SHARK NEWS

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Diving with elasmobranchs: a call for restraint

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Introduction

As curator of the International Shark Attack File, I have a special interest in shark/human interactions and have followed closely the development of ecotourism dive operations involving elasmobranchs. Most prevalent are attractions involving the feeding of sharks.

Shark feeding operations provide the best opportunity for most divers to see sharks close at hand, in the wild. These are grey reef sharks in the Red Sea. Photo: J. Stafford-Deitsch.

At least three types of shark feeding operations occur. Metal or PVC shark cages are used mainly in white shark *Carcharodon carcharias* dives at numerous locations worldwide; also by blue shark *Prionace glauca* and reef shark *Carcharhinus* spp. feeding attractions in California and Australia, respectively. Chain mail suits (no cages) are utilized by other operations largely targeting blue sharks (e.g. in California) but also in at least one Bahamas carcharhinid dive. Finally, many feeding operations do not provide tourists with any protective gear (Bahamas, Florida, Maldives, and probably other localities). The common denominator in all operational types is chumming or baiting. Some go so far as to promote hand-feeding of sharks or even to 'train' their clients in hand-feeding techniques.

Non-feeding observation dives with whale *Rhincodon typus* and basking sharks *Cetorhinus maximus*, and manta (Mobulidae) and stingray (Dasyatidae) feeding operations also take place.

Shark feeding

My reservations about feeding-type dives are based on four interrelated factors: the safety of the divers; the likelihood for negative publicity directed at sharks if a shark bites a diver during one of these dives; the possibility for ecological disruption; and potential negative impact on multi-user recreational use of the feeding area.

Diver safety

Shark cage diving generally appears to be safe. I am unaware of any serious injuries to divers, excepting biting wounds to hands placed outside the cage: Chain mail and no-protective-gear dives have resulted in injury to participants. Chain mail suits offer protection only from small to medium-sized sharks. However, the tooth tips of even small sharks can penetrate the mesh resulting in injury – well documented in the much-replayed video involving Valerie Taylor. The powerful jaws of larger sharks may produce crushing injuries even if teeth do not penetrate the mail. A large shark with serrated, shearing teeth, e.g. a white, tiger *Galeocerdo cuvier*, bull *Carcharhinus leucas*, or dusky *Carcharhinus obscurus*, would likely be able to cut through such mesh. The metal mail may even be electromagnetically attractive; white sharks, in particular, are well documented biters of metal ship hulls and propellers.

In the Bahamas, where unprotected dive-with-sharks operations developed quickly as a tourist draw, more than a dozen injuries have occurred in the last several years, at least two quite serious. Most were not publicised because of efficient damage control by local operators. Perhaps fortunately for the operators, most victims were host dive masters, but a serious injury to a diving tourist is inevitable.

Last year I took part in an unprotected Bahama feeding dive to view its design and safety. The experience was exhilarating. An aggregation of about 50 sharks (blacktip *Carcharhinus limbatus*, Caribbean reef *C. perezi*, and nurse *Ginglymostoma cirratum*) were attracted to a frozen fish 'chum ball' at a site utilised continuously (3–4 times a week) for several years. Hundreds (thousands?) of bony fishes were similarly attracted. I did not feel threatened by the sharks swimming above and around me as we knelt on the sand bottom of a natural 'amphitheatre'. I did note one blacktip, apparently low in a dominance order, confined to the perimeter of the circling mass of fishes and reluctant to approach the central chum ball. It exhibited apparent displacement or frustration behaviour: periodic mouth gaping, increasing over time, and occasional erratic swimming movements, including back hunching and pectoral fin dropping. This type of behaviour has been observed immediately prior to attacks on divers at other Bahamas shark feeding dive sites, and is similar to gray reef shark behaviour observed by Nelson *et al.* (1986) in the Pacific.

An unanswered question is whether individual bait-entrained sharks are more or less dangerous to humans than their wild peers. Observations of feeding reef sharks in the Bahamas, which largely ignore divers, could suggest 'no more' or even 'less' of a threat. However, shark attack rate is profoundly influenced by the concentrations of sharks and humans occupying the water at the same time. Increases in either generally result in an increased probability of an attack. Obviously, high concentrations of both sharks and humans are found together in a small area in baited-shark dives. It is also clear that sharks attracted to bait are in a heightened state of excitement, some approaching or achieving frenzy. In addition, the unnaturally high concentrations of sharks pursuing a limited resource (the bait) may lead to increases in density-dependent agonistic behavioural displays (see above) and increased likelihood of attack. Furthermore, we do not know how the food-conditioned sharks behave when the free food stops. Recently a documented attack occurred on a diver swimming at a Bahamas feeding site on a non-feeding day.

To reduce risk of shark attack:

- avoid diving in an area known to be frequented by sharks
- avoid diving in waters known to contain animal carcasses and blood
- avoid wearing shiny objects and contrasting colors while diving
- do not touch sharks

Many dive operations actually encourage ecotourists to touch the sharks. At least one offers "shark feeding instruction." Such ill-considered activity promotes irrational human behaviour like that prominently displayed in a recently published US dive magazine devoted to diving with sharks. The cover depicts a diver holding a 2–2.5 m *Carcharhinus*, hands on snout and dorsal fin. A photograph accompanying one story ("Friendly Encounters") captures a diver grabbing a ride on the tail of a "16 ft" white shark. Another article ("Cool and Cuddly Sharks") is accompanied by photos of divers hugging sharks. I am not a shark attack alarmist – at the ISAF we have consistently tried to put attack in perspective and turn media attention to more important conservation-based shark issues – but we cannot ignore the fact that sharks are wonderfully designed predators that can and occasionally do harm humans. While some entrained sharks can be approached and even handled readily, do we want to send the message that divers routinely can approach, touch, and even hug sharks in other situations? I can't think of *any* situation where grabbing the tail of a 16 ft white shark is advisable.

The recent rise in the number of inshore baited white shark dives has raised a serious concern: will these operations attract a larger number of white sharks into the area, resulting in an increased probability of attack (potentially serious trauma and fatality) on other user groups operating there? Whites are a more serious threat to humans than most carcharhinids – they are larger and normally consume larger prey. I believe a short-term localised increase in their number is a real possibility; with that increase comes a greater chance of whites and humans interacting.

Ecotourism dives aside, shark attacks on humans are rare. Nevertheless, shark attack still is of great interest and concern to the public. The ISAF routinely provides advice on how to reduce the already tiny chance of attack. It is ironic that shark-feeding dives freely violate several of the axioms of conventional wisdom advocated by virtually all attack researchers (see box). That more than two dozen reported attacks have occurred worldwide during shark feeding comes as no surprise to those who study shark attack.

Media hype

If safety of participants was the only concern, I would not object to shark feeding dives, assuming, of course, that divers are duly forewarned that injuries have occurred and that the sport carries an inherent risk (currently, many operations maintain bites have not occurred *anywhere*). Any injury or fatality then could be rationalised as an unfortunate accident. However, when such a serious attack does occur – and I predict unequivocally that it will – media coverage will be tremendous. The tabloid press predictably will hype a story involving a diving tourist who loses a hand or arm during one of these operations. Imagine what reaction a fatality will bring! Actual video of the incident is likely to be available to tabloid television as these dives are routinely taped by host dive operators and participants alike. Needless to say, the shark will not be portrayed favourably – the "Jaws" image will be reinforced *ad nauseam*. The recently reshaped, biologically accurate public image of sharks that many have worked so hard to foster will be undercut quickly and decidedly.

Ecological disruption

This is of equal concern in the shallow-water shark-feeding areas, where the feeding operations are altering the natural system. Based on my personal dive experience and those of others, it is clear that the concentrations of sharks and bony fishes at feeding sites are unnatural. It is normally difficult to see blacktip or reef sharks in non-feeding situations in the Bahamas; they tend to avoid divers, are quite skittish, and (except for nurse sharks) are rarely encountered while diving (unless spearfishing). The lure of the feeding operations, of course, is the guarantee of success in giving divers a chance to see and photograph sharks which are largely oblivious to the divers. However, the resident sharks and some bony fishes at these sites are now trained 'show animals' and at least partially dependent on free food.

Gray reef shark *Carcharhinus amblyrhynchos* exhibiting agonistic behavioural display during a shark feeding dive. Photo: Jack Jackson.

That the Bahamas sharks are indeed entrained is demonstrated by their response to the sound of boat motors. Dive operators routinely rev their engines as they approach the feeding site in order to attract the sharks, which rapidly arrive, surrounding the boat long before the first food or diver hits the water (sound Pavlovian?). Similar entrainment has been reported at Australian feeding sites.

Groupers (Serranidae) at some Caribbean and Bahama feeding sites are similarly well-trained, rising from the reefs in search of handouts from divers entering the water. At Grand Cayman, where diver feeding of reef fishes was fashionable for years, I observed mushrooming populations of sergeant-major *Abudefduf saxatilis* and yellowtail snapper *Lutjanus chrysurus*. They became pests at feeding sites, hovering around divers looking for handouts (and in the case of sergeant-majors, frequently biting divers' fingers).

The highly migratory nature and differing reproductive strategies of *Carcharhinus* spp. prevents direct analogy to these situations,

but it seems possible that their population size is increasing locally at feeding sites. We do not know if such local concentration of sharks at feeding sites allows natural levels of density and distribution to be maintained over adjacent areas. Alternatively, the feeding sites may simply relocate sharks from nearby areas and overall populations may be stable or even in decline. No hard data are available, but the large numbers congregating around feeding sites indicate that repetitive feeding attracts sharks from wide distances. Feeding may promote higher than normal local shark population levels since food is readily obtainable at virtually no energetic cost. Additionally, localised clustering of sharks and associated bony fishes entrained to feeding may present an easy mark for poachers, as it did in the Bahamas when rogue fishers wiped out a local aggregation of sharks associated with a shark-feeding attraction.

Conversely, while some operations use otherwise discarded remains of recreationally caught fishes as bait, others obtain chum or bait fishes by spearfishing. Localised depletion of reef-fishes may occur in these areas. Some South African white shark dive operators reportedly catch juvenile bronze whaler *Carcharhinus brachyurus* and smooth hammerhead *Sphyrna zygaena* sharks to use as bait. As with reef-fishes, repetitive fishing for these species in a small area may lead to reductions in local populations.

Impacts on other water users

The presence of sharks entrained to the sound of a motor may lead to localised loss of multi-party recreational activities such as fishing, spearfishing, and traditional skin or SCUBA diving where divers are not interested in encountering sharks *en masse*. If sharks appear whenever a motorboat visits a region, anglers are likely to lose their hooked catches to opportunistic sharks or have the sharks frighten away potential catches. Skin and SCUBA divers seeking sharkless diving will encounter unwelcome escorts. As noted above, a tourist diving at a feeding site on a non-feeding day was bitten on the head by a carcharhinid shark. We have heard of a diver who had a shark follow his outboard motor-driven boat from dive stop to dive stop, eventually ending in a bite.

I am of the opinion that inshore feeding of sharks is not in the best long-term interest of an area's economy. While the activity will draw in ecotourists, inevitably a serious shark bite will occur, producing significant trauma or death. The ensuing negative publicity likely will result in the loss of that segment of tourists as well as at least some others who do not wish to meet sharks regularly during their dives.

Pelagic shark-feeding cage operations may be of less consequence than inshore unprotected dives. The feeding sites generally are located far away from centres of human activity, entrainment of the sharks is less likely, and the ecotourists are adequately protected.

Whale sharks, basking sharks and mantas

Whale shark and manta ray ecotourism dives have appeared recently, primarily in the Indo-Pacific. Basking shark ecotourism has potential in some temperate waters. Activities focusing on these large planktivores raise some of the same concerns historically directed at ecotourism operations targeting whales; that the natural behaviours of these species will be altered by the proximity of divers and boats, and possibly spotter airplane noise and shadows. Strict regulations address observation and harassment of marine mammals, and stipulate specific separation requirements in the USA. In contrast, 'riding' whale sharks and mantas is shown in some magazine photographs and television videos and evidently is viewed as a desirable activity by some. This situation has been addressed in Western Australia (see page 5), where human-whale shark interactions are now managed and monitored. The development of similar protocols elsewhere would be prudent.

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Editorial

Shark feeding provides virtually the only guaranteed means of experiencing shark encounters 'in the wild' in most parts of the world. As such, this is now a well-established activity world-wide and in huge demand from diving tourists. Its economic value to some coastal communities is therefore large and rising. Shark tourism is also a very important factor supporting policies and legislation in favour of shark conservation (the value of individual sharks to local economies is demonstrably so very much higher and more sustainable than the income from shark fisheries). It is definitely here to stay.

However, the rise in numbers of operators and tourists engaged in this activity is now being accompanied by increased concern over the conduct of these activities. As George Burgess points out, unregulated or poorly-managed shark feeding operations have the potential to result in harm to divers and other water-users, to shark populations, to the marine environment, and ultimately, to local economies heavily reliant on income derived from tourism associated with a much wider range of water uses. It is particularly alarming that these concerns are now being voiced by some individuals who were involved in the development and promotion of shark feeding activities, as well as by scientists and conservationists with a long history of studying the problems associated with human/wildlife interactions.

On a more positive note, some countries are now beginning to regulate shark diving activities. This newsletter presents examples from Australia and South Africa. However, it is vitally important that such initiatives are extended to other countries as a matter of urgency, and are strictly enforced. Tourist industries and governments must recognise that this is vital to their own interests and their coastal economies as well as to the future well-being of the tourists and the shark populations on which they are increasingly dependent.

We also report the closure of the Philippines whale shark fishery. This was showing a classic pattern of expanding effort as a result of the high value of whale shark products in international trade, combined with an apparent decline in catches. One stimulus for the closure of this fishery was the high potential value of the species for dive tourism, as demonstrated by the booming Western Australian whale shark dive trade. WWF is now working on developing whale shark ecotourism in the area where the fishery was formerly under way. However, some observers have expressed concern that, while the benefits of the whale shark fishery were undoubtedly flowing directly to local fishing communities (albeit likely in a unsustainable manner), it is difficult to ensure that all coastal communities formerly hunting whale sharks will be able to participate in and benefit from ecotourism to the same extent. The problems posed by the remote nature of many of the villages, the lack of communications and other infrastructure and other factors make this impossible to achieve. Additionally, whale shark hunting, which replaced traditional whaling in the area, was a very important community activity, playing a significant cultural role in these villages. Ecotourism developments cannot replace this. Hopefully the lessons learnt in many countries following the closure of coastal whaling and attempts to turn to whale watching instead will help such communities to weather these changes.

Finally, a word of caution about the economics which encourage the replacement of commercial and subsistence fishing for sharks by dive tourism or recreational fishing. While a dead shark may be worth only tens of dollars, and a live shark on a diving reef perhaps thousands, these figures are not comparable if the fisherman who has forgone his $10 is unable to benefit from the $1,000 income which flows to a tourist development owned by a company possibly not even registered in the same country or employing staff from local villages. Conservation ultimately fails without local support.

Sarah Fowler

Recreational fishing and conservation

Carl Safina, Living Oceans Program, National Audubon Society, USA

In most parts of the world, fishing is a business or subsistence activity. Where recreational fishing occurs, sharks are more likely to be considered pests than targets. Big game fishers hated sharks because they attacked 'premier' glamour species like marlin and swordfish, whose struggles at the end of the line were ended if a shark cut them in half – thereby spoiling all the fun.

In most parts of the world there are now too few big sharks to pose much of a problem. And because directed billfishing itself is deteriorating in some places, sharks have been promoted from underdog to game fish status. In a few places, recreational fishers exert lots of time and money chasing sharks. The east coast of North America between Cape Hatteras and Cape Cod, for example, may well host more directed recreational fishing for large sharks than anywhere in the world, and in the southern US states, 'rec' fishers catch lots of small coastal sharks.

Recreational fishers blame commercial fishing for the drastic declines in virtually all species of large sharks in certain regions. Their enmity is not misplaced, but neither is recreational fishing wholly exonerated from causing regional declines for some species. Compelling evidence exists that before fin prices created market incentive for killing most sharks, recreational fishing was driving declines of some important species. The fin trade sharpened those declines and caused deep depletions, including (according to strong anecdotal evidence) recent depletions in regions far from recreational pressures. For their part, recreationals have gone largely to catch-and-release for most large species. But recreational fishers should not underestimate their continued killing power for certain sharks along certain coasts, and should seek to reduce their own impacts as much as possible.

For example, off the north-east US, where recreational fishers release virtually all large coastal species and blue sharks, they still keep virtually all makos and threshers. Female makos mature at around 700 pounds, i.e. almost every single mako taken is a juvenile, and the continental shelf where the fishing occurs is the nursery area. Many tournaments and individual captains now have voluntary minimum size requirements of around 100-pounds. Such a minimum size should be required by law. This size, while arbitrary relative to size at maturity, improves the yield-per-recruit, and, most importantly, allows many makos to get another chance at survival for one more year, increasing their chances of surviving to maturity.

Further, even for released individuals, standard recreational fishing practices are not best for ensuring post-release survival. Recreational fishers usually allow sharks to 'run with the bait' before hooking them. This assures more hookups. It also assures more gut-hooked animals. Virtually all recreational releases of large fishes involve cutting the leader, leaving animals with hooks in the gut, throat, or moving mouth parts. Such imbedded hooks can cause serious eventual injury or death, as in all likelihood can cut-off wire leaders that continually rub against skin. New de-hooking tools (e.g. made by De-Hooker Inc., +1-800-772-5804) allow hook removal for even gut-hooked sharks, and should be standard equipment.

Large sharks are not well equipped to take the kind of pressure directed fisheries – even recreational fisheries – can apply in certain regions. Terrestrial big game hunters must often pay large fees for the privilege of killing an animal, and often the annual individual take is limited to one or two per person per season. This would be appropriate for sharks. Where shark fishing is popular, I believe fishers on private boats should be required to obtain a licence or permit that limits the take to one per boat per year. For charter boats that take paying passengers out daily, the party should perhaps be required to pay ahead of time for a licence entitling them to kill a large shark in the event that they catch a desirable individual. Otherwise, release would be mandatory.

Commercial fisheries remain problematic. But recreational fisheries also contribute significantly to shark mortality in some regions. The recreational community can do more for shark conservation if they choose.

Carl Safina is Head of the National Audubon Society's Living Oceans Program and a keen recreational angler.

Diving with elasmobranchs: a call for restraint

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Stingray feeding

This does not appear to be of such concern, although there is some potential for injury where it occurs (several localities in the Caribbean and Maldives, and perhaps elsewhere). Video footage of a shallow-water feeding operation in the Virgin Islands shows numerous large *Dasyatis americana* swimming amongst and through the legs of tourists standing in waist deep water, knocking some off their feet. It is likely that a large spine will be encountered sometime during a fall. The 'media image' problem, however, is not likely to arise, nor are there concerns over multi-user recreation. Ecological disruption is probably minimal.

Conclusions

Dive-with-sharks operations have been lauded as a positive environmental experience for those divers who can afford this activity and vicariously for thousands of television viewers of documentaries and dive programs. Certainly allowing many people to see sharks *in situ* is good publicity for these animals and helps to dispel the 'man-eater' stereotype. But are entrained sharks performing on cue really exhibiting any more natural behaviour than we see in trained circus animals? Does swimming in circles and gnawing on a frozen 'chum ball' or taking bait fishes off a spear or out of the hand or mouth of a human constitute 'sharks in the wild'? Public aquaria offer basically the same view of sharks without fostering the 'eating machine' image enhanced by frenzied feeding.

It appears that the pendulum has completely swung as a newly restructured shark image emerged in the shark-feeding dive community. Sharks have been transformed from being blood-thirsty man-eaters to playful puppies by some of those most closely tied to shark-feeding operations. As often is the case, the truth lies somewhere in between these two extremes. Based on the safety, ecological, social and conservation considerations noted above, I believe that scientific/conservation endorsement of most shark-feeding attractions is unwise. On balance, it appears that sharks have more to lose than to gain by these operations.

Acknowledgments

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Reference

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Whale shark management programme, Western Australia

Jeremy Colman, Department of Conservation and Land Management, Western Australia

The Western Australian Government recently released a management programme that will ensure ecological sustainability for one of the most important nature-based tourism activities in the region – whale shark interactions at Ningaloo Reef.

A seasonal aggregation of whale sharks occurs in the waters of the Ningaloo Marine Park from March to May each year and this predictable occurrence has led to the development of a small but expanding tourist industry, focusing on human/whale shark interactions. The whale shark is a protected species within all Western Australian waters. From 1993 onwards, commercial whale shark tourism within the marine park has been managed by the Department of Conservation and Land Management (CALM) through a system of controls, including the licensing of a limited number of operators for whale shark interaction tours. Currently, there is some demand for an increase in the number of interaction licences, over and above the 14 existing licences.

It is unclear whether increased tourism pressure is presently generating any short or long-term detrimental impacts on individual sharks or the group as a whole. The natural variability in whale shark abundance and distribution, the reasons for the aggregation at Ningaloo Reef, and the carrying capacity of the industry are all unknown. Consequently, evidence of any impacts is difficult to obtain and interpret.

With the limited information currently available a precautionary approach to management has been adopted, and a restriction on the number of commercial interaction licences has been adopted as the main strategy for managing tourism pressure until more information is available from current and future research work.

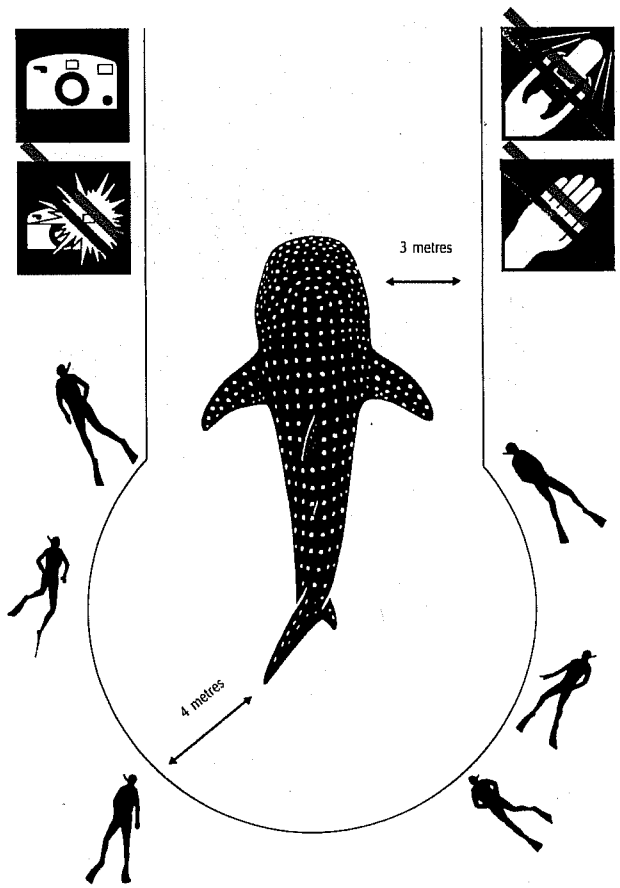
The management programme provides an overview of the information available on the biology and ecology of the whale shark and describes the reasons for management. It establishes management objectives, reviews current management controls and compliance monitoring procedures, and describes future management actions. It also details the research necessary to gain a better understanding of the animal's population biology, ecology and the natural variability of its environment, and the monitoring required to determine if any impacts are occurring as a result of increasing tourism pressure.

The objectives of the programme are, in the short-term, to improve the management of whale shark interactions, and in the long-term, to provide the scientific basis to determine if the management strategies need to be modified to minimise any impacts.

Once more detailed information is available and appropriate monitoring programmes are implemented it will be possible to better ensure that whale shark populations, particularly at Ningaloo, are not being subjected to an unacceptable level of disturbance, and that the development of whale shark tourism in Western Australia's marine reserves is sustainable and equitable.

The policies and management controls contained in the programme are likely to provide a model for other whale shark interaction activities that are developing elsewhere in the Indo-Pacific region. Philippines government authorities, working with the World Wide Fund for Nature (Philippines), are formulating appropriate guidelines for tourism operations currently targeting the aggregation of whale sharks in the waters of Sorsogon Province, based on the Ningaloo 'code of conduct'. In March 1998, fisheries legislation was introduced banning the killing of whale sharks and the trade in whale shark meat and other products anywhere in the Philippines (see page 11).

Department of Conservation and Land Management



Swimming with Whale Sharks – The Code of Conduct

To ensure that you have a safe, enjoyable experience and to prevent the animals from being harmed or disturbed, the following code of conduct applies when interacting with whale sharks:

Swimmers and Divers must not:

- attempt to touch or ride on a whale shark
- restrict the normal movement or behaviour of the shark
- approach closer than 3 metres from the head or body, and 4 metres from the tail
- undertake flash photography
- use motorised propulsion

Figure: The Western Australian Code of Conduct for swimmers.

The above is summarised from: Colman, J.G. 1997. *Whale shark interaction management, with particular reference to Ningaloo Marine Park. Wildlife Management Programme No. 27*, Department of Conservation and Land Management, Perth, Western Australia.

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Management of the US Atlantic recreational shark catch

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Introduction

Many times, when the general public thinks of fishery management, controlling commercial fisheries come to mind, but for many fish stocks in the US Atlantic recreational fishing effort must be considered as well; sharks are no exception. In the US Atlantic, the recreational and commercial fisheries are governed by Total-Allowable-Catch (TAC), which is allocated between the two user groups. Whereas there are detailed records for commercial landings to close the fishery when their portion of the total quota is reached, no system exists to rapidly monitor recreational fishing; total annual landings are not known for some time. Additionally, recreational weight quotas are redefined as daily or trip bag (creel) limits, where anglers are allowed to keep so many fish daily (with an assumed average weight), with the intention of keeping the fishery open year-round. Unfortunately, given the amount of angler effort, the current bag limits have allowed this sector to more than double its allowable take since the implementation of the US Atlantic federal shark fishery management plan. Management needs to address the issue of recreational take because as shark stocks recover, recreational catch rates will increase, plus more anglers will enter the fishery, thus increasing the take even more.

Trophy anglers were partly the cause of the decline in US Atlantic stocks of large sharks over the past 20 years. Photo: John Stevens.

Background

The popularity of recreational shark fishing in the US Atlantic region increased dramatically during the 1970s (Hoff and Musick 1990, NMFS 1993). The fishery was a trophy fishery targeting extremely large sharks, and was prosecuted from both for-hire and private boat platforms. These trophy anglers have declined substantially in number over the past 20 years, being replaced by anglers who target (or incidentally catch) smaller sharks. This shift stems in part from the declining numbers of large sharks, which in turn was caused by the heavy fishing pressure from the trophy anglers (NMFS 1997). The current bulk of the small coastal catches probably occurs from anglers on headboats (for-hire vessels carrying nine or more passengers), whereas large shark catches come from private or charter (for-hire vessels carrying six passengers or less) boats (Fisher and Ditton 1993).

Another factor in this shift from targeting large trophy fish to catching smaller sharks may stem from a changing attitude about shark fishing by the general US public. For example, during the trophy fishing period, it was generally considered that 'a good shark was a dead shark', and anglers who landed large sharks often received substantial positive local media attention. By the end of the 1980s, the populace was embracing a greater conservation ethic, and media attention of a large shark landing began generating negative reactions from the public. More and more anglers have incorporated catch-and-release into their fishing methods (or simply attempted to avoid negative reactions of landing large trophy sharks).

There is little information available on the characteristics of anglers who target or catch sharks. For the Gulf of Mexico, Fisher and Ditton (1993) suggested that tournament anglers who fished for sharks could serve as a proxy for shark fishers in general. That group tended to fish >50 days per year, had nine years of fishing experience, and approximately half fished from a boat less than ten miles from shore. Fisher and Ditton (1993) estimated that 215,000 private boat trips were taken in the Gulf of Mexico in 1989 specifically targeting sharks. According to them, these specialised anglers began shark fishing after several years of saltwater fishing experience was gained, and nearly a third of the anglers indicated that if they could not fish for sharks, there would not be an acceptable substitute.

Assessing catch levels

Evaluating the intensity of recreational catch is difficult because different sources (Anderson 1990; Hoff and Musick 1990; Scott *et al.* 1996) report different values, even though each author worked with the same database. For example, for 1986, Anderson (1990) noted 10,000 t (metric tons – round weights) were caught, Hoff and Musick (1990) stated 49,691 t were caught and over 12,000 t were killed, but Scott *et al.* (1996) indicated approximately 6,000 t were caught. However, in general, catches for sharks (excluding dogfish) rose from just over 2,000 t in 1965, to an average that fluctuated around 8,200 t throughout the 1970s and early 1980s, peaked at over 10,000 t in 1986, and subsequently declined during the 1990s to 2,000–2,500 t.

Scott *et al.* (1996) also provided a breakdown according to the various species categories of the current management strategy. This indicated that the annual recreational catch of large coastals dropped from an average of 3,750 t in the 1980s to about 1,100 t annually in the 1990s, annual pelagic catches dropped from approximately 2,000 t in the 1980s to about 750 t annually in the 1990s, and small coastal catches increased from almost 300 t annually during the 1980s to nearly 500 t annually in the 1990s.

Recreational landings differ by geographic and environmental regions (Table 1). Catches (in numbers of fish) in the north-east US (Maine to Cape Hatteras) are dominated by mako species, thresher species, blue sharks, and a selected group of demersal carcharhinids (primarily sandbar and dusky sharks), whereas catches in the south are dominated by sandbar, blacktip, and Atlantic sharpnose shark. Even though the north-east and mid-Atlantic region has long been considered a strong focal point of recreational shark fishing, the catch north of Cape Hatteras pales in comparison to the heavier catch (and fishing effort) in the south-eastern regions, where the blacktip shark dominates the large coastal catch.

Regulating the fishery

Monitoring recreational landings is difficult; controlling them is even more so. Total-allowable-catches (TACs) for the recreational fishery are based on a weight quota which is translated into bag limits that should, in concept, allow recreational fishing to continue throughout the year without exceeding the TAC. The initial bag limits were set at four large coastal/pelagic sharks per boat per trip (day), plus five small coastal sharks per person per trip (day). According to the landings in 1994 and

Table 1. Recreational catch of sharks (numbers of fish) in the US Atlantic region for 1994–1995 combined (from Scott *et al.* 1996).

	North-east/ Mid-Atlantic	South-east Atlantic	Gulf of Mexico	TOTAL
Sandbar/dusky	38,082	11,464	8,037	57,583
Blacktip	3,032	29,072	101,048	133,152
Other spp.	269	45,149	36,623	82,041
'Requiem'*	3,241	15,722	37,449	56,412
Hammerheads	1,003	24,388	3,322	28,713
Atl. sharpnose	—	24,388	113,453	137,841
Other small coastal	—	17,231	60,290	77,521
Shortfin mako	34,850	687	7	35,544
Other pelagics	2,558	—	—	2,558
Smooth/spiny dogfishes	149,391	14,007	5,942	169,340
Unidentified	82,815	62,481	5,010	150,306

*Includes sharks identified to family or genus only, i.e. 'carcharhinid family' or 'requiem shark'.

1995 (Table 2), the recreational fishery generally doubled its large coastal TAC, and met its pelagic TAC. (The 302 t landing in 1994 is very low compared to other years; as noted above, average pelagic shark landings during the early 1990s were about 750 t.)

To reduce mortality on the large coastal stock, in 1997 NMFS halved the TAC for both recreational and commercial fisheries. The large coastal recreational TAC was lowered from 490 t to 250 t; the pelagic TAC was not altered (NMFS 1997). To achieve this reduction, bag limits were reduced. Whereas the bag limit had been four large coastal/pelagic sharks per boat per trip, and five small coastal sharks per person per day, it was restricted to two sharks of any category (i.e. adding small coastals) per boat per day, plus two Atlantic sharpnose sharks per person per day. Obviously, however, given that the 'old' bag limit was allowing a take that doubled the large-coastal TAC, simply halving the bag limit will still allow excessive takes in this fishery.

In part, the oversight of the excessive landings may stem from a miscalculation. NMFS (1997) states: "Since implementation of the FMP, approximately 70%–86% of the large coastal recreational quota of 1,230 t has been taken annually...". The large coastal quota wasn't

Table 2. Estimated landings versus the TAC (in metric tons carcass weight) for the first two years after the FMP was implemented (from Scott *et al.* 1996).

Year	Large Coastal Landings (TAC)		Pelagic Landings (TAC)		Small Coastal Landings	Unknown spp. Landings	Other spp. (non-mgmt)
1994	849 (490)	+73%	302 (980)	-69%	462	121	214
1995	1,064 (490)	+117%	1,384 (980)	+41%	552	44	177

Note: Scott (1996) and NMFS (1997), citing Scott *et al.* (1996), indicated that approximately 780 t of large coastals were taken annually in 1994 and 1995 by recreational fishers; however if one multiplies the numbers of sharks landed times the average weight for each species as listed in Scott *et al.* (1996), one derives the values above. No matter which value is used, it greatly exceeds the recreational allocation of 490 t for the timeframe.

1,230 t; 1,230 t was the sum of the large coastal and pelagic TACs combined, and the large coastal landings divided by this 'combination TAC' equates to those percentages. In reality, landings had exceeded the large coastal TAC approximately two-fold in both years. Since the bag limit is an aggregate bag limit, including large coastals and pelagics, one could consider the landings and TACs in combination. Even if one sums the large coastal and pelagic landings and compares that to the aggregate 1,230 t TAC, the landings still generally meet or exceed the TAC; especially if the 302 t pelagic landing in 1994 is an underestimate. Obviously, the bag limits did not restrict the fishery to the TAC, thus the current bag limits need additional reductions. Having an appropriate bag limit will become more important as shark stocks rebound and become more abundant, and catches increase. As more recreational anglers re-enter the fishery, the take will also increase.

Economics of recreational fishing

Economic information on the recreational shark fishing effort in the US Atlantic is limited. Based on the 1977 recreational fishing efforts, the Gulf of Mexico Fishery Management Council (1980) estimated that charter fishing for sharks in the Gulf of Mexico generated expenditures of roughly $800,000 in charter fees, and approximately $840,000 in non-fee expenditures in Gulf coast communities. As for non-charter shark fishing during the same timeframe, the Council estimated that roughly $1.0 million was spent in coastal communities by shark fishers; this figure did not include economic-base multipliers which potentially could double the magnitude of the values. Total economic impact due to shark fishing in the Gulf of Mexico in 1977 was approximately $3.5 million, which generated approximately $1.0 million in personal income and 113 jobs in coastal communities.

Fisher and Ditton (1993) estimated that the average shark angler spent $197 per fishing trip. Based on an estimate of 215,000 shark fishing trips by recreational fishers in the Gulf of Mexico in 1989, a total of $42 million was spent on shark fishing in the region, with a consumer surplus of nearly $24 million for a total value of $66 million. Based on Marine Recreational Fishery Statistics Survey estimates of the numbers of sharks caught and landed in the Gulf of Mexico for 1989, Fisher and Ditton suggested that the value was approximately $158-$183/shark ($101-$117 equivalent value and $57-$66 consumer surplus).

A word of warning – one must use caution when attempting to use economic numbers to make judgements as to what form of resource utilisation has greater overall 'value'. Whereas recreational expenditures usually represent an angler's total expenses for a fishing trip (including fishing and non-fishing expenditures), the commercial values are usually reported as the ex-vessel selling price of the product. The former would represent total economic benefit to the local community, with the latter representing only economic value to the individual commercial fisher. Ex-vessel value obviously does not include the many expenditures (fishing and non-fishing) by a commercial fisher which also produce economic benefit to the local community. Direct comparisons of numbers that represent such very different economic 'value' are totally inappropriate.

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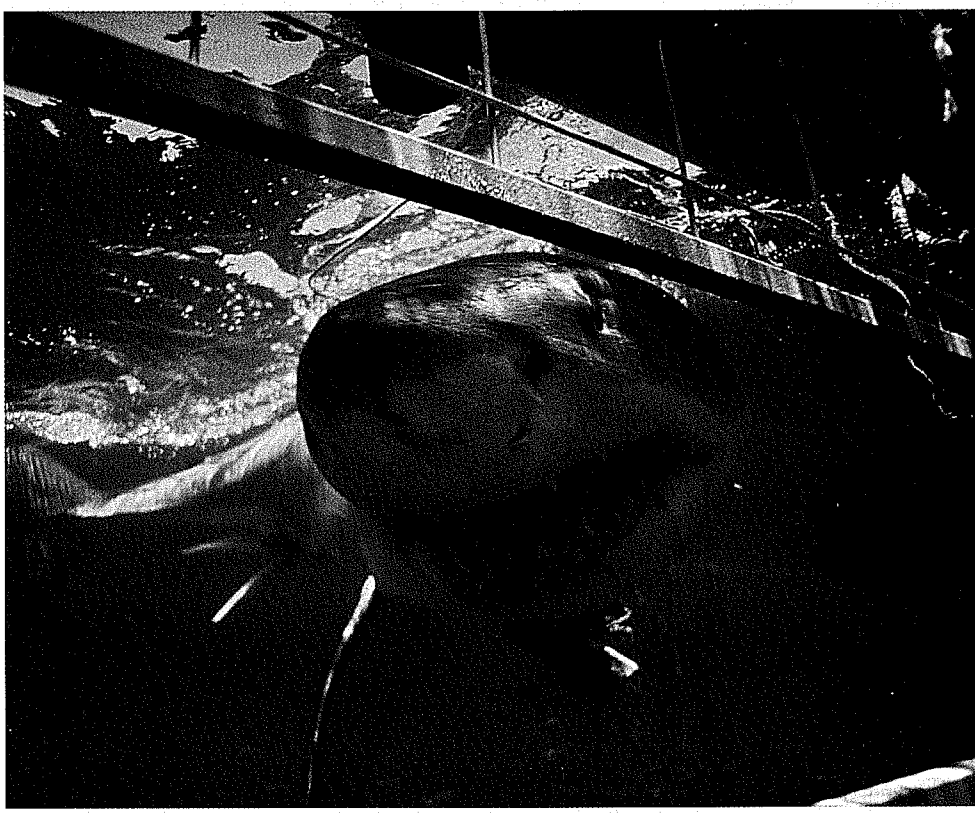
A craze for shark-cage diving has its dangers ... for sharks

Ellen Bartlett, Johannesburg, South Africa

The bartender from Miami is standing tall on the port side of the boat, face to the wind, eyes in a happy squint in the glare of the morning sun. "There's bungee jumping, there's jumping out of an airplane and there's this," he is saying excitedly. "This is it. I saw the sign at the airport and I said 'I gotta do this'." He laughs, a high nervous giggle. "If you told me five days ago I'd be in South Africa diving for sharks, I'd 'a told you you're crazy."



Great white shark *Carcharodon carcharias* investigates a metal cage. Photo by Jeremy Stafford-Deitsch.

But here he is, in a boat bound for Dyer Island off the Cape coast, where he will don diving gear and descend into an underwater cage for a close encounter with *Carcharodon carcharias*, the great white shark. He has paid R450 for the experience.

The boat is piloted by Andre Hartman, former Springbok spear fisherman turned diving entrepreneur. It is a 7m twin-hulled open fishing boat, painted a tired and peeling red. What little standing room there is is occupied by a huge wire cylinder with a trap door at the top – the shark cage. Passengers fit around it as best they can.

The mood is giddy. "Is this a will you're writing?" someone asks. "This is right up there," says another, in a reverent tone. "Right up there for stupid, you mean," he is corrected. Could be.

For as long as it has existed – about three years – the Cape's shark-cage diving industry has been described as a disaster waiting to happen; tales abound of inexperienced operators taking unsuspecting clients out in ill-equipped vessels, dropping them into shark-infested waters like so much bait.

The Department of Sea Fisheries was so swamped by complaints last year – most from diving operators complaining about their competitors – it decided to investigate. The department concluded it was a "user-group conflict", a matter for the diving operators to sort out, but agreed to mediate. The result has been a much-lauded code of conduct, to be signed by operators and binding them to meet minimum standards of safety, competence and etiquette.

It's good news for the human element in shark cage diving. But what about the sharks?

"The problem, among other things, is that more people want to see white sharks than there are white sharks," says Len Compagno, a leading shark taxonomist and head of shark research at the South African Museum.

How shark-cage diving is affecting the white sharks of Dyer Island is a matter of debate. Not surprisingly, those in the shark-watch business say the impact is negligible. But marine biologists who work with the sharks disagree, and say that such dallying could have far-reaching consequences for man as well as beast. They point out that in 1991 South Africa became the first country in the world to declare the white shark a protected species, but that it has done little since then to ensure its protection. Reports have been rife of sharks being brought too close to the boats, caught in netting and lines, and cut by the boats' engines.

Marcel Krouse, biologist with the Department of Sea Fisheries, acknowledges the problems and the protected status of the white shark. "You are not allowed to injure, harm, harass a great white shark. But there is nothing that stops you from diving around a shark. You can't prove it's harassment if you throw a fish over the side."

Others contend that the disturbance is of a more subtle nature.

Mark Marks is a Californian who came to South Africa in 1994 to conduct research into the behavioural ecology of the great white shark, specifically the sharks that congregate around Dyer Island. He had to abandon his research, because he could no longer regard the Dyer Island as 'natural' shark habitat. "I was trying to look at the animals in their natural context," he says. The advent of shark-cage diving, the presence of the boats, the bait used to attract the sharks, made it impossible for him to continue.

"It's not uncommon to see three, four, five boats at a time in the channel," he says. "You're talking about an area only about 120 m at its narrowest, and 600 m to 700 m long. It's also a fragile ecological habitat. That seems to be missed repeatedly. You would be hard-pressed to get any of the operators to voluntarily admit that their presence disturbs the animals there. But how can it not?"

For much of the morning, Hartman, his crew of one, and his eight clients are alone in the channel. Nor do there seem to be any sharks.

Having dropped anchor, Hartman opens a cooler, containing a lump of meat the size of a soccer ball, marbled pinkish gray. "Mako shark liver, " he says. He cuts off several slabs, ties them up in scraps of netting and throws them into the water.

Shark bait is known as chum; it varies from dead seals – the optimum bait, but generally not used for fear of upsetting the tourists – to ground-up pilchards, tossed overboard to form a long, greasy slick in the water. "I got a white shark liver once," Hartman says, evading the question of how he obtained the liver of a protected species. "White sharks don't like their own liver; they're not cannibals."

When still no shark appears, Hartman throws out a small white plastic surfboard. The use of a child's beach toy to act as a shark attractor raises a few eyebrows on board. Hartman shrugs. In any case, it does not appear to work.

When the first white shark appears, it is from the opposite direction. The shark ignores the surfboard and heads for the boat.

It pokes its head out of the water, has a look around. Swims away and, then returns, nudging the stern. A youngster, Hartman says, less than 3 m long.

All excitement now, the divers yank on their wetsuits, ready themselves for the real adventure. One by one, they perch on the starboard rail, then clamber down into the cage and disappear into the green water.

The shark plays its role perfectly; it swims around the cage, zooming in for close-ups, disappearing into the distance, reappearing again.

The view is just as good from above. The shark politely divides its time between the deep and the shallows, surfacing at the rail, close enough to touch. There are enough sightings that it is arguable whether there is one fast-moving shark, or two sharks, or three.

Once everyone has had a turn in the cage, the divers regroup onboard, satisfied customers. They will go home happy. But the question that remains is what these encounters mean to the sharks.

Theo Ferreira, a former great white shark hunter turned self-styled shark conservationist and "white sharkaholic," is one who believes they mean trouble. "You've got people putting chum into the water, stimulating the sharks, feeding them. You've got people in cages down there. So the sharks have been fed, stimulated and conditioned to see human beings as food-related," he says.

"You're going to have a problem developing where they lose their instinctive and natural cautiousness and fear around humans. Common sense tells me you could have a situation where sharks start preying on humans." Ferreira cites the recent disappearance of a spear fisherman off the Cape coast, believed to be the result of a white shark attack.

Though Marks believes such talk is speculative, he calls it a potential can of worms. "Sharks have always pitched up near fishing boats," he says. "Like any other predator, if it gets an easy meal, it'll come up and take it."

Hartman's partner John Botha calls the possibility of cage diving causing attacks "rubbish". "You must understand something," he says. "Sharks are a fact of life. It's like driving through a game reserve. Theoretically, in Kruger National Park, if there's an elephant around, it can stomp on you. It's the same thing with sharks. I don't see the shark physically wanting to take a diver out of the cage. Anything is possible, but that's like lightning hitting you."

Before the possible becomes probable, Cape Nature Conservation has stepped in. Dyer Island has been a provincial reserve since 1988, designated to protect rare birds that nest on the island. The department is simply extending the Dyer Island reserve to include the waters around the island, with effect from 1 April 1998. From that date, access to the channel will be by permit only. The department is still working out details of the permitting process, but promises it will be strict, and that the numbers of operators will be limited.

"Having seen the mounting problems with white shark diving operations, with them working within a limited space in the channel, we were fearful that all this actually could lead to some disaster," says Duncan Heard, manager of the region responsible for Dyer Island. "It won't be a free-for-all any more."

The decision has been welcomed by biologists, though Ferreira, for one, is adopting a wait-and-see attitude. "The commercial guy, he doesn't care a continental about the law," he says. "They're going to find a loophole. At the end of the day this is becoming a multi-million rand industry. These guys aren't going to let the government stop them from making their money."

Ellen Bartlett is a writer living in Johannesburg, South Africa. Email: <ebartlet@iafrica.com>. Her article first appeared in the Johannesburg Mail and Guardian, 6 March 1998.

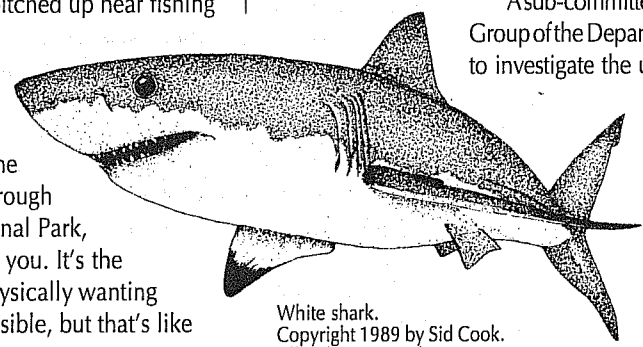
Shark cage diving in South Africa – sustainable recreational utilisation?

Marcel Kroese, Sea Fisheries Research Institute, South Africa

Shark cage diving started around 1990–1991 at Dyer Island, Gansbaai, situated close to the southern-most tip of Africa. Initially used for research observations, cage diving developed into a funding generating venture. Other individuals noticed a niche market and several started offering the same service to tourists. Commercial cage diving has since spread to other areas of southern Africa, Mossel Bay in 1993, and most recently False Bay in 1996. At present there are ten cage diving operators, taking out an estimated 4,000 divers annually.

Initially the cage diving industry was embroiled in user conflict issues with commercial fishermen and abalone divers utilising the same area. Additionally, conflict flared up within the cage dive fraternity, and between cage dive operators and scientists studying white sharks. Unscrupulous behaviour of some operators led to incidents where sharks were injured and reported flaunting of small craft safety regulations led to the reputation of shark cage operators as 'cowboys'.

The fledgling industry realised this reputation was adversely influencing their business and initiated a White Shark Cage Diving Association. The express aim was to improve the standards of the cage diving as well as protecting the white sharks. It was also realized that a maximum number of operators had been reached, therefore there would be limited entry into the cage diving operations.



White shark.

A sub-committee of the Chondrichthyan Working Group of the Department of Sea Fisheries was formed to investigate the user group conflict and the cage diving operations. The resultant extensive consultative forum of user groups, cage diving industry and scientists eventually led to a code of conduct and an operational management plan for shark cage diving in South Africa.

Provisional regulations allow for a geographically restricted permit system, closed areas, and range restrictions. All permit holders must be signatories of the Code of Conduct. The Code of Conduct makes recommendations on the level of technical training operators need, equipment standards in terms of cages, and safety gear. The specific chum types, quantities allowable per day, bait presentation and shark handling are also outlined.

The provisional regulations became available at the end of June, following their review by the Department of Sea Fisheries. They will be presented to the industry and other usergroups at a meeting in July, and are not expected to be Gazetted until later in the year.

The cage diving issue is not out of the woods yet. A recent spate of six attacks on surfers and divers in the space of five weeks, the highest since 1994, has led to accusations that the cage diving industry has either habituated or excited sharks into attacking swimmers and surfers. However, only one such attack has occurred within 150 km of a cage diving site. Other environmental factors such as the proximity of sardine (pilchard) schools in the vicinity and murky water close to river mouths were present, negating the link between cage diving and shark attacks.

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Testing the Shark POD

Valerie Taylor, New South Wales, Australia

In January 1992, Ron and I began a series of tests on a newly designed electronic device that was claimed by the Natal Sharks Board to repel sharks. The invention produced a pulsing electronic field that interfered with sharks' sensitive electro-receptors, creating an unpleasant but harmless irritation.

Our first tests took place in the Durban Sea World shark tank, in South Africa. The director of the Natal Sharks Board, Graeme Charter, was interested in having a diver testing the repeller against potentially dangerous sharks, underwater.

At first we were both sceptical: in the past we had tested many different shark repelling inventions. With the exception of the power head (an explosive device on a spear), which killed the shark, and the steel mesh suit, which worked well with small to medium sized sharks, nothing else tested by us had worked.

Along with two raggedtooth sharks *Carcharias taurus* and a huge sawfish *Pristis* sp., three large bull or Zambezi sharks *Carcharhinus leucas* were living in the Durban tank. I was to test the device against the bull sharks, who showed a keen interest in our presence. I stood against the wall while Ron, with his back against a cage, filmed from the centre of the tank. Every time I switched on the electronic repeller the shark would flick away, returning to normal behaviour when the device was turned off, or it had swum out of range. (The radiating field has an effective range of 4–5 metres.) The most dramatic results occurred when I delayed activating the device until the shark was at its closest (1 metre away). This produced a very rapid departure. When the device was constantly working, the sharks stayed further away. They would retreat rather casually to the far end of the tank as soon as they detected any irritation. During our later experiments in the tank, we had the bull sharks, jaws agape about to take a fish, suddenly jerking away when they encountered the pulse.

It was pretty exciting stuff, so exciting that we decided we should try the repeller against white sharks *Carcharodon carcharias* in the open ocean. Ron felt that would be the ultimate test, stopping a great white when it is homing in on a meal. If the device could turn a great white, he felt it would probably turn all other shark species.

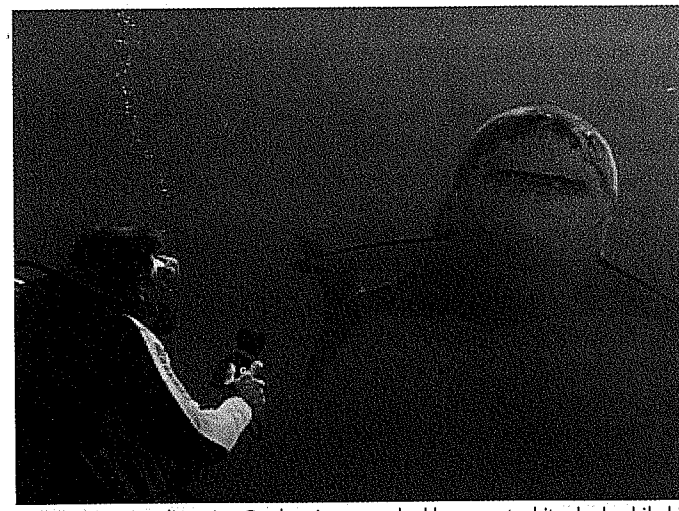
Ron chose an island with a large sea lion colony for the white shark tests. Along with shark experts from the Natal Sharks Board, who had invented the repeller, we travelled to Dyer Island near Cape Town. Leonard Compagno, the world's most knowledgeable shark expert, accompanied us.

We attracted sharks almost immediately there were baits in the water. Our surface testing, which consisted of floating out a bait, then activating the electric field as the shark was about to take it, proved so successful that we decided we could dive and film these sharks without the protection of a cage (we did not have one at the time). Two South African divers accompanied us, one as a safety diver and the other as second cameraman. We spent two weeks working with the Dyer Island great whites.

So successful was the effect of the repelling device, we were able to do all our underwater filming swimming free in the water with the sharks. This was something that had never been done before. We felt invincible after that first dive. There were a dozen or more sharks around, of which five appear on film, and they all kept their distance.

Following this most successful and exciting experiment, we begin a series of tests with different shark species back in Australia. Even when the area was baited, the repeller never failed to turn the sharks away. All these tests were recorded on film.

Based on the success of this early testing, the Natal Sharks Board created a separate company to develop a repeller suitable for divers to wear as protection while swimming in waters where sharks could be a problem. At first, we tested a prototype while filming great whites off South Australia. This gave us a great thrill; once again we found ourselves working outside the cage. The Shark POD (short for Protective Oceanic Device), as the repeller was now called, continued to work well, never failing to turn the shark when it came too close. Ron and I decided that a good TV documentary could be made about this latest testing. It was history in the making; we felt it would be of immense interest to divers and the general public.



A free-swimming diver, Ian Gordon, is approached by a great white shark while his Shark POD is inactive.

After South Australia, we took ourselves into the Coral Sea where we knew we would encounter several species of sharks. The dive charter boat, "*Spoil Sport*" loaned us a rubber boat of our own to work from, well away from the other divers. This proved to be a most interesting and action-packed experience. There was no shortage of sharks and we would have two or three species circling at a time.

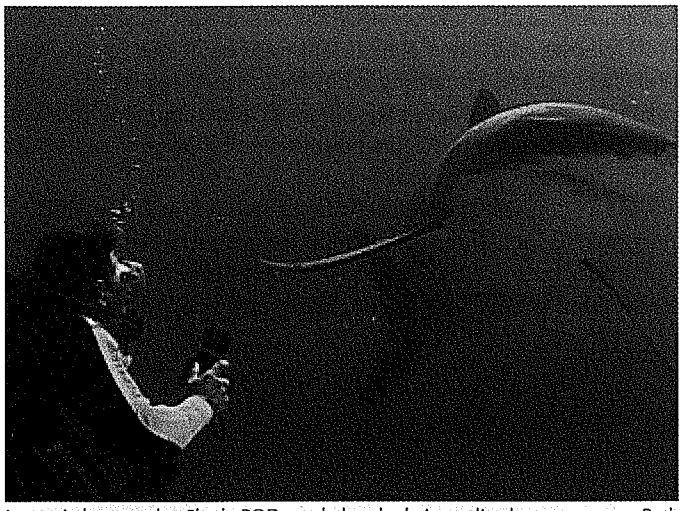
It was during these experiments that we first noticed the sharks' eyes twitching in tune with the electric pulse emitted by the POD. We also discovered that, unlike the prototypes we had used in our earlier tests, once the sharks were feeding they showed a serious reluctance to stop even though obviously affected by the pulse (eyes blinking, mouth twitching, gills cramping). The POD would stop them approaching the baits, but when turned off to let them get their teeth into the fish, then reactivated, they would not release the food. This unexpected lack of reaction was a worry, particularly for the inventors back in South Africa. Once they released the bait, we could keep them from returning, but switch off the POD and they would be back into the food in seconds.

By now we had done well over 100 separate tests on at least ten different species of shark. It was time to hunt for that well known 'man eater' of tropical waters, the tiger shark *Galeocerdo cuvier*.

We travelled to North Queensland where a friend, Shane Down, took us out to work with a group of tiger sharks he had been studying for several years. The location was a shallow lagoon well off shore, heavily populated by stingrays, a favourite food of the tiger shark.

The sharks were quickly attracted to our stingray baits. Once they started to feed, we conducted a series of tests. Marine biologist Ian Gordon, a specialist in shark behaviour, assisted with the experiments.

As expected we found the pulse would stop the tigers taking the bait, but turning off the device so the tigers could started feeding, then reactivating the POD while they had food in their mouths had little effect. They could not be stopped from feeding



Ian switches on the Shark POD, and the shark immediately turns away. Both photographs are video stills taken from the Taylors' *SHARK POD* documentary.

once they were on the baits. If the tigers released the bait, even for a few seconds, the activated POD stopped them continuing to feed. They would circle, obviously wanting to return, but the radiating electric field would keep them away.

During these tests, lemon sharks *Negaprion acutidens*, a great hammerhead *Sphyrna mokarran*, a whaler *Carcharhinus amblyrhyncos*, and a tawny shark *Nebrius ferrugineus* came to the baits as well as the tigers. We had the same experience with all of them. Only the big Queensland grouper *Epinephelus lanceolatus* was unaffected. Whether POD was on or off, the big fish continued to eat some of the bait.

These experiments reinforced our feeling that once a shark starts eating, the desire to feed overrides the instinct of self preservation. No matter how unpleasant the irritation of a POD, it will not release its meal.

The latest POD is a battery powered device which generates a pulsing electric field between two electrodes. One terminal is on the diver's tank and the other on the diver's fin. Sharks have ultra-sensitive electro-receptors with which they can detect the minute electric fields generated in the muscles of marine life. The pulsing, radiating fields around the POD irritate the sharks' receptors, forcing them to move away.

Humans, along with most other forms of sea life, due to their lack of sensitive electro-receptors, are not affected by the electric field.

With over 40 years of diving, you would think Ron and I had seen all the amazing things, had all the greatest adventures, but after making this documentary, I realise we have only just scratched the surface of our adventure with the sea and its amazing inhabitants. We did things believed impossible ten years ago that will probably become commonplace in the next ten months. However, extreme caution is required when diving with potentially dangerous sharks.

These Shark POD tests, conducted over a period of five years, have been another tiny step towards a better understanding of that amazing other world that covers two thirds of our planet and I for one feel privileged to have been given the chance to take it.

Our hour-long documentary *SHARK POD* (from which the video stills illustrating this article are taken) won the Jury award at Antibes, in France. It is now screening on television, world-wide.

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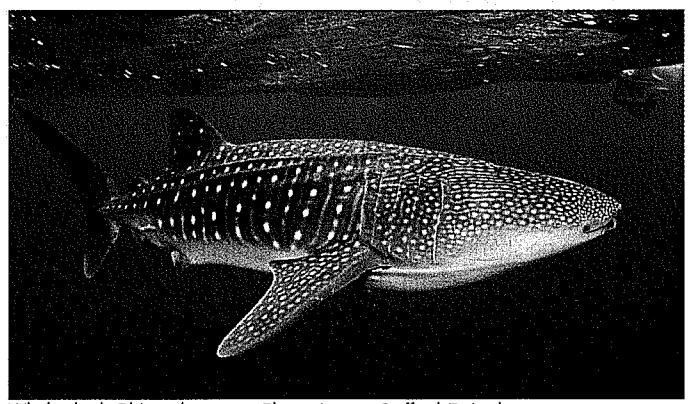
More information on the Shark POD is available from Theo Meyer, Marketing Manager, email: <meyer@sharkpod.co.za>. The POD website at <http://sharkpod.co.za> has details of dealers. Australian divers obtain their units from Paul Lunn, PO Box 82, Kingscote, Kangaroo Island, South Australia 5223. Tel: +618 8553 0101.

Closure of Philippines whale shark fishery

Whale sharks have been hunted traditionally (with spears and gaff hooks from small boats) in the Visayas and Mindanao areas of the Philippines, providing food for local fishing communities. However, the rising value of whale shark products in other countries (particularly Taiwan, where meat sells for up to US$15/kg) has stimulated larger harvests over the past seven years. Worryingly, recent catches in these areas may have fallen by 70%–80%, despite increasing fishing effort.

A new concentration of whale sharks was discovered in January this year by a local diver in the waters of Donsol, Bicol region, where they had not previously been fished. A dozen or more sharks could be encountered here in a day, without the use of spotter planes. Monitoring was immediately commenced by a team from the World Wildlife Fund - Philippines, Silliman University, Hubbs Sea World Research Institute, Scripps Institution of Oceanography, the US National Oceanographic and Atmospheric Administration, and the Department of Agriculture. Some tagging was undertaken (including the attachment of one satellite tag). The team also worked with local authorities to protect whale sharks in the area (the government of Donsol issued a municipal resolution to protect the sharks on 9 March), and to increase local revenues through the development of ecotourism involving whale shark interaction tours, in collaboration with the Provincial Tourism Council.

However, on 12 March, buyers of whale sharks arrived from the Visayas region. Seven sharks were killed and sold for the export under licence of their meat and fins to Taiwan. WWF-Philippines immediately expressed concern that the population could be wiped out in just two weeks of intensive fishing, preventing the establishment of a highly valuable tourist industry. They urged the imposition of a moratorium on the fishery and trade in Bicol until sufficient data could be gathered on population size, movement and sustainable use.



Whale shark *Rhincodon typus*. Photo: Jeremy Stafford-Deitsch.

News of the plight of the Donsol whale sharks soon reached the Philippines national press. Three days after an article appeared on the front page of a national newspaper, the government (Department of Agriculture) banned the fishery. On 26 March 1998, Fisheries Administrative Order No. 193 was issued prohibiting the catching, selling, purchasing and possessing, transporting and exporting of whale sharks and manta rays (which are also caught in large numbers in the Visayas and Mindanao) throughout the Philippines.

WWF is currently helping the community in Donsol to cope with the massive visitor influx to their small town. A programme is being developed for them which will ensure well-managed tourism activities and protection of the whale shark and its habitat.

The whale shark season ended abruptly on 22 May this year, but they are expected to return in November or December.

For more information contact: Mr A.A. Yaptinchay, WWF-Philippines, 23-A Maalindog St, U.P. Village, Diliman, Quezon City 1101, Philippines. Fax: + 63 2 426 39 27, email: kkp@mozcom.com

The American Zoo & Aquarium Association: elasmobranchs in public aquaria

Doug Warmolts, The Columbus Zoo, USA

The American Zoo & Aquarium Association (AZA) consists of over 180 accredited zoological parks and aquariums in North America. Collectively, AZA institutions reach over 122 million visitors annually. AZA members support a growing number of cooperative wildlife research and conservation efforts, both regionally and internationally. In 1995 alone, members initiated or supported over 1,200 conservation projects in over 60 countries and published 660 articles on wildlife management and biology. Through its newly reorganised Marine Fishes Taxon Advisory Group (MFTAG), the AZA plans to expand its support of and participation in elasmobranch conservation. Three examples of on-going programmes by AZA institutions follow:

Waikiki Aquarium

Waikiki Aquarium shark researcher Gerald Crow, Brad Wetherbee, and Chris Lowe from the University of Hawaii are studying the effect of fishing control programmes on shark populations around the main Hawaiian islands. Their series of papers (review of shark control, diet of the tiger shark, and a paper in preparation on the reproductive biology of the tiger shark) have raised awareness of the limits of our knowledge of shark population biology. The researchers also testified at the Hawaii State Legislature to stop a planned shark control fishing programme.

The Waikiki Aquarium has served as a vital source of factual information on shark biology. A current project at the Aquarium is a study of the thyroid gland. This research will determine baseline thyroid hormone concentrations from healthy and goitred whitetip reef sharks. The project also will investigate worldwide pathology records of goitred animals from the Registry of tumours of lower vertebrates. Goiters are one of the most common long-term problems in the husbandry of elasmobranchs in captivity. Although rare this condition has also been reported from the wild. This project will summarise pathology conditions and suggest possible solutions to this disease. The paper will be the first comprehensive review of goiters in elasmobranchs ever conducted.

The Waikiki Aquarium is currently maintaining the following sharks and rays: four blacktip reef sharks *Carcharhinus melanopterus*, one zebra shark *Stegostoma fasciatum*, one brown banded bamboo shark *Chiloscyllium punctatum*, and one pelagic ray *Dasyatis violacea*.

Monterey Bay Aquarium

The exhibits at the Monterey Bay Aquarium (MBA) are designed as habitat displays exhibiting fish and invertebrate communities. The Monterey Bay Habitats exhibit features sevengill sharks *Notorynchus cepedianus*, leopard sharks *Triakis semifasciata*, spiny dogfish *Squalus acanthias* and big skate *Raja binoculata*. The Outer Bay exhibit features soupfin shark *Galeorhinus galeus*. Almost all of the other exhibits have elasmobranchs along with teleosts, and some exhibit tanks are dedicated to big skate and swell shark *Ephaloscyllium ventriosum* egg cases. MBA maintains a bat ray *Myliobatis californica* 'petting pool' that will change in the future to a habitat display exhibiting animals that use wetlands as nursery grounds.

MBA interprets shark conservation messages, with its education programmes including a shark night for members and volunteers. The overfishing of shark stocks is interpreted with videos in our auditorium and also during our kelp forest feeding show.

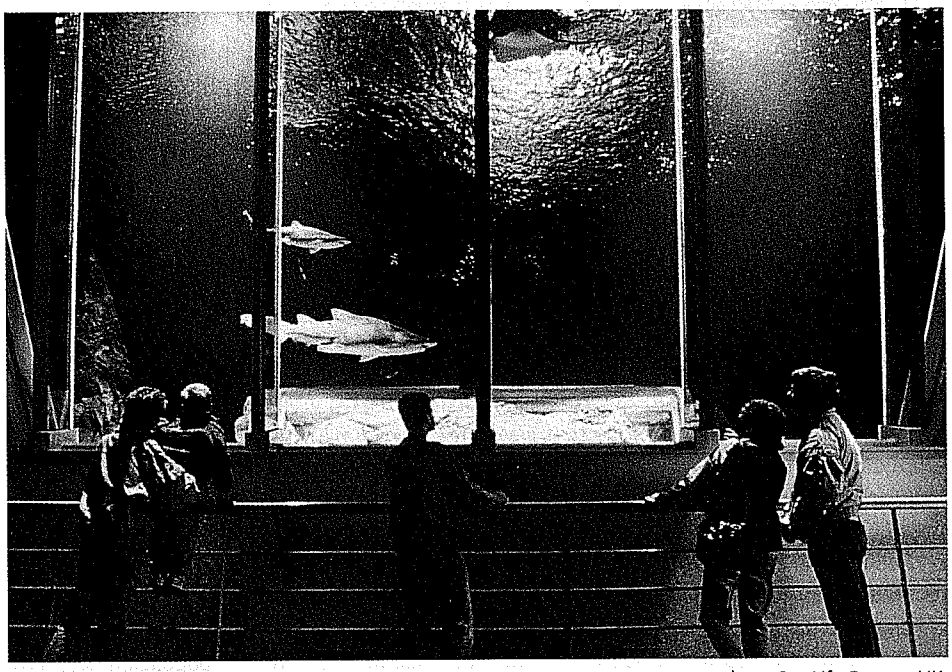


Photo: Sea Life Centres, UK.

MBA research on captive elasmobranchs includes looking for new husbandry techniques to allow the maintenance of blue sharks *Prionace glauca* on exhibit in the Outer Bay exhibit, as well as deep water animals such as filetail catsharks *Parmaturus xaniurus*, and ratfish *Hydrolagus colliei*, to be featured in a new exhibit on the animals of the Monterey submarine canyon.

Description of mating in the ratfish and an ongoing captive growth study of the pelagic ray have also been part of the programme. MBA staff are also looking at tooth shedding rates and metabolic rates of the pelagic ray.

A captive growth study on the sevengill shark was conducted at MBA in the past (Van Dykhuizen and Mollet 1992) and now we tag all sevengill sharks that are released from the aquarium due to snout abrasions, and send the information to California Department of Fish and Game for their pelagic shark database. MBA also learned that one animal released from the aquarium was at liberty for two years and also showed homing behaviour, swimming over three hundred miles to the point of original capture. This incident makes us believe that sevengill sharks may be released back into the wild with good chances of survival.

The Wildlife Conservation Society

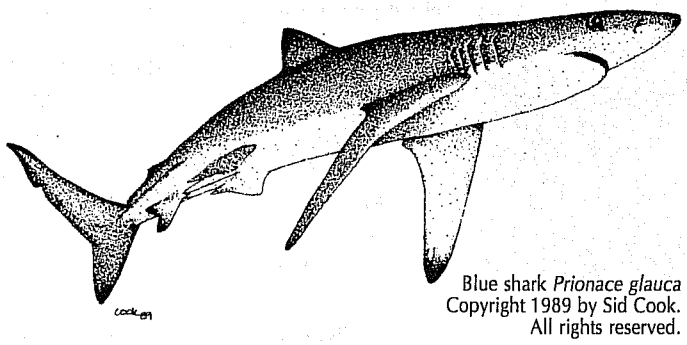
The mission of the Wildlife Conservation Society's (WCS) Fisheries Programs is to generate scientific information vital to the maintenance, conservation, and recovery of fish populations and the habitats that support them, and to promote the responsible and sustainable use of fisheries resources.

A critical lack of scientific information, combined with poor and inadequate management policies and practices, has resulted in widespread overfishing and the severe depletion of oceanic,

coastal and freshwater fish populations around the globe. WCS's Fisheries Programs, based at the Society's Osborn Laboratories of Marine Sciences (OLMS), seek to address the current fisheries crisis through the integration of basic and applied research and policy work. Current areas of thematic emphasis include: 1) quantitative fishery analysis and assessment; 2) bycatch; 3) small-scale fisheries; 4) threatened freshwater fishes; and 5) coastal sharks and highly migratory pelagic fishes.

Sharks and other ocean giants such as tuna, marlin and swordfish are being depleted at an alarming rate. While declines of all these species are being driven, in part, by market demands, bycatch remains the major source of mortality for sharks on a global basis. Many shark species are long-lived, grow slowly, mature late and produce few offspring, which makes them particularly susceptible to overfishing, and very slow to recover once depleted. Highly migratory sharks routinely cross national boundaries, yet international management plans for these species are non-existent. Moreover, there are serious gaps in data and methodologies needed to assess and manage these populations properly.

WCS's work on sharks integrates several Fisheries Program themes: quantitative assessment, bycatch and the international aspects of fisheries issues. At present, novel quantitative fishery analysis and assessment methods are being developed and applied to assist recovery of populations of large coastal sharks in the Northwest Atlantic Ocean, some of which have declined by 80% in the past decade. The expertise of WCS scientists in developing techniques for reducing bycatch is being applied to shark bycatch concerns. This year we are testing the feasibility of using satellite telemetry to track sand tiger sharks and to evaluate the ability of this technique to estimate bycatch survival. A shark research facility at WCS's Osborn Labs is currently in planning. Through



Blue shark *Prionace glauca*

WCS's science, policy and international expertise, and through our work with the Ocean Wildlife Campaign (OWC) – a coalition of conservation organizations dedicated to conservation and restoration of giant ocean fish – WCS's Fisheries Programs is working to effect policy changes that will conserve, restore and manage shark populations both regionally and globally.

Reference

Van Dykhuizen, G, and Mollet, H.F. 1992. Growth, age estimation, and feeding of captive sevengill sharks, *Notorynchus cepedianus*, at the Monterey Bay Aquarium. In: *Sharks: Biology and Fisheries*. J.G. Pepperell ed. *Australian Journal of Marine and Freshwater Research 43*: 297–318.

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Elasmobranch research and conservation efforts at the National Aquarium in Baltimore (NAIB)

Alan D. Henningsen and Kimberly Morris-Zarneke, National Aquarium in Baltimore, USA

Human populations have profound and often destructive effects on natural habitats worldwide. Zoos and aquariums have both the capacity and the responsibility to increase public awareness of these issues, and to implement programmes that connect their institutions to conservation activities. The National Aquarium in Baltimore (NAIB) promotes conservation of elasmobranchs through educational programmes for school children, member lectures, and exhibitry. The Aquarium's two major display tanks for cartilaginous fishes, the 985,000 litre Central Elasmobranch Exhibit and the 852,000 litre Open Ocean Exhibit, house ten shark species (23 individuals) and 12 batoid species (79 individuals). These exhibits offer visitors a realistic perception of sharks of the region and increases awareness of shark life history patterns.

NAIB supports elasmobranch conservation through staff involvement with such pioneer groups in elasmobranch conservation as the American Elasmobranch Society, the Shark Specialist Group of IUCN, and the Center for Marine Conservation. The Aquarium supported the 1993 Fishery Management Plan for Sharks in the Atlantic Ocean and the 1997 amendment to reduce fishing quotas for sharks, and supports development of a conservation plan for the spiny dogfish *Squalus acanthias*.

The National Aquarium in Baltimore is located near the Chesapeake and Delaware bays, which are important nursery areas for the sandbar shark *Carcharhinus plumbeus*, and other migratory coastal species. For the past 16 years, NAIB has collected elasmobranchs for display using bottom set longlines in the Delaware Bay. A summary of this work was presented by Henningsen *et al.* (1996). In addition to capturing animals for display, over 250 sharks have been tagged in conjunction with the National Marine Fisheries Service Apex Predator Investigation Program. Juvenile sandbar sharks are maintained in captivity for one year, and then tagged and released into the Delaware Bay. During their stay in captivity, information is collected on their growth and food intake as well as tag shedding. The work in the Delaware Bay has also been used to gather data on biology and reproductive physiology (endocrinology). Blood samples collected from wild-caught sharks are examined for cell morphology, counts and distribution. There is little clinical information on elasmobranch haematology; these data serve as a reference for health assessment of the NAIB collection sharks. Information gathered by the National Aquarium in Baltimore is shared through conference presentations and journal publications.

Reference

Henningsen, A., Hecker, B., Hampton, P., and Jones, R.T. 1996. Survey of large coastal sharks in the Delaware Bay by longline. *Proceedings of the 76th Annual Meeting of the American Society of Ichthyologists and Herpetologists, 12th Annual Meeting of the American Elasmobranch Society, New Orleans, LA, June 13–19*. p. 171 (abstract).

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Shark and ray fisheries in Turkey

Hakan Kabasakal, University of Istanbul, Turkey

Because of the unusual appearance of sharks and rays, the smell of their meat, and the religious beliefs of the Turkish people, only limited quantities of these fish are eaten in Turkey. However, recent drastic reductions in the stocks of traditional commercially important sea fishes mean that chondrichthyan fishes are now actively being considered as new opportunities for fisheries development.

In Turkey, the main fishing areas for sharks and rays are in the Black Sea and the northern Aegean. Fishermen use otter trawls, purse seines, bottom long-lines and shark nets. The shark nets used by fishermen are a form of gill net. Combinations of 12 to 20 of these nets are set on the bottom. Each net is 200 m long by 6 m deep, with a mesh size of 12 cm (knot to knot). Seabream and turbot long-lines are also commonly used in the shark fishery, but the gear is made from stronger materials.

Spiny dogfish *Squalus acanthias*, thornback ray *Raja clavata* and smooth-hounds *Mustelus* spp. are the species targeted. The first two species are commonly caught in the Black Sea. Spiny dogfish and thornback rays are, according to Kutaygil and Bilecik (1976), very important among the Black Sea's demersal fish fauna, and constituted 18.1% and 5.7%, respectively, of the total demersal catch on the Turkish coasts of the Black Sea at this time.

Thornback rays are abundantly caught on the western Black Sea coasts of Turkey between 30 and 50 m depth (Kutaygil and Bilecik 1979). The main fishing grounds of the large individuals (80–110 cm TL) of spiny dogfish are the coasts of the central Black Sea (Kutaygil and Bilecik 1977). Fishing depths for the spiny dogs ranged from 90 m to 110 m or a little deeper.

Unfortunately, we do not have detailed information on the present status of the stock structure and population dynamics of these chondrichthyans in Turkish seas.

Many of the smooth-hounds landed in Turkey are taken by shark nets, particularly in the northern Aegean Sea. The lesser spotted dogfish *Scyliorhinus canicula* is another shark caught in the Sea of Marmara and the northern Aegean Sea. The length of this species rarely exceeds 50 cm and it is therefore usually discarded by fishermen.

Large sharks are not subjected to a targeted commercial fishery in Turkey, but they are accidentally caught during the fisheries for other commercially important species. The commercial swordfish long-line fishery in the Gulf of Antalya (on the Mediterranean coasts of Turkey) takes thresher sharks *Alopias vulpinus* incidentally. The bycatch of these vessels is mostly landed for export. Purse seine vessels only rarely land bluntnose sixgill shark *Hexanchus griseus* bycatch in the Sea of Marmara.

The meat of the spiny dogfish and smooth-hounds is typically processed (smoked or salted) for export, or marketed as fresh whole carcasses. Fins and oil-filled livers of sharks are processed and exported, but no data are available on production quantities. Rays and skates are typically processed as wings, and marketed frozen and without skin.

Our knowledge of the life history parameters (i.e. age and size at first maturity or breeding season) and the population dynamics of sharks and rays in Turkish seas is very scarce. Furthermore, no management measures have been implemented for sharks and other species of chondrichthyan fishes. These two points are possibly the major factors hindering the development of a sustainable chondrichthyan fishery in Turkey.

Annual spiny dogfish and thornback ray landings (tons) in Turkey, 1994.

Fishing area	Spiny dogfish	Thornback ray
Black Sea		
Eastern part	463	341
Western part	1,969	346
Sea of Marmara	79	60
Aegean Sea	129	165
Mediterranean Sea	240	326
Total	**2,880**	**1,238**

(From 1994 Fishery Statistics, State Institute of Statistics, Prime Ministry of Republic of Turkey.)

Annual landings (mt) of sharks and rays in Turkey, 1989–1994.

Species	1989	1990	1991	1992	1993	1994
Smooth-hounds (*Mustelus* spp.)	5,140	1,715	2,292	2,404	1,436	2,880
Angelfishes (*Squatina* spp.)	25	34	17	13	13	15
Skates (*Raja* spp.)	2,028	1,056	1,209	1,557	1,557	1,238

(From: FAO yearbook, Fishery statistics (Catches and landings), 1994.)

Istanbul Harbour. Photo: Paul Goriup.

Exported chondrichthyan production of Turkey, 1994.

Product	Quantity (kg)	Value (US$)
Shark fillets, smoked	2,145	2,698
Spiny dogfish, fresh/chilled	8,423	21,222
Lesser spotted dogfish, fresh/chilled	220	518
Spiny dogfish, frozen	33,680	66,590
Spiny dogfish and lesser spotted dogfish, frozen fillets	45,640	69,827
Shark fillets, frozen	66,950	122,140
Shark fillets, fresh/chilled	25,864	50,823
Shark fillets, smoked	7,361	35,810
Shark fillets, salted	130	377
Shark fillets, processing type unknown	2,790	4,464
Total	**193,203**	**374,469**

(From 1994 Fishery Statistics, State Institute of Statistics, Prime Ministry of Republic of Turkey.)

References

Kutaygil, N., and Bilecik, N. 1976. Observations sur les principaux produits démersaux qui sont pêchés sur les côtes Turques de la mer Noire. *Rapp. Comm. Ýnt. Mer Médit.*, 23, 8:75–77.

Kutaygil, N., and Bilecik, N. 1977. Recherches sur le *Squalus acanthias* L. Du littoral anatolien de la mer Noire. *Rapp. Comm. Ýnt. Mer Médit.*, 24, 5:81–83.

Kutaygil, N., and Bilecik, N. 1979. La distribution du *Raja clavata* L. sur le littoral anatolien de la mer Noire. *Rapp. Comm. Ýnt. Mer Médit.*, 25/26, 10:95–98.

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Basking shark protection extended again

The basking shark *Cetorhinus maximus* has been strictly protected for several years in a small area around the Isle of Man, Irish Sea, UK. This extremely limited protection has (unsurprisingly for a migratory species) not prevented a steady decline in recorded summer sightings around the island over the past decade. However, the area of protection for the species has gradually been extended during the past three years.

The first significant move was the addition in 1995 of Mediterranean basking sharks to Annex II: Endangered or Threatened Species, of a Barcelona Convention Protocol, albeit meaningless until ratified and implemented (*Shark News* no. 8, p. 7). This was followed by the April 1997 listing of this species and several others in a rule protecting them from directed fishing in US federal Atlantic waters (*Shark News* no. 10, p. 8).

A few months later, in August 1997, the States of Guernsey (an independent group of islands in the English Channel) voted unanimously for a law sponsored by the Department of Fisheries giving total protection to the species in their waters. The Department recognised that the protection provided would not significantly reduce the species' vulnerability in European waters. This would require legislation from coastal powers with greater sea areas under their jurisdiction.

A move in this direction took place in December 1997 when the listing of the Mediterranean basking shark population on Appendix II (Strict Protection) of the Bern Convention on Conservation of European Wildlife and Natural Habitats was agreed, albeit with a reservation from the European Union. Once this reservation is lifted, the species will automatically also become listed on the European Habitats and Species Directive, and Member States will be required to prohibit the killing, capturing and keeping of basking sharks from the Mediterranean. Most recently, in April 1998, the UK government announced the full protection of the basking shark in British waters (out to the 12 mile limit).

Further protection in Europe will require similar conservation legislation on the part of other range state countries, or action on the part of the European Union as a whole. The latter might be achieved by lifting the Bern Convention reservation and extending the listing, or by establishing a zero Total Allowable Catch for basking sharks under the Common Fisheries Policy. New Zealand, for example, banned target fishing for the species in 1991 (although bycatch may still be landed).

New publication:
IUCN Guidelines for Re-introductions

These Guidelines were prepared by the Species Survival Commission/ IUCN Re-introduction Specialist Group (RSG) and officially approved by the 41st Meeting of IUCN Council in May 1995.

The re-introduction guidelines are written to encompass the full range of plant and animal taxa, and are therefore general. They will be regularly revised, and are also intended to act as a launching pad for the development of taxa and species-specific guidelines, to be developed in handbook form in the future. Meanwhile, IUCN would like to receive criticisms, both positive and negative, arising from the application of these guidelines in designing and implementing re-introduction projects. These will enable future updates to be made and specific guidelines to be developed.

Copies of the booklets have been published in Arabic/English, Chinese/English, French/English, Russian/English, Spanish/English and English only. They are available from the IUCN Publication Services Unit, 219c Huntingdon Road, Cambridge CB3 0DL, United Kingdom. Fax: + 44 1223 277175. Prices are $7.50 or £5 for the bi-lingual versions and $6 or £4 for the English-only version. SSC and IUCN members are entitled to a one-third discount.

The guidelines are also on the Web in English, French and Spanish at http://iucn.org/themes/ssc/pubs/policy/index~1.htm.

Chumming the *Elphinstone* wreck, Egypt

Christian Wagner, who took a diving holiday on a liveaboard in the Red Sea at the end of last year, wrote to *Sport Diver* with news of a dive boat seen baiting a 4 m oceanic whitetip shark from its dive platform in order to enable the shark's mouth to be photographed out of the water. This activity was underway while Wagner was swimming back to his own dive boat some 25 m away. He reports he was "glad to cuddle the dive boat's propellor" as the shark headed in his direction.

He concluded: "next time you dive the *Elphinstone* keep your eyes behind you, as there is an oceanic whitetip that has been trained to bite meat that hangs from a dive platform." Egyptian authorities were informed.

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: .....

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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.

The Columbus Zoo is proud to be a sponsor of the eleventh publication of *Shark News*. As part of the Zoo's ongoing attempts to support conservation and education internationally, we hope this issue continues to be a vital link between the members of the Shark Specialist Group and others.

The mission of the Columbus Zoo is to promote an awareness and understanding of our natural world through the encouragement of responsible conservation and the dynamics of education. Under the guidance of the Zoo's Animal Management, Health and Scientific Studies Committee, the Zoo promotes global awareness by assisting in legislative sponsorship and supporting over 30 international research and conservation initiatives. At home, the Zoo continues to make advances in education and environmental interpretation. Programming designed to encourage a holistic approach to conservation is offered throughout the year, in hundreds of programming efforts, reaching an audience of over 1 million annually.

Understanding our world allows us to understand ourselves. With each new advance towards this goal we insure our future. If we encourage proper management of our resources, creative information exchanges and exciting educational opportunities, we will promote understanding through true appreciation of the uniqueness and diversity of our natural world.

We gratefully acknowledge the help of the National Audubon Society with the distribution of *Shark News* and the donations for newsletter production and other work received from the following individuals and organisations: Steven Brockwell, André Carvalho, Marc Chadwick, Alberto Luis Cione, Angela Evans, Manoel Gonzalez, Karger Libri AG, Maurice Kottelat, Jochen Chr. Krause, Mohamed Moonaff, Daniel Morgan, the Recreational Fishing Alliance, The Shark Trust, Survival Anglia Ltd, and Douglas Watson.

Meetings

American Elasmobranch Society 14th Annual Meeting

During the ASIH meeting, Guelph, Ontario, Canada. 16–23 July 1998. Two symposia will be sponsored by the AES: **1) Feeding biology of elasmobranch fishes** and **2) The behavior and sensory biology of sharks and rays.** For more information, go to http://www.elasmo.org

INTECOL, VII International Congress of Ecology: "New tasks for ecologists after Rio 92"

Florence, Italy. 19–25 July 1998.
See web site at <http://www.tamnet.it/intecol.98> or contact INTECOL Secretariat. Email: <afarina@tamnet.it> Fax: + 39 187 420727.

Expo98: The Oceans, a Heritage for the Future

Lisbon, Portugal. 22 May to 30 September 1998.

European Elasmobranch Association meeting

Lisbon, Portugal, 15 September 1998.
The Portuguese Association for the Study and Conservation of Elasmobranchs (APECE) will host the EEA Science Meeting the day before the ICES Science Meeting, if there is enough interest from speakers and participants. Contact Paula Joao Faria for more information. Fax + 351 1 891 7051. Email: <pjfaria@expo98.pt>

ICES Annual Science Conference

Lisbon, Portugal, 16–19 September 1998.
Themes include: Deep-Water Fish and Fisheries, Convener: J.D.M. Gordon (UK). For more information see web site at www.ices.dk/asc, or contact ICES: Fax: +45 33 93 42 15, email: <asc@ices.dk>

Japanese Elasmobranch Society Symposium: Recent status of elasmobranch studies

Ocean Research Institute, University of Tokyo. 19–20 November 1998. A Southeast Asian Shark Specialist Group regional meeting may 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. Send offers of posters by 15 October 1998. Contact: Professor Henrik Gislason, Danish Institute for Fisheries Research, Charlottenlund Castle, DK-2920 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>

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:

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