senior Scientist & Director,
Center for Shark Research, Mote Marine Laboratory,
1600 Ken Thompson Parkway, Sarasota, FL 34236 USA
Tel. (+1) 941-388-4441, fax. (+1) 941-388-4312
Email: <rhueter@mote.org>

Letters to the Editors:

Responses to "Diving with elasmobranchs – a call for restraint"

(George H. Burgess, *Shark News* 11, July 1998)

From Jeremy Stafford-Deitsch:

I read George Burgess' article in the last issue of *Shark News* with considerable interest. I would imagine that over 80% of my own shark photos required some sort of baiting procedure to bring the sharks in close enough to be photographed. I attended a shark feed in the Bahamas a few years back and was highly alarmed by the aggressiveness of the sharks *Carcharhinus perezi*. One large shark rammed a diver in the back of the head and sent him tumbling – and this before there was any bait in the water. If we assume that a shark's snout is indeed highly sensitive, then the velocity of impact presumably hurt the shark – I have a nasty suspicion that it was in fact going to bite but changed its mind at the very last moment. When raising my concerns to the resort operator he showed no interest – the shark feed was *the* tourist attraction. I too suspect that serious injury/fatality is inevitable.

Having helped to popularise sharks I am aware of the hypocrisy of criticising others who are doing more or less the same. However, a problem that we are too polite to address is the considerable number of shark 'experts' who use sharks not to educate the public about the reality of sharks, but rather to demonstrate their own supposed heroism. It is too readily assumed that when the public has the opportunity to dive with sharks, the result will be an improved understanding of and respect for sharks. Unfortunately it all too often gives 'experts' an opportunity for self-promotion.

Incidentally, the caption to the photo that appears on page 2 accompanying the article states that the grey reef shark is in a threat display. It isn't. It is merely turning. I should know – that's me in the background.

Jeremy Stafford-Deitsch, London, UK.

Painted/undulate ray reproduction – erratum

Martin Vince and Mike Pawson commented on the short note on reproduction in the painted ray which appeared in *Shark News* 10, p. 7. They noted that the painted ray is generally regarded to be *Raja microocellata*, not *R. undulata* which is the undulate ray. As this observation is a valuable contribution to sparse literature on the subject, it would be helpful if the confusion could be clarified. The editor hopes this note and the photograph does so!

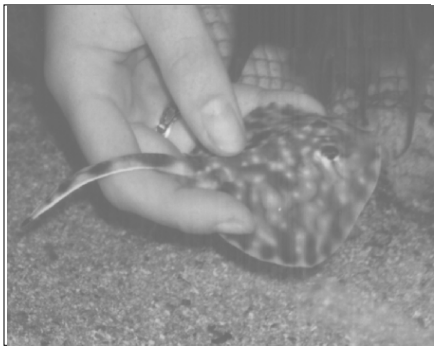


Photo: Francisco José Pinto de la Rosa.

From Doug Perrine:

George Burgess's article in the July issue, deploring the current shark-feeding trend in recreational diving and advising against scientific and conservationist advocacy of this trend, is well thought-out and presented. All of the points he makes are eminently reasonable, and I agree with his sentiments. However, I heartily disagree with his conclusions.

There is an unstated implication in the article that this type of activity is too new for the accident rate to be known. In fact, these dives have been conducted for more than 20 years, and have been extremely popular for over ten years. The number of divers exposed to non-cage feedings is now in the hundreds of thousands world-wide. It would probably not be all that hard to get a reasonably accurate figure for the accident rate. Based on my personal familiarity with the sport, and reports from participants and operators, I would estimate the accident rate to be in the range of a few incidents per tens of thousands of dives – well within the range of many popular 'adventure sports' and certainly safer than snowboarding or rock climbing. Most of these injuries are very minor – 'Band-Aid nicks' – and the few serious injuries have been, to my knowledge, exclusively to the feeders, who have now learned to use stainless mesh gloves or suits, or else present the bait by some remote method.

These injuries have not been played up in the press. If a customer does eventually receive a serious injury and files a lawsuit, it is likely that this will get nodding mention in the mainstream press, as do current reports of shark attacks on surfers, spearfishermen etc., and wrongful injury and death lawsuits against dive operations due to drowning and other accidents. The tabloid press will probably play it up, but if such an event does not occur, they will make up one, as they do every few months anyway ("Man bitten in half by shark, but lives ..." etc.). Any such negative publicity will be insignificant compared to the massive positive publicity that sharks have received over the last ten years, and continue to receive, as a result of the public participation in these dives.

Probably even more important than the positive press that these dives generate is the change in attitude of the divers who participate. Hundreds of thousands of divers have gone from fearing sharks (and thus wishing to eliminate them as a threat) to admiring sharks (and thus seeking to preserve them). This is a vital step in the creation of a 'constituency' for shark preservation, without which all conservation efforts are doomed to failure.

Even more important in the short run is the economic value which these dives attach to sharks as a living resource. This provides a vital incentive for dive operators and other economically impacted groups to lobby forcefully to restrict fishing, at least in their own areas, creating impromptu sanctuaries which can serve to replenish other areas if effective management is ever achieved over larger areas.

It is true that fishermen have on a few occasions been foolish enough to target what may or may not be artificially created aggregations of sharks at feeding areas (no one has ever shown that sharks are in fact drawn to feeding sites from very far away, or occur there in greater concentrations than on similar reefs elsewhere). In the case in the Bahamas, to which Dr Burgess refers, the response from the operators affected has resulted in long-lining for sharks being banned in the entire country. The result was that the remainder of the sharks in the country were saved, whereas they would have been decimated if the long-liners had not made the mistake of making their first sets in the feeding areas. Sharks from adjacent areas have since migrated onto the reefs where the feedings occur, and the shark feeders are back

in business. If there had been no shark feeding, there would now be essentially no sharks left in the Bahamas, as nobody else made the effort to have the fishing stopped. [*Other conservationists active in the Bahamas may disagree! Editors' note.*]

No one has yet done a study to determine how much of any of the attracted sharks' energy requirements are met by the artificial feedings. Even at "Stingray City", where feedings occur all day, every day, the stingrays are observed feeding naturally in the sand. At the feeding site where Dr Burgess did his dive, informal observations indicate that a few dominant sharks do most of the feeding, and many of the sharks present do not feed at all.

A number of writers have pointed out that we have learned that it is not a good idea to feed bears. I agree, but would beg these writers to admit that it might have been a good idea to feed them at one time. Prior to feeding them, we were shooting them. It was probably necessary to 'tame' them temporarily, with the well-known adverse results, in order to get enough public appreciation for them to be able to manage them properly as desirable but potentially dangerous wildlife.

A similar progression has occurred in the sport-diving world with regards to moray eels. Not too long ago, they were considered 'monsters of the deep', and a threat to every diver. When spotted by any diver of the 'excess testosterone' variety (90% plus in those days), eels were instantly killed with a spear or 'bang stick'. After a few eels were tamed with hand-feedings and posed for 'cuddly pet' pictures with divers, the public image changed and feeding became the rage. Over time, and after a number of serious injuries, resulting in loss of fingers, hands, and lips, divers came to realise that conditioning such near-sighted predators to associate humans with food was not a good idea, and in most areas eel-feeding has been given up. However, divers have not lost their appreciation of morays as beautiful non-aggressive animals, and as a rule no longer spear them.

However, morays have little economic value as fisheries products. Such is not the case with sharks. Worldwide, sharks are threatened with the most determined, widespread, and intensive extermination effort aimed at any group of animals since the great whales were driven to the brink of extinction. Many cetologists disdain the disturbance to the natural behaviour of cetaceans caused by whale-watching, but accept it as necessary to achieve a constituency and an economic value for live whales. Likewise we should embrace shark-watching (of necessity based on artificial attraction with bait) as the most likely salvation of many populations of these slow-growing and slow-reproducing animals. The time will come to give up feeding sharks for tourists, and I will applaud when it does, but that time has not yet arrived. The public's attitude towards these magnificent predators is going through a process of enlightenment – a process which has already been completed with whales (also feared and loathed at one time), bears and morays, and should not be interrupted before a consensus for conservation is achieved.

Finally, I disagree with Dr Burgess's contention that public aquaria accomplish this goal in a superior, or even adequate fashion. Many of them advertise their feeding times, and promote the 'feeding frenzy' impression as much or more than shark dives. The spectators still believe that if they fell into the shark tank, they would be instantly consumed, whereas divers at shark feeds learn otherwise. I agree heartily that dive operators should and must be more honest with their customers about the occurrence (as opposed to the 'possibility' – which they do admit) of accidents. I believe that most of their customers would readily accept the small risk involved.

Doug Perrine, Innerspace Visions, 75-1027 Henry Street, Suite 444, Kailua-Kona, HI 96740-3137, USA.
Fax: (+1) 808-329-6659. Email: <perrine@kona.net>

Recent sawfish records

With sightings of sawfish, *Pristis* and *Anoxypristis* species, becoming increasingly scarce, these photographs are unusual recent records. They also illustrate graphically the main reason for the decline in this group of elasmobranchs – bycatch in other fisheries, possibly exacerbated by the extremely high value of sawfish products in trade.

Isla Mujeres, Quintana Roo, Mexico

This photograph of *Pristis perotteti* was first published in the Newspaper *Novedades of Quintana Roo, México* on 17 August 1997, a few days after the sawfish was landed by artisanal fishermen. It was reported because sightings are now so very rare in the area (fishermen say that they were very abundant in coastal waters 30 years ago). Unfortunately no researchers examined the specimen, but the fishermen said it was 5.4 m TL and 800 kg, and had two uteri with about 80 eggs.

Photo: Ovidio López Méndez.

This information was provided by fisheries biologist Leonardo Castillo-Géniz, who has never seen a sawfish despite 15 years working with artisanal fishermen in the region. For more information contact him at Instituto Nacional de la Pesca, Pitágoras No. 1320, 4º Piso, Col. Santa Cruz Atoyac, Distrito Federal, C.P. 03310, México. Fax: (+5) 604 4887. Email: <leonardo_castillo@infosel.net.mx>

East Malaysia (Borneo)

This is a copy of a black and white photograph seen by Scott Mycock and Rachel Cavanagh in a Chinese shop in Sarawak this year. The sawfish (probably *Pristis microdon*) was caught a few years ago in the sea near Sibu, a town on the Batang Rajang river.

Other photographs, taken by Mycock in a Chinese shop in Sandakan, Sabah, show two sawfish tail fins, the larger about 90 cm long. While sawfish products, including saws, on display in Chinese shops in Sabah are usually marked 'not for sale', this single fin was clearly marked with a price: RM 8,888. Eighteen months ago this would have been equivalent to about US$3,000, but at today's exchange rate, the fin would cost about US$2,300. Such a high value product is likely destined for international trade.

Sarah Fowler

International Plan of Action for the Conservation & Management of Sharks[1]

Andrea Oliver, Glenn Sant and Sarah Fowler

Background

In 1994, the 9th Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) adopted a Resolution on the Biological and Trade Status of Sharks in response to growing concerns that some shark species are overexploited due to increases in the international trade in shark parts. *Inter alia*, this Resolution requested FAO and other international fisheries management organisations to establish programmes to collate biological and trade data on sharks in cooperation with all nations utilising and trading shark products.

In response to the issues highlighted during implementation of the CITES resolution, members of the FAO Committee on Fisheries (COFI) requested in 1997 that FAO, in collaboration with the governments of Japan and the United States, organise an expert Consultation on the conservation and management of sharks. The objectives of the Consultation were:

- to determine the specific requirements for sustainable global and regional management of shark species;
- to develop guidelines for such management; and
- to develop a Plan of Action aimed at promoting the widespread use of these guidelines by appropriate management bodies and arrangements at national, regional and/or international levels.

In late 1997 a series of workshops developed regional strategies for shark conservation and management, and contributed to background information presented to the April 1998 meeting of the Technical Working Group in Tokyo, to the Guidelines currently in preparation, and to the Draft International Plan of Action for Sharks.

Aims of a National Shark-Plan

- Ensure that shark catches from directed and non-directed fisheries are sustainable.
- Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use.
- Identify and pay special attention, in particular, to vulnerable or threatened species.
- Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States.
- Minimise unutilised incidental catches of sharks.
- Contribute to the protection of biodiversity and ecosystem structure and function.
- Minimise waste and discards from shark fisheries in accordance with paragraph 7.2.2.g of the Code of Conduct for Responsible Fisheries (e.g. requiring the retention of sharks from which fins are removed).
- Encourage full use of dead sharks.
- Facilitate improved species-specific catch and landings data and monitoring of shark fisheries.
- Facilitate the identification and reporting of species-specific biological and trade data.

October 1998 Consultation

Following a preparatory meeting in July 1998, at FAO in Rome, the Consultation culminated at the end of October, when world governments met in Rome to discuss the Management of Fishing Capacity, Shark Fisheries, and Incidental Catch of Seabirds in Longline Fisheries. The meeting considered and finalised text of International Plans of Action (IPOA) for sharks and seabirds, and agreed Elements of an International Instrument for the Management of Fishing Capacity. These documents will be submitted for endorsement by consensus at the FAO COFI meeting in February 1999, and adoption by the FAO Conference in November 1999.

Heading the IUCN delegation to the October FAO Consultation was John Waugh (IUCN Washington), with other delegation members Sarah Fowler (co-chair IUCN Shark Specialist Group) and Glenn Sant (TRAFFIC network). Other Shark Specialist Group members, including Mathieu Ducrocq (IUCN Mauritania), attended as part of some FAO member State delegations. The CITES Secretariat and Animals Committee was represented at the meeting.

Following much debate, States eventually reached a consensus on the text for the IPOA for the Conservation and Management of Sharks. The IPOA-Sharks finally agreed consists of an introduction, guiding principles, framework, objective, procedures for implementation (consistent with the Code of Conduct for Responsible Fishing), and Appendices listing the suggested contents of a Shark-Plan and a Shark Assessment Report. (The text also refers to FAO *Technical Guidelines on the Conservation and Management of Sharks* by Terence Walker, now being finalised by FAO.)

The stated objective of the IPOA is "to ensure the conservation and management of sharks and their long-term sustainable use". The introduction acknowledges the increase in effort and catch of shark fisheries over the past few decades and that shark life histories make them susceptible to overfishing. It notes that the current state of knowledge of sharks and shark fishery practices causes problems in the conservation and management of sharks due to the lack of available catch, effort, landings and trade data, as well as limited information on biological parameters and difficulties with species identification.

The IPOA encourages States to assess the state of shark stocks within their EEZs and those fished on the high seas. States should then determine if there is a need for them to develop a National Plan of Action for conservation and management of shark stocks (*Shark-Plan*). National plans are called for if (a) directed shark fisheries exist, and / or (b) if sharks are regularly caught in non-target fisheries. If, after their initial assessment, a State determines there is no need for a *Shark-Plan*, it should review that decision regularly, but as a minimum collect data on catch, landings and trade.

States are asked to report to FAO on the assessment conducted, and to present biennially (when reporting under the Code of Conduct), a brief summary of the Shark-Plan and its progress, or the results of the assessment that concluded no plan was needed. This information will be made available to all concerned States.

States are also encouraged to cooperate and where appropriate develop regional Shark-Plans through regional and sub-regional fisheries management organisations or arrangements, and other forms of cooperation. The FAO Secretariat is directed to support the implementation of the IPOA-Sharks, including the preparation and implementation of Shark-Plans by States, through technical assistance projects. States are requested to have a Shark-Plan in place by the COFI Session in 2001. The resources to be made available to FAO will be discussed when the IPOA is presented to COFI in 1999.

Conclusions

The FAO IPOA is an important first opportunity to gain control of overfishing occurring in many shark fisheries. While entirely voluntary in nature, it identifies the actions needed for effective conservation and management of sharks. The number of States who have not only made the initial assessment under the IPOA, determining if there is a need for a Shark-Plan, but have also implemented a Shark-Plan by 2001, will reflect its success. This may have ramifications for future actions under CITES. The next CITES meeting in Kenya in 2000 will review progress under the Resolution.

For more information

Reports of the Technical Working Group, the Preparatory Meeting held in July, and papers for the October Consultation are posted on the FAO Fisheries website at http://www.fao.org/waicent/faoinfo/fishery/faocons/faocons.htm.

[1] *Throughout this page, the term 'sharks' includes rays and chimaeras.*

Fisheries effects and management of North Sea rays

Paddy Walker, Netherlands Institute for Sea Research, Texel

Long-term trends in abundance and changes in growth and maturation have been identified in the ray populations in the North Sea (Walker 1998). Although it is not possible to attribute these unambiguously to effects of fishing, there is certainly circumstantial evidence that exploitation has played a major role.

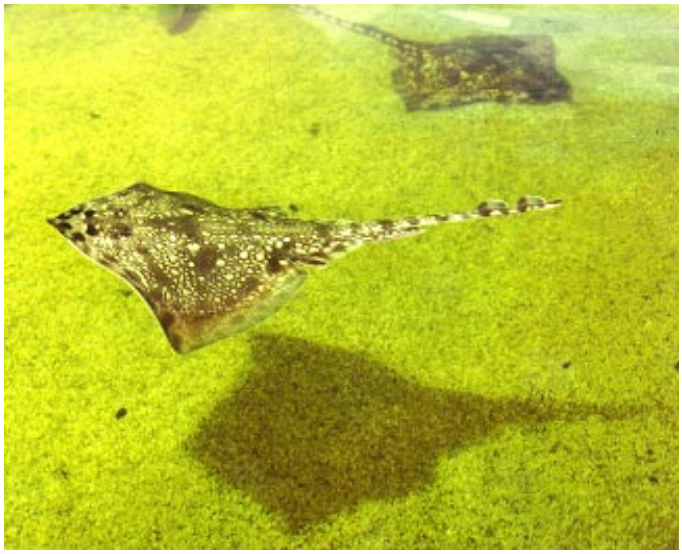


Photo: P. Penning

Species composition, growth and maturation

The species composition of ray populations has changed in such a way that those species most sensitive to enhanced mortality (e.g. common skate *Raja batis*) have severely declined in numbers, while more resilient species (e.g. starry ray *R. radiata*) have increased (Walker and Hislop 1998). Changes in growth and maturation have been ascertained for thornback *R. clavata* and starry rays which are indicative of a decrease and increase, respectively, in density (Walker and Witte, submitted). These observations fit expectations predicted by matrix modelling (Brander 1981, Caswell 1989).

Size

Additional evidence for fisheries effects can be seen in the change in length distributions. The length distributions of all species, with the exception of the starry ray, have shown a shift over time, with a paucity of fish above 80 cm now, whereas individuals of 100 cm and above used to be common (Walker & Hislop 1998). This indicates a major increase in total mortality, which is probably attributable to fishing. Moreover, this has meant a loss of all or some of the reproducing females for the larger species (common skate and thornback ray).

Catch composition

Official catch statistics decreased during the 1930s and again between 1955 and 1975, following a period of recovery during the Second World War. Since the mid-1970s catches have remained stable (Walker & Heessen 1996). As the common skate has become virtually extinct, this catch supposedly consists largely of thornback rays and to a lesser extent of spotted *R. montagui* and cuckoo rays *R. naevus*.

According to the surveys these three species have very limited distributions, which suggests that the fishery is able to maintain stable catches due to local strongholds in the population. Nevertheless, large areas have become void of the larger rays, which may be primarily caused by the extensive demersal fisheries in those areas.

Strongholds as sources of recruitment

The idea of strongholds, or sources, within the North Sea, where mortality (or emigration) is lower than natality (or immigration) (Pulliam 1988) is an appealing one from the point of view of replenishment of exploited stocks. The topography of the North Sea is highly heterogeneous and there are areas which are difficult to fish. Thornback rays, for example, are still found between the banks off the east coast of Britain and in deep, stony pits (i.e. Silver Pit). These and similar areas could function as sources of recruitment to the more exploited areas, but the very characteristic of a source (birth rate > death rate) makes it difficult to identify with classical methods.

This concept of sub-populations with different demographics, within the entire area of distribution of a species, needs careful evaluation before it can be ascertained to play a role in the North Sea ray stocks. The successful dispersal of individuals from one sub-population to the other is a necessary condition for the continued existence of the species in all suitable habitats.

In the case of individuals of the source population being removed faster than they disperse to the sink (e.g. by fishing), stocks decline (Pulliam 1988, Dias 1996). Moreover, the rate of movement from source to sink may be dependent on population size in the source (Holden 1974, Pulliam 1988). Therefore, if the source population is reduced then dispersal (and immigration to the sink) will also be reduced. Moreover, if the balance of birth and death rates is tipped, the source may become a sink and the entire stock can decline, unless another source is close by.

This illustrates the importance of identifying sources and sinks, and protecting at least the sources to maintain the spatial mosaic of habitat-specific demographic rates. Although abundance and migration data may indicate where particular sources may be found, information on local demographics is needed to identify the relationship between local sub-populations.

Fisheries management options

Tagging experiments indicate that rays are quite sedentary and form local sub-populations with limited exchange of individuals (Walker *et al.* 1997). This suggests that these local populations can be effectively protected by restricting fishing activities (closed areas). The current information on distribution and movement of rays may be used in selecting particular hotspots (Walker *et al.* 1997, Walker unpublished).

This will not, however, bring back the ray populations in other areas, where they once occurred regularly, because their decline or disappearance is mainly due to the total effort of the demersal fisheries. Consequently, to boost ray populations in the entire North Sea and improve conditions for the ray community, a significant reduction in fishing effort would be required.

In January 1998 a precautionary TAC (total allowable catch) for skates and rays (all species) of 6,060 metric tonnes was introduced in the North Sea. This level is based on landing statistics from the past 5 years. The precautionary nature of the TAC is from the point of view of allotment of fishing rights in the North Sea, and not necessarily from a biological perspective (ICES, in press). It is unlikely that the TAC will have a positive effect on ray population size. In this respect an embargo on ray landings would be the most effective way of reducing the mortality on the species.

Need for urgent action

The current level of mortality experienced by skate, thornback and spotted rays, is higher than that of the replacement mortality. The status of ray and skate stocks in the North Sea as identified by the ICES Advisory Committee for Fisheries Management (ICES 1998)

ranges from almost extirpated (common skate) to within safe biological limits (starry ray). The thornback ray and spotted ray stocks are estimated to be outside safe biological limits, and the cuckoo ray only marginally above (ICES 1998). Time is pressing, because if these stocks are not managed soon, some species may disappear completely.

References

Brander, K. 1981. Disappearance of common skate *Raia batis* from Irish Sea. *Nature*, 290: 48–49.

Caswell, H. 1989. *Matrices in Population Biology*. Sinaeur Associates, Sunderland, MA, USA, 328 pp.

Dias, P.C. 1996. Sources and sinks in population biology. *TREE* 11: 326–330.

Holden, M.J. 1974. Ray migrations – do bigger eggs mean better dispersal? *Proc. Challenger Soc.* 4(5), p. 215.

ICES 1998. Report of the ICES Advisory Committee on Fishery Management, 1997. *ICES Coop. Res. Rep.* No. 223.

ICES, in press. Report of the Study Group on Elasmobranch Fishes.

Pulliam, H.R. 1988. Sources, sinks and population regulation. *Am. Nat.* 132(5): 652–661.

Walker, P.A. 1998. Fleeting Images: Dynamics of North Sea Ray Populations. PhD Thesis, University of Amsterdam, 145 pp.

Walker, P.A. and H.J.L. Heessen, 1996. Long-term changes in ray populations in the North Sea, *ICES Journal of Marine Science*, 53: 1085–1093.

Walker, P.A. and J. Hislop, 1998. Sensitive skates or resilient rays? Spatial and temporal shifts in ray species composition in the central and north-western North Sea between 1930 and the present day. *ICES Journal of Marine Science* 55: 392–402.

Walker, P.A., Howlett, G. and Millner, R. 1997. Distribution, movement and stock structure of three ray species in the North Sea and eastern English Channel. *ICES Journal of Marine Science*, 54: 797–808.

Walker and Witte, submitted. Variation in age and size at maturity of North Sea rays in relation to growth.

Paddy Walker, Netherlands Institute for Sea Research,
PO Box 59, 1790 AB Den Burg, Netherlands.
Fax: +31 222 319674. Email <paddy@nioz.nl>

Dark clouds on Mediterranean elasmobranchs: the case of endemic skates

Giuseppe Notarbartolo di Sciara wrote to express concern over the status of some of the 78 elasmobranch species known to occur in the Mediterranean Sea.

Lack of knowledge of many of these species, due to the absence of serious and consistent data collecting, may be conspiring with the well-known problem of overfishing in the region, particularly as far as bottom trawling is concerned, to negatively affect marine biodiversity. Many of the least common batoid species, for example, such as the Lusitanian cownose ray *Rhinoptera marginata*, the darkspotted stingray *Himantura uarnak*, and the small-tooth sawfish *Pristis pectinata*, have not been reported in the scientific literature from the Mediterranean for many years, in some cases decades.

The greatest concern obviously goes to those species which are endemic to the region, such as the maltese skate *Raja melitensis*, the speckled skate *R. polystigma*, and Rondelet's skate *R. rondeleti*, all of which may have disappeared altogether, as far as one can tell. There is an urgent need for a greater attention to elasmobranchs from fishery statisticians, a greater ability and willingness to identify specimens in the catches to the species level, and more communication among scientists working on cartilaginous fishes throughout the region.

For more information contact: Dr G. Notarbartolo di Sciara,
ICRAM (Istituto Centrale per la Ricerca Applicata al Mare),
via di Casalotti 300, 00166 Roma, Italy.
Fax (+39) (6) 61550581. Email: <disciara@tin.it>

Atlantic skates under threat of extinction

The North Sea and Mediterranean are not the only areas within which larger skates may be under threat of extinction as a result of mortality through utilised or discarded bycatch in multi-species fisheries. Casey and Myers (1998) report on the retreat of the barndoor skate *Raja laevis* to the southern edge of its range in the Northwest Atlantic, and Dulvy and Reynolds (in prep.) suggest that several Northeast Atlantic endemics may be similarly under threat.

References

Casey, J. and R. Myers. 1998. Near extinction of a large, widely distributed fish. *Science* 281: 690–692.

Dulvy, N.K. and J.D. Reynolds. In preparation. How many more skates face extinction?

NAFO focus on Northwest Atlantic elasmobranchs

At their September 1998 Annual Meeting, Contracting Parties to the Northwest Atlantic Fisheries Organization (NAFO) adopted their Scientific Council's recommendations calling for improved training in identification and reporting of elasmobranchs and swift assessment of elasmobranchs in the NAFO Regulatory Area.

In response to the CITES resolution on shark data collection, the NAFO Parties agreed to expand the list of individually identified species of elasmobranchs included on NAFO data collection questionnaires and requested that the national authorities submit catch statistics with a maximum degree of detail.

Citing increasing interest in elasmobranchs worldwide, the NAFO Parties requested that analyses on the distribution and abundance of elasmobranchs be carried out and the results reported to the Scientific Council at the earliest opportunity.

The United States also requested that NAFO consider development of precautionary quotas for the skate fishery that occurs in NAFO waters.

NAFO's management purview includes all fishery resources except salmon, tunas, marlins, cetaceans, and sedentary species of the continental shelf in international waters of FAO Statistical Area 21. Contracting Parties include Bulgaria, Canada, Cuba, Denmark, Estonia, the European Union, Iceland, Japan, Korea, Latvia, Lithuania, Norway, Poland, Romania, Russia, and the United States.

Sonja Fordham

Spiny dogfish management proposed in US Atlantic waters

The Northwest Atlantic US population of spiny dogfish *Squalus acanthias* was declared 'overfished' by the National Marine Fisheries Service in 1998. A draft fishery management plan for the spiny dogfish fishery in US waters has recently been released for public comment through to 23 November 1998. The final management proposal can be obtained through the Mid-Atlantic Fishery Mangement Council (302-674-2331) by January 1999. Look for an article on dogfish management in the Atlantic in the next issue of *Shark News*, and see page 12 of this issue for Canadian initiatives.

Shark cartilage and cancer

Journal of Clinical Oncology, November 1998, contains the results of a three-month study of shark cartilage conducted by the independent Cancer Treatment Research Foundation (Arlington Heights, Illinois) on terminally ill cancer patients. The team of investigators concluded that shark cartilage did nothing to slow their disease or to improve their quality of life.

Commercial landings of sharks in south-western England

Philip Vas and Teresa Thorpe

Commercial fisheries can have a significant impact upon the status of elasmobranch populations (Anon. 1997). Consequently it is important that any fisheries which land such species, either as a directed catch or as by-catch be strictly regulated. To regulate such fisheries, it is important to have not only the biological data on which to build a management plan, but also to maintain accurate species-specific records of landings for monitoring purposes (NMFS 1997). Unfortunately, in many parts of the world, this information is all too frequently lacking.

The north-east Atlantic, FAO Fishery Area 27, contributes roughly one-tenth of the world's total elasmobranch landings. One of the major elasmobranch fishing countries in this region is the United Kingdom, with average annual elasmobranch landings in excess of 25,000 tonnes/year, of which 67% are sharks (Bonfil 1994). The principal shark species taken in the UK are the spurdog *Squalus acanthias*, lesser spotted dogfish *Scyliorhinus canicula* and the bull huss *Scyliorhinus stellaris*. A number of other species are known to be taken, but official figures currently fail to differentiate between them, reporting them collectively under the heading of "dogfish". Furthermore, these figures do not include details of by-catches or discards and thus the true landings are likely to be somewhat higher.

In 1995 and 1996, recreational 'tag and release' shark fishing tournaments were held in the Cornish city of Penzance in the far west of England. During these tournaments, it was possible to conduct some observations on elasmobranch landings at the nearby fishing port of Newlyn, one of the most important and oldest ports in the UK. From these initial observations, it was evident that a wide range of elasmobranch species were taken and that different species were susceptible to different gears. These preliminary observations formed the basis for a more detailed and thorough survey of the fisheries at Newlyn conducted between 1997 and 1998.

The port of Newlyn and its fisheries

Newlyn is situated one mile west of Penzance and around seven miles east of Lands End. Consequently, it is the most western of the major ports in southern England and has ready access to both coastal and deeper, offshore waters of the Celtic Sea and Bay of Biscay.

The port is home to a large fleet of vessels ranging from 8 to 20 m in length and between 11 and 40 GRT in weight. The smaller vessels primarily work inshore grounds, usually either trawling or crabbing, with some occasionally fishing using longlines. These vessels operate on a daily basis, returning to port to land catches at night.

The larger vessels are either gill netters which target hake *Merluccius merluccius* and monkfish *Lophius piscatorius*, or beam trawlers targeting a wide variety of flatfish and shellfish. One or two of the larger vessels occasionally fish using demersal longlines set for conger eels *Conger conger*. These larger vessels operate further offshore on extended trips of five to seven days, occasionally as far out as the Bay of Biscay. During the summer months, several of the vessels specifically switch to driftnets in order to work the profitable tuna grounds in the Bay of Biscay, with trips lasting around 15 days.

The port of Newlyn is also important in that it is a major fish market, receiving landings by road from as far afield as Newquay, Padstow and many of the smaller Cornish fishing villages for sale. Thus, observations of landings made here are truly representative of those for the whole south-west of England.

Detailed shark landings

All of the fisheries were observed to land sharks at one time or another during the study period. Those that landed sharks as a by-catch were considered to be 'incidental fisheries', while those targeting sharks were considered 'directed fisheries'.

A total of 11 different species of shark were recorded during both the preliminary observations and study period. Spurdog and catsharks (*Scyliorhinus* spp.) were the most abundant of all sharks taken and were present in landings throughout the year. Spurdog were usually taken in association with gill nets or bottom-set longlines and were considered a targeted species by some vessels. In contrast, the catsharks were taken closer inshore, usually by trawlers, and were considered a by-catch. Few catsharks were sold on the market for human consumption, with the majority (90% of those observed) being sold for bait to commercial crab fishermen. As the landings of spurdog and catshark are recorded by the Ministry of Agriculture, Food and Fisheries in the UK, little else will be said of their landings at this point.

Of the remaining species, blue shark *Prionace glauca*, tope *Galeorhinus galeus* and porbeagle *Lamna nasus* were the most abundant. Three species were represented by single specimens in the catches: two from tuna vessels, the bigeye thresher *Alopias superciliosus* and the kitefin shark *Dalatias licha*, while the starry smoothhound *Mustelus asterias* was taken in a gill net. One species, the sixgill shark *Hexanchus griseus*, was found to be surprisingly abundant in the landings, appearing regularly in gill net catches during the late summer and autumn.

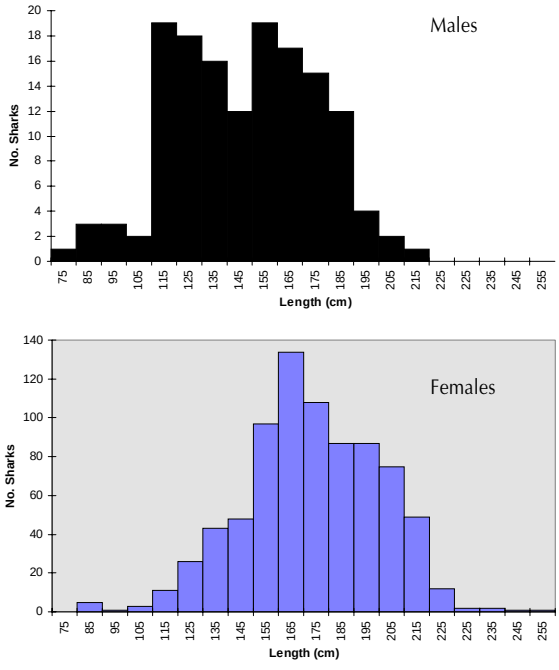


Figure 1. Length of male (top) and female (bottom) blue sharks landed by inshore fisheries

Inshore shark landings

Blue sharks

Of the larger sharks, the blue shark was the most commonly landed species, being taken on a variety of gears. Some were taken on bottom set longlines with some individuals taking the baits on the way down, others while the gear was set in 40–50 m of water. A small proportion were caught in gill nets, set close to the bottom in 50–70 m of water. In both instances, these sharks were considered a by-catch.

The greatest proportion of blue shark (excluding tuna catches) were taken on lines set specifically for the sharks. Off the Cornish coast, it is common practice for fishermen to set lines attached to the dahns on the ends of the nets. These lines support 5–8 hooks, each baited with squid, and are designed to catch the blue sharks which are locally abundant between May and October. The blue sharks, although targeted with these hooks, do not form the principal catch of the fishery

(which is the hake, taken in the nets), but are regarded by the fishermen as a bonus catch. Thus the sharks represent an 'accessory catch' to the net fishery.

A total of 796 blue sharks were observed, 86% of which were females. Males ranged in length from 72 to 214 cm TL while females were from 88 to 251 cm TL. The average size of male sharks was always less than that of females.

Landings of sharks were made as early as June and, rather surprisingly, as late as December when a group of very small females 88–130 cm TL were caught. No blue sharks were caught in November, during a period of bad weather which restricted fishing. Sixty-seven percent of all blue sharks caught were taken in July and August 1997.

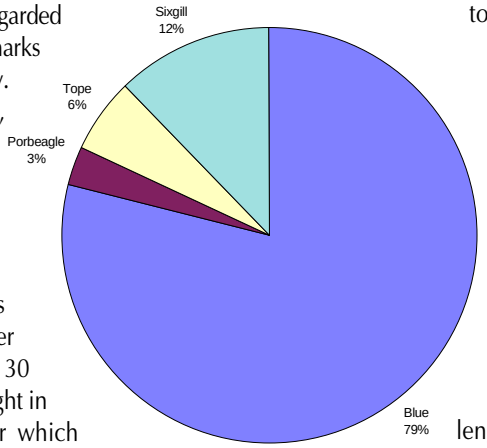


Figure 2. Relative landings of sharks from inshore fisheries by species.

Porbeagle sharks

Porbeagle sharks were landed on a regular basis, with all being landed as a by-catch from gill nets. None were taken on longlines. A total of 31 porbeagles were observed although a number of others were landed when no observer was at the market. Males and females occurred in roughly equal proportions (15 males, 16 females), though again males were slightly smaller (71–210cm TL) than females (101–244cm TL).

No evidence of seasonal abundance was apparent in the landings, with roughly equal numbers being taken in all months. Unlike the blue sharks which are gutted at sea and fetch a low price at the market ($0.50\lb), the porbeagles were highly prized, landed ungutted and sold for a much higher price (up to $2–3/lb) at auction. Many were exported to France after sale.

Tope sharks

A total of 59 tope were landed during the study. All were taken in gill nets set in at least 60 m of water and were landed in an ungutted condition. While examining boxes in the market, several tope were found mixed in with spurdogs and so were not readily visible. Whether they had been recorded separately by the skippers or Ministry of Agriculture, Food and Fisheries (MAFF) officers is not known. The observers themselves may have missed some individuals as several landings of spurdog could not be checked. Consequently, it is likely that the figures for tope are an underestimate of those actually caught.

Of the tope observed, 59% were males ranging in length from 44 to 148 cm TL, while the females ranged from 81 to 157 cm TL, with an overall larger average size. There was a noticeable seasonal change in the sex ratio of the landings, with males becoming more abundant than females later in the year.

Six-gill sharks

This species was rarely landed as it has no effective market value. Consequently, those taken as a by-catch in gill nets were usually discarded at sea. However, once the fishermen knew that the observers were interested, records were kept of numbers caught. During the study, a total of 123 records were provided. Of those that were returned to market (primarily for the observers interest), all were females ranging length from 78 to 161 cm TL. Catches of this species were more common in the western approaches and there was some suggestion of localised abundance, with skippers catching either isolated specimens or large hauls (up to 60 sharks).

Offshore tuna landings

During the months of July and August each year, up to five of the larger vessels (18 m in length), changed from gill nets to drift nets and prosecuted the tuna fishery in the Bay of Biscay (40–51°N, 10–15°W). Fishing for 8–10 days with nets of 2.5 km, these vessels took large by-catches of sharks, primarily blue shark. As these sharks were not the targeted species and took up valuable space in the hold, many were discarded. An on-board observer programme in 1995 indicated a discard rate for blue sharks in this fishery of 37% (Tregenza 1995).

A total of 588 blue sharks were landed from five tuna trips observed. Individual catches ranged from 96 to 180 sharks with the number varying depending on the quality of the tuna fishing. Generally more sharks were landed when tuna were scarce. Males ranged in length from 115 to 253 cm TL and accounted for 46% of the landings but were generally smaller than the females (105–222 cm TL). There was a slight variation in sex ratio of the catches between vessels, attributed to geographical differences in fishing locality.

Two other species of shark were regularly (i.e in more than one trip) taken as a by-catch, the porbeagle and shortfin mako *Isurus oxyrinchus*. Unlike the blue sharks, because of their high market value, 100% of these species were retained. In 1997, three makos were observed (two males and one female, 117–172 cm TL). Higher numbers are known to have occurred in previous years. For porbeagle shark, a total of 12 specimens were observed (seven males 88–217cm TL, five females 102–212 cm TL).

From these data it is clear that the blue shark represents the principal elasmobranch by-catch from this fishery. However, the British vessels represent only a relatively small proportion of the effort expended in the tuna fishery. Larger numbers of Spanish and French vessels also prosecute this fishery, previous studies indicating total by-catches of blue sharks in excess of 82,000 sharks in 1993.

The study has extended our knowledge of the regional biology of various shark species and has also thrown up several new problems. For example, why do commercial fisheries catch male blue sharks while recreational fisheries in the same waters do not? It has also shown that blue sharks may remain longer in British coastal waters than was thought. Previous studies suggested few if any sharks, remained as late as October. And finally, the study has shown that the six-gill shark is comparatively abundant and the area may provide an opportunity for an extended study of this species.

This study has demonstrated the relative susceptibility of sharks to fisheries in the NE Atlantic and given some indications of which areas need consideration. It is clear that drift net fisheries produce the highest mortality upon shark populations in this region. Monitoring of these fisheries will continue through 1998–1999, but additional studies will focus on technical methods of reducing the by-catch from such fisheries.

References

Anon. 1997. An Overview of the impacts on the biological status of sharks. Discussion Paper Pursuant to CITES Resolution CONF. 9.17.

Bonfil, R. 1994. Overview of world elasmobranch fisheries. FAO Fisheries Technical Paper 341.

National Marine Fisheries Service 1997. Managing the Nation's Bycatch: Priorities, Programs and actions for the National Marine Fisheries Service. US Dept of Commerce, Washington DC, March 20, 1997.

Tregenza, N. 1995. Cetacean bycatch in the UK tuna driftnet fishery in 1995. Contract Report to the Ministry of Agriculture, Fisheries and Food. P639.2/11,95. Science & Environment Section. House of Commons Library.

A more detailed account of this study is in preparation: Commercial and recreational landings of sharks in SW England, *Aquatic Conservation*.

Philip Vas, c/o 15 Woodlands Ave, Peel Green, Eccles, Manchester, M30 7GN, UK. Email: <106370.1164@compuserve.com>

Australia's southern shark fishery goes spatial

André Punt, CSIRO Division of Marine Research, and Terry Walker, Marine and Freshwater Research Institute, Australia

Introduction

The fishery for school shark *Galeorhinus galeus* off southern Australia has operated for about 70 years. During that time, it has developed from a fishery based in Bass Strait and off eastern Tasmania to one that now extends through South Australia to about 100 miles into southern Western Australia (Figure 1). Trends in catch rate for different parts of the fishery differ substantially, even though tagging studies have shown that some school sharks are capable of long distance migrations.

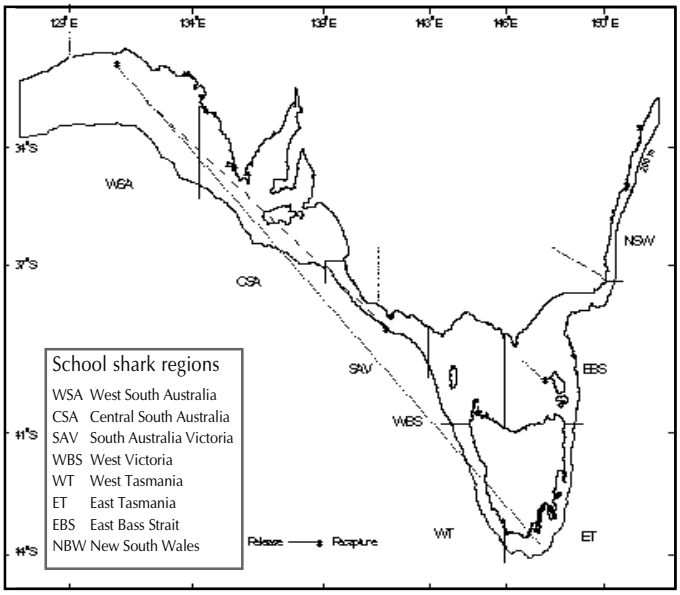


Figure 1: Map of southern Australia showing current location of the southern shark fishery, the eight regions, and tag & recapture locations for three tagged school sharks.

An assessment of the school shark stocks in southern Australia is currently being revised using a model that makes the spatial-structure of this fishery explicit. The Southern Shark Fishery Assessment Group (SharkFAG) has developed the model and is considering a variety of alternative hypotheses in a cooperative manner. SharkFAG consists of biologists, modellers, shark fishers, an economist and the manager of the Southern Shark Fishery. This cooperation has meant that the assessments and their results have considerably greater support than would have been the case if scientists did the analyses without external input.

Overview of the model

Like previous assessments of these stocks (e.g. Punt and Walker 1998), the model is designed to capture the underlying peculiarities of shark populations and fisheries by considering multiple gear-types (hooks, and various sizes of gill-nets) and by explicitly modelling the pupping and recruitment processes.

For modelling purposes, the fishery has been divided into eight "regions" (Figure 1) based on the size/age-structure of the population and the history of exploitation. The model allows for multiple stocks to enable consideration of a wide range of hypotheses regarding stock-structure and movement. A recent extension to the model allows sharks from New Zealand to move to Australian waters. In this extension, New Zealand sharks therefore form part of the Australian catch. This extension was motivated by the large number of recaptures in Australia of school sharks tagged in New Zealand.

The model uses a monthly time-step to mimic shark movement dynamics effectively. Movement is modelled as being the probability of a shark of a given age and stock in a given region moving to another region. The movement probabilities are currently selected to represent both large-scale pupping and feeding migrations as well as random movement. The initial choices for the movement probabilities are based on the output from an individual-based movement model that operates on a daily time-step and considers movements among 1° square blocks (Taylor 1997a, b). The assessment model incorporates features that permit these initial probabilities to be modified to fit the data better.

Data included in the model

Previous assessments of school shark have been based on either tagging data (e.g. Olsen 1954, Grant *et al*. 1979) or on trends in catches and catch-rates (e.g. Punt and Walker 1998). However, the current assessment incorporates all of these sources of information and, because of its spatial nature, fits the model to trends in catch-rate by region rather than to the trend in catch-rate aggregated over the whole fishery. Although not currently included in the model, the possibility exists for incorporating data on the size-/age-structure of the catch and trends in the mean mass of sharks in the catch.

Results and further work

Given the model's complexity, it is important to select ways in which to summarise the model output succinctly yet in an easy to follow manner. Currently, the results are presented as tabular or graphical summaries, but work is underway to develop a graphical interface to the model along the lines suggested by Walters (1995).

Figure 2 shows fits of the model to trends in catch-rate for the four regions for which reliable effort data are available. The model-estimates of catch-rate differ among the regions because of differences in the underlying population structure and the mix of gear-types used in each region. Plots of observed and model-predicted tag returns (by year, and by the distribution of recaptures among regions) give further confidence in the ability of the model to mimic the actual data and hence make reliable predictions.

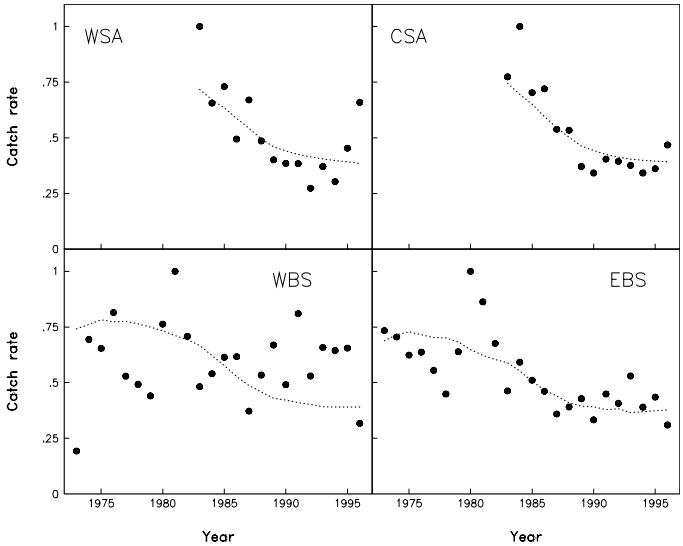


Figure 2: Observed (solid dots) and model-predicted (dotted lines) catch-rates for four of the seven regions.

This modelling work has been conducted primarily to investigate the implications of spatial structure for the management of the resource. Another objective for developing a complicated model of school shark dynamics is to have a basis for testing the robustness of simpler assessment methods (Punt 1992) and to assess the value for management of additional monitoring (McDonald and Smith 1997). The model framework is relatively general and will be used in the future for an assessment of gummy shark *Mustelus antarcticus*.

References

Grant, C.J., Sandland, R.L. and A.M. Olsen. 1979. Estimation of growth, mortality and yield per recruit of the Australian school sharks, *Galeorhinus australis* (Macleay), from tag recoveries. *Australian Journal of Marine and Freshwater Research* 30: 625–637.

McDonald, A.D. and A.D.M. Smith. 1997. A tutorial on evaluating expected returns from research for fishery management. *Natural Resource Modelling* 10(3): 185–216.

Olsen, A.M. 1954. The biology, migration, and growth rate of the school shark, *Galeorhinus australis* (Macleay) (Carcharhinidae) in south-eastern Australian waters. *Australian Journal of Marine and Freshwater Research* 5: 353–410.

Punt, A.E. and T.I. Walker. 1998. Stock assessment and risk analysis for the school shark off southern Australia. *Marine and Freshwater Research 49(7)*: 553–572.

Punt, A.E. 1992. Selecting management methodologies for marine resources, with an illustration for southern African hake. *South African Journal of Marine Science* 12: 943–958.

Taylor, B.L. 1997a. Computer Software Tool for Displaying Tag Release-Recapture Data from the Australian southern shark fishery. p. 53–56. *In*: Fisheries Research and Development Corporation. Southern Shark Tagging Project". Walker, T.I., Brown, L.P., and N.F. Bridge (Eds) (Marine and Freshwater Resources Institute: Queenscliff, Victoria, Australia).

Taylor, B.L. 1997b. Movement modelling shell for the school shark (*Galeorhinus galeus*) in the Australian southern shark fishery. p. 57–61. *In*: Fisheries Research and Development Corporation. Southern Shark Tagging Project". Walker, T.I., Brown, L.P., and N.F. Bridge (Eds) (Marine and Freshwater Resources Institute: Queenscliff, Victoria, Australia).

Walters, C.[J.] 1995. Use of gaming procedures in evaluation of management experiments. *Canadian Journal of Fisheries and Aquatic Science*. 51: 2705–2714.

André E. Punt, CSIRO Division of Marine Research, GPO Box 1538, Hobart, Tasmania 7001, Australia. Fax: (+61) 3 6232 5000. Email: <andre.punt@marine.csiro.au>

and

Terence I. Walker, Marine & Freshwater Research Institute, PO Box 114, Queenscliff, Victoria 3225, Australia. Email:<terry@msl.oz.au>

Sri Lankan shark fisheries

A news item circulated on the Internet in August 1998 indicated that the Sri Lankan National Aquatic and Resources Agency (NARA) had expressed an interest in recent international shark conservation and management initiatives stimulated by the 1997 meeting of the Convention on International Trade in Endangered Species (CITES).

Sri Lanka is reported to have an annual shark production of 8,000–9,000 tons, or 6% of the country's total fish output. The country's landings of sharks represent over half of regional landings from the Bay of Bengal, which are reported as just 11,000–13,000 tons. More than half of the Sri Lankan catch is of silky shark *Carcharinus falciformis*, a pelagic species now targeted by oceanic tuna fisheries. There are good markets for shark meat and fins in Sri Lanka and large sharks are reportedly now more profitable than tuna. Most of the country's other 45 recorded species of shark will also be landed, likely as bycatch in other fisheries. NARA reports that most of this catch is of juvenile sharks.

Whale shark fishery in India

A significant target fishery for whale shark *Rhincodon typus*, the world's largest living fish, has reportedly developed in India, at least partly to supply the growing external demand for whale shark fins and meat.

Whale sharks occur off the west coast of India between November and April each year, when large schools of sardines, mackerel, skipjack and yellowfin tuna, bonitos and frigate birds also visit these coastal waters. Whale sharks are used by fishermen as indicators of tuna aggregations in some regions.

The fishery is particularly active in March to April in Veraval and Okha, on the coast of Gujarat, but the species is also taken as bycatch in other maritime states. Gujarat is the major maritime state of India, with the longest coastline (1,640 km) and widest continental shelf (36% of India's continental shelf area).

Gujarat fishermen harpoon whale sharks ranging from 4 m to 12 m in length, or 2–8 tonnes weight, then haul them by boat (or *vice-versa*!) for up to 8–10 hours until the animal is exhausted, or the fishermen abandon the capture attempt. The shark is then towed alongside the fishing boat back to the shore, where the meat is cut up in shallow water, dried or frozen, and dispatched for resale.

The initial purchase price for fresh meat received by fishermen is low: Rs. 2–5/kg (at about Rs. 30–40 = US$1). The value of one shark has been calculated as about Rs. 6500 (US$160–200) before operational costs, or a net income of Rs. 4000 ($100–120).

Huge profits, however, are made by fish traders. The resale value of frozen whale shark meat for export to Taiwan, Korea, Hongkong and Singapore has reached Rs. 40, or US$1/kg. A set of four dried fins fetches Rs.15,000–17,000, or US$400–500. Customs records indicate that India exported about 200 tonnes of whale shark meat (excluding dried fins) in 1995/96.

The whale shark is a delicacy in Taiwan, where it is referred to as the tofu shark because of its soft, white flesh. Demand has risen in recent years, and whale shark meat is now the most expensive of the shark meats available in Taiwanese markets, where retail prices have reached US$15/kg (Chen *et al*. 1997). Export data from India show that whale shark meat is also exported to other East Asian markets, e.g. Singapore and Hong Kong.

Chen *et al*. (1997) have made several recommendations regarding the species' management and conservation in Taiwan. Bans on the fishing of whale sharks were introduced in the Maldives in 1993 and the Philippines in 1998.

The apparently low abundance and highly migratory nature of this species could mean that the whale shark's protected status in a few Indian Ocean countries (e.g. Maldives and the Philippines) and the valuable whale shark tourism industry in Australia, the Philippines, Maldives and Seychelles may be compromised by unregulated fisheries in other parts of the species' range. It is important to further study the fishery and trade in India in order to assess the impact on whale shark populations, and to determine whether regulatory or other measures are necessary in order to ensure the conservation of this species. TRAFFIC (WWF) India received a grant from the Rufford Foundation in 1998 to undertake such a study. The project will investigate trade in whale sharks and their products off the Gujarat coast, India. Field work will be started in October 1998 or later (weather permitting in this cyclone-prone area).

Reference

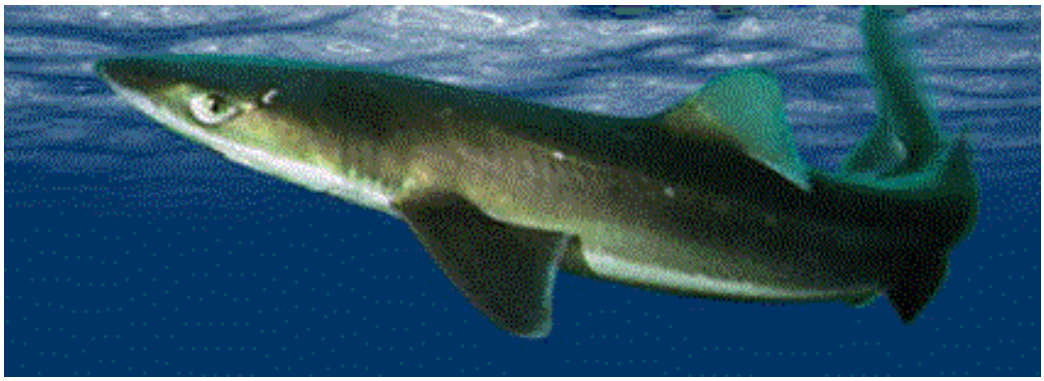
Chen, C. T., Liu, K.M. and Joung, S.J. 1997. Preliminary Report on Taiwan's Whale Shark Fishery. *TRAFFIC Bulletin* 17(1):53–57

Fahmeeda Hanfee, TRAFFIC (WWF)-India, 172-B Lodi Estate, New Delhi, 110003, India. Email: trfindia@del3.vsnl.net.in

Management and perceptions of spiny dogfish in Atlantic Canada

Christina Semeniuk, Concordia University, Canada, and Thomas Hurlbut, Assessment Biologist, Department of Fisheries and Oceans, Canada

Spiny dogfish *Squalus acanthias* off the east coast of North America may be in trouble. A recent (1997) assessment by the United States' National Marine Fisheries Service indicates that the spiny dogfish stock in the Northwest Atlantic has begun to decline due to recent increases in exploitation. Furthermore, it was shown that minimum biomass estimates of mature females have dropped by nearly 50% since 1990, a higher proportion of males are now being fished, mean lengths have rapidly begun to decline, and fishing mortality rates are much higher than what is considered sustainable.



Source: David Wrobel. Copyright © 1997 Discovery Communications, Inc.

Lack of management

Although these findings are mainly based on data from fisheries and surveys in US waters, they have serious ramifications for spiny dogfish that migrate into Canadian waters because all dogfish in the west Atlantic are considered to be a unit stock, and because Canadian fishers have their own view of the fishery and its status. There are no quotas or TACs to limit fishing for spiny dogfish in Atlantic Canada, or elsewhere, throughout the rest of the management unit (nor have there ever been).

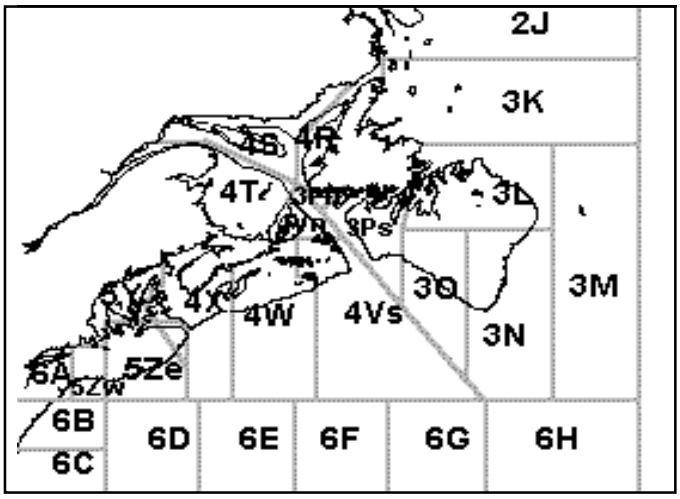


Figure 1. NAFO subareas 2–6.

In the southern Gulf of St Lawrence, where directed fishing for spiny dogfish began to increase in the mid-1980s, management measures have mainly been limited to the establishment of minimum fish sizes, minimum mesh and hook sizes, and daily by-catch limits for cod and white hake. Moratoria and quota reductions on the fisheries for traditional groundfish species in the southern Gulf and along the Scotian Shelf (i.e. cod, white hake, haddock, etc.) may have contributed to this increase in fishing effort directed at spiny dogfish [*as is the case in US waters to the south – Editor*].

In these two areas (NAFO subareas 4TVWX – see Fig. 1), landings of spiny dogfish have averaged about 950 tonnes per year since 1990, compared to the average 30 tonnes being landed annually during the early 1980s. Moreover, if more groundfish fisheries are closed, it is conceivable that fishing pressure will continue to increase on spiny dogfish – once considered the 'unlimited resource'.

The pest and the predator

Another serious threat to dogfish is their perception by fishers. Spiny dogfish are considered a nuisance by Atlantic fishers due to their destructive impact on fishing gear and predation and competition on/with commercially valuable groundfish species. Some Atlantic fishers believe that spiny dogfish may be responsible for the slow recovery of groundfish stocks that are under moratoria. Some also feel that dogfish have driven traditional groundfish species from some areas by either dispersing the stock, or, as is more widely believed, by eating a significant quantity of mature or pre-recruit fish [*there are data to refute this assertation – Editor*].

In essence, there are many commercial fishers that feel the numbers of dogfish should be reduced, either by means of eradication or a sustained dogfish fishery. Yet, as news from across the border informs us that spiny dogfish numbers are low, an eradication procedure seems unreasonable. And what exactly is a sustainable fishery for dogfish in Canadian waters? Needless to say, more biological data needs to be compiled, and joint assessment and management of this resource by Canada and the US needs to be considered.

Canadian action

For its part, the Department of Fisheries and Oceans (DFO) is presently trying to dispel/validate the claim that spiny dogfish predation negatively impacts groundfish species by carrying out stomach content analyses on dogfish collected during groundfish surveys in the NAFO 4TVWX subareas. Preliminary results of this study suggest that spiny dogfish in Atlantic Canada are primarily benthic, invertebrate feeders. As a more complete picture is formed, it is possible that some of the negative opinions and perceptions held by Canadian fishers will be changed, allowing for a more satisfying management plan to be devised for all parties involved – especially the spiny dogfish.

Further reading

Hurlbut, T., G. Nielsen, R. Hébert, and D. Gillis. 1995. The status of spiny dogfish (*Squalus acanthias*, Linnaeus) in the Southern Gulf of St. Lawrence. *DFO Atlantic Fisheries Research Document 95/42.*

Rago, P., and K. Sosebee. 1997. Spiny dogfish (*Squalus acanthias*). SAW-26 SARC Working Paper D1. NMFS Northeast Fisheries Science Center, Woods Hole, MA.

Christina Semeniuk, Concordia University, Canada.
Email: <ca_seme@alcor.concordia.ca> and
Thomas Hurlbut, Assessment Biologist,
Department of Fisheries and Oceans, Canada

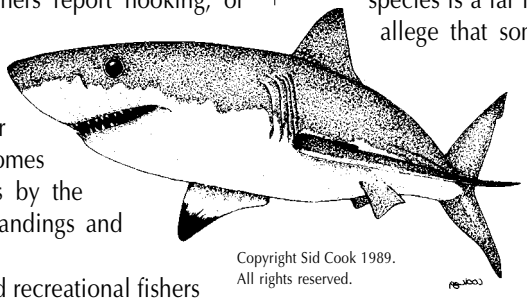
Great white shark news

Victorian waters a safe haven for white sharks

A 'declaration of protected aquatic biota' under the Victorian Fisheries Act 1995 on 4 August 1998 brought full protection to the white shark *Carcharodon carcharias* in Victorian waters. This declaration is designed to prevent people from killing, injuring or disturbing the species.

This together with two existing pieces of legislation effectively makes all waters within 3 nautical miles of Victoria a white shark sanctuary. Risk from accidental kill is minimised by a ban implemented 10 years ago on the use of shark gillnets and shark longlines in these waters. Unintentional disturbance is reduced by a ban adopted earlier this year on the use of mammal blood or any body part as berley (chum). These are significant initiatives for the conservation of this species because Victoria is an important area for white sharks. Both large and small white sharks occur here, although mid-sized animals between about 2.5 and 3.5 m total length appear to be less abundant.

There are signs that young white sharks aggregate and that their numbers are increasing in the region off the east coast of Wilson's Promontory near Ninety Mile Beach. Evidence for this comes from recreational fishers targeting snapper *Pagrus auratus* and other species of teleost over limestone reefs. These fishers report hooking, or attracting to their boats, white sharks of length less than 2.5 m during the spring and summer. Occasionally snapper are bitten off their hooks by small white sharks. Other evidence of small animals in the region comes from newspaper reports and observations by the author during the 1970s of commercial landings and research cruise catches.



Copyright Sid Cook 1989.
All rights reserved.

Anecdotal reports from professional and recreational fishers and divers indicate large white sharks aggregate at four Australian fur seal *Arctocephalus pusillus* breeding colonies in Victoria. These breeding colonies are at Lady Julia Percy Island, Seal Rocks, Kanowna Island and The Skerries. Seal biologist Robert M. Warneke observed and recorded seal pups in the stomachs of white sharks caught near Seal Rocks. During 1967–1969 he captured ten white sharks 3.5–4.5 m total length off Seal Rocks at various times of the year: January (2), March (1), April (1), June (1), August (1), September (1), October (1) and November (2). He also observed white sharks taking seal pups in the water and young seals ashore with shark bite wounds (pers. comm.).

Terence I. Walker, Marine and Freshwater Resources Institute, PO Box 114, Queenscliff, Victoria 3225, Australia

Moratorium on white shark research

The Chondrichthyan Working Group (CWG) within the South African Chief Directorate: Sea Fisheries recently recommended that research activity on white sharks in South Africa (including Dyer Island) should be controlled. The CWG, which includes all shark biologists of note in South Africa, has sent a recommendation through to the Chief Director of Sea Fisheries suggesting criteria to judge research proposals. It is anticipated that the CWG will control all future research projects.

This decision arose as a result of concern over the amount of harrassment being caused to a protected species by unregulated and unreviewed research activity, some of which could potentially cause injury to individual sharks, as well as interfering with their behaviour. It was made possible under the amended regulations of the new Marine Living Resources Act, which now makes it illegal to handle or attract white sharks.

In the mean time, Cape Nature Conservation has declared the area within a 500 metre radius of Dyer Island as a nature reserve. They have received some research applications and asked Sea Fisheries to make comments on their value. The CWG recommendation to Cape Nature Conservation was: "All research on white sharks in the reserve should be temporarily suspended until 1 November, pending the implementation of the new Marine Living Resources Act and pending discussion and finalization of other research proposals". In future, research proposals in standard format will be invited from all interested parties for examination by the CWG.

Commercial cage operators and filming teams must also apply for a permit and will be regulated by permit conditions and a Code of Conduct.

White shark exploitation in South Africa

Gans Bay, formerly a sleepy seaside dorp, is now undergoing a local boom thanks to its conversion into what has been described as 'the white shark dive mecca of the world'. At least six local cage dive operators are based in the town, and estimates indicate that activities related to cage diving contribute about five million Rand (US$885,000) to the local economy. Concerns over the regulation of white shark cage diving and research activity in the area are described in *Shark News* no. 11 and elsewhere on this page.

While there is no doubt that disturbance to white sharks by these user groups is a problem, the continued killing of this protected species is a far more serious issue. Some cage-dive operators allege that some local fishermen are clandestinely killing legally protected white sharks at sea, removing jaws and fins, and selling them to East Asian longliners. Overseas visitors have also quoted huge prices for white shark jaws and teeth. The large jaw of a Gans Bay shark, recently recovered after being stolen, was valued at US$50,000. Small jaws may be sold for as much as US$15,000 and individual teeth from small sharks for US$600. The South African Museum recently obtained the headless carcass of a newborn white shark (estimated at about 1.6 m long), found by a dive operator after reportedly being killed by a commercial fisherman.

Australia to propose white shark for CITES listing

Lobbying by Australian NGOs, including the Humane Society International (HSI), resulted in a pre-election promise from the Australian government to nominate the white shark for a CITES listing at the next Conference of Parties in the year 2000 in Kenya. Now that the government has been re elected, HSI has made a request for information about international trade in shark products to be provided for reference while developing the nomination proposal.

Beach meshing to continue in New Zealand

Beach meshing for sharks has been underway in Australia and South Africa for many years. However, it is not widely known that New Zealand also has a long-running programme in the Dunedin area. Recently, the Dunedin City Council reviewed the use of beach meshing during summer off three swimming beaches. The nets have been in use since 1969–1970, following three fatal attacks by white sharks over a four-year period. The Council has decided to retain the nets, in consideration of the following factors:

- greater concern for human life than shark life.
- the low number of sharks caught each year (19 on average in recent years).
- little evidence of significant harmful effects on the marine ecosystem.
- the excellent record of the shark nets (no attacks since 1971 – for whatever reason).
- the relatively low per annum cost of the programme (NZ$25,000).

The Council also decided to continue to require improved catch records from the contractor, as has been the case in recent seasons.

The shark and skate fishery in the Algerian Basin:
biological and technological aspects

Farid Hemida, Laboratoire Halieutique, ISN-USTHB, Algeria

The demersal and pelagic fisheries operating off the coasts of Algeria are multispecific (they take several species of fish at a time). Target species and fishing grounds have remained the same since the early 1960s. However, the fishing gears used have changed over the years. The traditional type of bottom trawl net, with a vertical opening of about 2 m in height, is still in use. This mainly targets blue and red shrimp *Aristeus antennatus* and deep-water pink shrimp *Parapenaeus longirostris* in deep waters, and striped red mullet *Mullus surmuletus*, red mullet *Mullus barbatus* and sparids in coastal waters. More recently, new trawlers have begun using a second kind of trawl net, the french net, which has a vertical opening of up to 10 m in height. Boats equipped with french nets have more powerful engines than boats which use the traditional trawl nets. French net catches include demersal and some pelagic species, like european pilchard *Sardina pilchardus*, european anchovy *Engraulis encrasicolus* and atlantic horse mackerel *Trachurus trachurus*.

Trawl fishing is permitted in the coastal waters of Algeria from August 31 to May 31. An intensive seine fishery also occurs throughout the year. This last fishing activity takes place very close to the shore, never more than 1 mile out to sea. The ring net boats spend no more than 12 hours at sea during fishing trips; the trawlers are out of port for 20 to 24 hours.

A survey was carried out in September 1982 to evaluate the size of stocks of small pelagic species. The estimation was up to 180,000 tonnes with a maximum sustainable yield of 30,000 tonnes. Small-scale fisheries catch littoral and demersal species and some big pelagic fishes such as tunas, swordfish and sharks (including blue shark *Prionace glauca*, bignose shark *Carcharinus altimus* and thresher *Alopias vulpinus*). Skates and demersal sharks are frequently taken by the trawls and form a large part of the biomass, especially the huge bluntnose sixgill shark *Hexanchus griseus*.

The elasmobranch survey

This project represents the first attempt to evaluate the dynamics of the abundance and mortality of the sharks and rays which represent an important part of fishing product in Algeria. These species are regularly present in the markets and are consumed like the other commercial fishes. However, until now no information about the biology and life cycle of these species has been available in this country, so it has been impossible to understand and predict the responses of their stocks to exploitation. Fish stock assessment data (e.g. total length, total weight etc.) have therefore been collected since October 1996. The length frequency distributions collected have yet to be separated into male and female records. However, length frequency distributions for three species have been broken down into normal components using the Bhattacharya's method (1967). The Von Bertalanffy growth parameters were then estimated for smallspotted catshark *Scyliorhinus canicula*, longnose spurdog *Squalus blainvillei* and gulper shark *Centrophorus granulosus*.

We started a systematic survey of elasmobranchs occurring along the Algerian coasts in 1996, recording the list of sharks and rays present during regular visits to fish markets. Sixteen species of sharks (from eight families) and eight species of rays (all genus *Raja*) have been recorded, using international identification keys (Bauchot and Pras 1980, Compagno 1984, Whitehead *et al.* 1986, Fisher *et al.* 1987). Those elasmobranchs appearing in commercial catches from the Algerian basin are listed in Table 1. Photos are available for most species, especially for *Carcharinus altimus*.

Table 1: List of the sharks and skates caught in the Algerian basin, by all types of gear (up to October 1997).

Order	Family	Species	Common name
Hexanchiformes	Hexanchidae	*Hexanchus griseus*	bluntnose sixgill shark
	Lamnidae	*Isurus oxyrhincus*	shortfin mako
	Alopiidae	*Alopias vulpinus*	thresher shark
	Sphyrnidae	*Sphyrna zygaena*	smooth hammerhead
Galeiformes	Carcharinidae	*Carcharinus altimus*	bignose shark
		Prionace glauca	blue shark
	Scyliorhinidae	*Scyliorhinus canicula*	smallspotted catshark
		Scyliorhinus stellaris	nursehound
		Galeus melastomus	blackmouth catshark
	Triakidae	*Galeorhinus galeus*	tope shark
		Mustelus mustelus	smoothhound
		Mustelus mediterraneus	blackspotted smoothhound
Squaliformes	Squalidae	*Squalus blainvillei*	longnose spurdog
		Squalus acanthias	piked dogfish
		Centrophorus granulosus	gulper shark
		Dalatias licha	kitefin shark
Rajiformes	Rajidae	*Raja asterias*	starry ray
		Raja miraletus	brown ray
		Raja clavata	thornback ray
		Raja oxyrhincus	longnosed ray
		Raja alba	white skate
		Raja montagui	spotted ray
		Raja radula	rough ray
		Raja undulata	undulate ray

The great morphological similarity between some species of rays makes their identification particularly difficult and uncertain. Systematic keys based only on external morphological characteristics do not help. We are therefore analysing biometric parameters and will also attempt a biochemical systematic investigation to give, if possible, improved precision at taxonomic level.

Finally, data obtained from a trawl-survey (ISTPM 1982) have been used to determine the geographical and depth distribution of eight species of shark (smallspotted catshark *Scyliorhinus canicula*, blackmouth catshark *Galeus melastomus*, tope shark *Galeorhinus galeus*, smoothhound *Mustelus mustelus*, blackspotted smoothhound *Mustelus mediterraneus*, longnose spurdog *Squalus blainvillei*, gulper shark *Centrophorus granulosus*, velvet belly *Etmopterus spinax*) and five species of rays (starry ray *Raja asterias*, brown ray *R. miraletus*, thornback ray *R. clavata*, longnosed ray *R. oxyrhincus*, and spotted ray *R. montagui*).

References

Bauchot, M.L. and Pras, A. 1980. Guide des poissons marins d'Europe. *Delachaux & Niestlé (ed), Neuchatel*: 427 pp., 67 pl.

Bhattacharya, C.G. 1967. A simple method of resolution of a distribution into Gaussian components. *Biometrics*, 23: 115–135.

Compagno, L.J.V. 1984. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. *FAO Fisheries Synopsis 125, Vol.4, Part 1 & 2*: pp 1–249 and 251–655.

Fisher, W., Bauchot, M.L., and Schneider, M. 1987. Fiches FAO d'identification des espèces pour les besoins de la peche. Mediterranée et mer Noire. Zone de peche 37. *Vol. II*: 761–1530.

ISTPM, 1982. Rapport de mission sur l'évaluation des ressources halieutiques de la marge continentale algérienne. Stocks pélagiques et stocks démersaux exploitables au chalut. *Campagne Thalassa, Ichthys, Joamy*: 101 pp.

Whitehead, P.J.P., Bauchot, M.L., Hureau, J.C., Nielsen, J., and Tortonese, E. 1986. Fishes of the North-Atlantic and the Mediterranean, Ed. Unesco. *Vol. I*: 683 pp.

Farid Hemida,
Laboratoire Halieutique, ISN-USTHB,
BP.39 El-Alia Bab-Ezzouar, Algiers, Algeria. Fax: (213) 2 51 50 71

New publications:

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. £10 or $15 plus postage and packing (20% surface, 40% overseas airmail) from *Shark News* Editors (see addresses on p. 16).

An introduction to the ecology, status and conservation of sharks and their relatives for a general audience. It draws attention to their unique biology 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. Shark fisheries cannot be managed sustainably, nor shark populations remain viable, in the absence of new conservation and management initiatives.

Regional Strategy Development Workshop reports

Oliver, A. and T. Walker (eds). 1998. Draft Report of the NW Atlantic, Gulf of Mexico and Caribbean Sea Regional Strategy Development Workshop for the Conservation and Management of Sharks. Held 4–5 December 1997, Mote Marine Laboratory, Sarasota, Florida, USA.

Oliver, A. and T. Walker (eds). 1998. Draft Report of the Indo-Pacific Regional Strategy Development Workshop for the Conservation and Management of Sharks. Held 9–10 November 1997, South Pacific Commission, Noumea, New Caledonia.

Oliver, A. and T. Walker (eds). 1998. Draft Report of the Eastern Pacific Regional Strategy Development Workshop for the Conservation and Management of Sharks. Held 7–8 December 1997, Monterey Bay Aquarium, Monterey, California, USA.

Copies of the above may be obtained by contacting Andy Oliver, World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037 or via email at Andy.Oliver@wwfus.org.

Case studies on the management of Elasmobranch Fisheries. FAO Fisheries Technical Paper No. 378, volumes I and II.

Pre-publication announcement. Approximate price US$100.
For more information contact R. Shotton at FAO, Via delle Terme di Caracalla, 00100 Rome, Italy, or by email: <ross.shotton@fao.org> putting "Request for Elasmobranch Report" in the subject line.

Sharks on the Line: A State-by-State Analysis of Sharks and Their Fisheries. Merry Camhi, 1998. 160 pp.

Effective management of shark fisheries is complicated by the highly migratory nature of sharks who simply do not respect political boundaries. In the US, shark fisheries in federal waters (3–200 miles) of the Atlantic and Gulf of Mexico are managed by the National Marine Fisheries Service (NMFS) under a federal management plan. However, sharks are also fished in coastal waters (0–3 miles from shore), where fishery resource management falls under the jurisdiction of state fishery agencies.

Juveniles of a number of large coastal sharks currently considered overfished by NMFS (e.g. sandbar *Carcharhinus plumbeus*, dusky *C. obscurus*, and blacktip *C. limbatus*) use shallow coastal waters as nursery grounds. Recent stage-based population models suggest that reducing fishing mortality of juvenile and subadult sharks may provide the greatest conservation benefit. Therefore, reducing fishing pressure on sharks in state waters will help these species rebuild.

Shark fisheries and their management vary widely by state. Shark fishery regulations are particularly important for states that have shark pupping and nursery grounds (13 states) and/or large shark fisheries in state waters (e.g. Florida, North Carolina, Louisiana). This National Audubon Society report reviews commercial and recreational shark fisheries on a state-by-state basis for the 18 coastal states from Maine to Texas, and recommends what these states can do to improve the status of sharks in their waters.

Currently, nine of the 18 states have no shark management, although three of these recently proposed their first shark regulations. Management measures, where they exist, include prohibition on landing certain species, size limits, recreational bag limits, ban on finning, and seasonal closures corresponding to the closure of federal waters. Although spiny dogfish *Squalus acanthias* are officially overfished, they are neither covered under the federal shark plan nor state regulations.

Failure to implement effective shark management at state level will undermine shark management and rebuilding at the national level. If overfished Atlantic sharks are to recover, all coastal states will need to implement effective and consistent shark fisheries regulations.

For a copy of the report contact Merry Camhi, Living Oceans Program, National Audubon Society, 550 South Bay Avenue, Islip, NY 11751, USA. Email: mcamhi@audubon.org

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 Sarah Fowler (payable to the "Shark Specialist Group"), or

3. by credit card. Send details to Sarah Fowler.

All addresses are given below.

Finally, please send any comments on the newsletter and suggestions for articles for future issues to the editors, Sarah Fowler or Merry Camhi (address on the back page).

I would like to continue to receive *Shark News*, and agree that my name and address can be held on the *Shark News* mailing database:

Yes: ..... **No: .....**

I would be prepared to subscribe to future copies of *Shark News*:

Yes: ..... **No: .....**

I enclose a donation for the Shark Specialist Group: .....
(Please state how much)

Please check here if you want your donation to be anonymous: .....

Name: .....

Address: .....

.....

.....

.....

I wish to pay by Visa/MasterCard; please charge to my account.

My number is .....

Expiry date ..... Signature .....

Return to: Sarah Fowler, *Shark News* Editor, Nature Conservation Bureau, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK.
or (with donations in US$) to: Sonja Fordham, Center for Marine Conservation, 1725 DeSales Street NW, Washington, DC 20036, USA.

During the last two years, sharks and their relatives have taken centre stage at CITES and FAO, graced the cover and pages of *Time* Magazine and many other news sources, and are finally on the radar screen of some fishery managers. We have the hard work of many Shark Specialist Group members and of a number of conservation organisations to thank for this new wave of shark awareness. Yet much work remains to ensure that shark fisheries – wherever they exist – will be responsibly managed so that shark populations remain viable and their fisheries become sustainable.

The Living Oceans Program is the marine conservation program of the National Audubon Society, a non-profit conservation organisation dedicated to protecting wildlife and wild places. A primary goal of Living Oceans is the conservation and restoration of the oceans' giant fishes, particularly sharks, tunas, and billfishes. We believe that effective fisheries management and conservation action must be based on sound science. *Shark News* links shark experts from around the world, publicises research in a timely manner, and confronts critical conservation issues. That's why Living Oceans has been a major financial supporter of *Shark News* since its inception in 1994, and why we are pleased to sponsor this 12th issue.

Living Oceans engages in shark conservation and management at many levels, from spearheading efforts to improve the US Atlantic shark management plan, to helping to address the conservation of sharks in Central America, to assisting in conservation initiatives at CITES regarding trade in sharks and at FAO through their Plan of Action. As Deputy Chair of the SSG, we assist in editing and distributing *Shark News*, coordinate SSG projects and publications, and manage many of the day-to-day functions of the SSG. At a more local level, Audubon recently published *Sharks on the Line*, a review of shark fisheries for the 18 coastal states along the US Atlantic and Gulf Coasts, and is pushing for improved shark management in state waters. For more information about Aububon's Living Oceans Program or our shark work, please contact Merry Camhi (see contact details below).

We urge other organisations and individuals to sponsor upcoming issues of *Shark News*. With a growing global distribution of more than 1,500 recipients, *Shark News* has become an important communication tool among shark scientists and other elasmophiles. Please support this newsletter by sending your contribution today – or better yet, by getting your institution to sponsor an issue. Contact Sarah Fowler or Merry Camhi for details.

We gratefully acknowledge the donations for newsletter production and other work received from the following: Center for Marine Conservation, C. Davey, Hanspeter Dinkelmann, Theo Duncan, Christopher Gurshin, Jeff Kurr, Daniel Morgan, The Shark Trust, Christine Wilkins, & Christopher Wylie.

Meetings

Japanese Elasmobranch Society Symposium: Recent status of elasmobranch studies

Ocean Research Institute, University of Tokyo. 19–20 November 1998. An **Asian Shark Specialist Group regional meeting** will take place after the symposium. Contact Dr Sho Tanaka, fax: + 81 54 334 5095. Email: <sho@scc.u-tokai.ac.jp>

ICES/SCOR Symposium: Ecosystem effects of fishing

ORSTOM, Centre de Conférences, Montpellier, France, 16–19 March 1999. Contact: Professor Henrik Gislason, Danish Institute for Fisheries Research, Charlottenlund, Denmark. Email: <hg@dfu.min.dk>

Shark Trust Second Annual Conference

The National Marine Aquarium, Plymouth, UK, 9–11 April 1999. Contact Sarah Fowler, Shark Trust, 36 Kingfisher Court, Hambridge Road, Newbury, Berks, RG14 5SJ, UK. Fax: (44) (0)1635 550230. Email: <sharktrust@naturebureau.co.uk>

American Elasmobranch Society 15th Annual Meeting

The AES meeting will be held during the ASIH meeting, College Park, Pennsylvania, 24–30 June 1999. Two symposia are planned:
Elasmobranch Genetics (for more information contact Ed Heist, fax: (+1) 618-453-7345, email: <edheist@siu.edu>)
The Evolution and Higher Systematic Relationships of the Chondrichthyes (contact Eileen D. Grogan, fax: (+1) 610-660-1832, email: <egrogan@sju.edu> or <egrogan@compuserve.com>
For more information on attending, go to http://www.elasmo.org

2nd Meeting of the Sociedade Brasileira para o Estudo de Elasmobrânquios (SBEEL)

Cabo Frio, Rio de Janeiro, 22–27 August 1999. For more information contact the Chairman Eduardo Pimenta <pimenta@alohanet.com.br>

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 will 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 editors at the address given on this page. They should be composed in English, legibly typewritten and double-spaced (generally 750–900 words, including references). Word-processed material on IBM-compatible discs would be most gratefully received. Tables and figures must include captions and graphics should be camera-ready.

Author's name, affiliation and address must be provided, with their fax number and email address where available.

Enquiries about the Shark Specialist Group and submissions to *Shark News* should be made to:

Newsletter Editor and Shark Specialist Group Co-Chair
Sarah Fowler
The Nature Conservation Bureau Ltd, 36 Kingfisher Court,
Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK
Fax: (44) (0)1635 550230
email: sarahfowler@naturebureau.co.uk

Shark Specialist Group Deputy Chair
Merry Camhi
National Audubon Society, Living Oceans Program,
550 South Bay Avenue,
Islip, NY 11751, USA
Fax (1) 516 581 5268
email: mcamhi@audubon.org

ISSN 1361-7397

Designed and produced by the Nature Conservation Bureau Limited, 36 Kingfisher Court, Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK.