SHARK NEWS

SHARK NEWS 7 NEWSLETTER OF THE IUCN SHARK SPECIALIST GROUP JUNE 1996

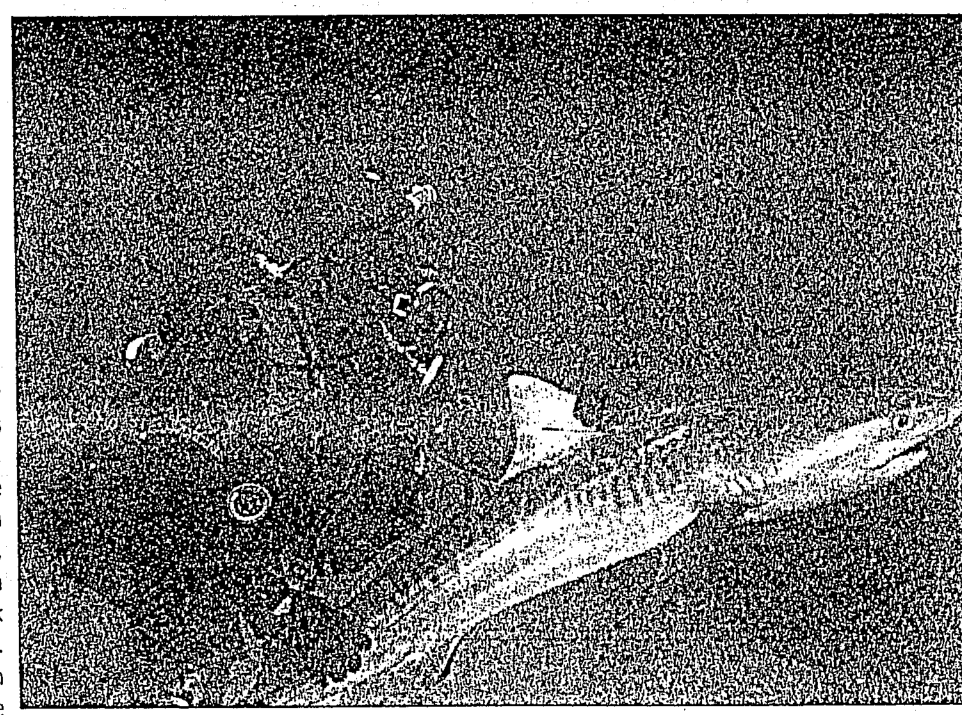
NMFS Cooperative Shark Tagging Program

Nancy Kohler, National Marine Fisheries Service, USA

The National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program (CSTP) is part of continuing research directed to the study of the biology of large Atlantic sharks. The CSTP was initiated in 1962 with an initial group of less than 100 volunteers. The Program has expanded in subsequent years and currently includes over 6,500 volunteers distributed along the Atlantic and Gulf coast of North America, and Europe. The tagging methods used in the CSTP have been essentially unchanged during the past 30 years. The two principal tags that are in use are a fin tag (Jumbo Rototag) and a dart tag ("M" tag). The rototag is a two piece, plastic cattle ear tag which is inserted through the first dorsal fin. These tags were primarily used by NMFS biologists on small sharks during the first few years of the CSTP. As the Program expanded to include thousands of volunteer fishermen, the dart tag was developed to be easily and safely applied to sharks in the water. The "M" tag is composed of a stainless steel dart head, monofilament line, and a plexiglas capsule containing a vinyl plastic legend with return instructions printed in English, Spanish, French, Japanese and Norwegian. These dart tags, in use since 1965, are implanted in the back musculature near the base of the first dorsal fin. More recently, a Hallprint tag has been used on a limited basis for use on small sharks in the nursery areas.

Numbered tags are sent to volunteer participants on self-addressed return post cards for recording tagging information (date, location, gear, size and sex of shark), along with a tagging needle, tagging instructions, an Anglers Guide to Sharks of the Northeastern United States, and a current Shark Tagger newsletter. This newsletter is an annual summary of the previous year's tag and recapture data and biological studies on sharks which is sent to all participants in the CSTP. Tagging studies have been mostly single release events in which recoveries are made opportunistically by recreational and commercial fishermen. When a previously tagged shark is re-caught, information similar to that obtained at tagging is requested from the recapturer. Initially, a five dollar reward was sent as an incentive for returning tags; since 1988, a hat with an embroidered logo has been used.

Between 1962 and 1995, more than 128,000 sharks of 40 species have been tagged and more than 6,000 sharks of 32 species have been recaptured, as a result of the CSTP. Eighty-six per cent of the tags are represented by eight species: blue shark *Prionace glauca*, sandbar shark *Carcharhinus plumbeus*, dusky shark *C. obscurus*, tiger shark *Galeocerdo cuvier*, shortfin mako *Isurus oxyrinchus*, blacktip shark *C. limbatus*, scalloped hammerhead *Sphyrna lewini* and Atlantic sharpnose shark *Rhizoprionodon terrraenovae*. The number of sharks tagged varies from two for the smalleye hammerhead *Sphyrna tudes* to 70,303 for the blue shark.



A juvenile tiger shark *Galeocerdo cuvier*, tagged by scientists in the Bahamas, about to be released. Photo: Jeremy Stafford-Deitsch.

Numbers of recaptures by species range from one for the Greenland shark *Somniosus microcephalus* to 3,098 for the blue shark. Eighty-six per cent of the recaptures are made up of seven species: blue shark, sandbar shark, tiger shark, shortfin mako, lemon shark *Negaprion brevirostris*, dusky shark, and nurse shark *Ginglymostoma cirratum*. The rate of recapture ranges from 1.4% for the Atlantic sharpnose shark to 10.6% for the nurse shark.

Anglers using rod and reel accomplish the majority of the tagging for all species combined. Biologists, NMFS fisheries observers, and commercial fishermen using primarily longlines, handlines, and nets (gill, trawl) account for the remainder. Conversely, commercial fishermen using longlines and net gear, and rod and reel anglers are responsible for the majority of the recaptures.

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Distances travelled for the 32 species ranged from no movement to 3,740 nautical miles (nmi). In total, one species, the blue shark, travelled distances over 3,000 nmi, three species travelled distances between 2,000 and 3,000 nmi (shortfin mako, dusky and sandbar shark), eight species between 1,000 and 2,000 nmi (tiger, bignose *C. altimus*, galapagos *C. galapagensis*, bigeye thresher *Alopias superciliosus*, night *C. signatus*, oceanic whitetip *C. longimanus*, blacktip, and porbeagle shark *Lamna nasus*) and seven species travelled distances between 500 and 1,000 nmi (scalloped hammerhead, spinner *C. brevipinna*, longfin mako *I. paucus*, silky *C. falciformis*, sand tiger *Odontaspis taurus*, Atlantic sharpnose and white shark *Carcharodon carcharias*).

The longest time at liberty for any shark in the CSTP is 27.8 years. Overall, one species of shark, the sandbar shark, has been at liberty over 20 years, three species have been at liberty between 10 and 20 years (dusky, night and tiger shark), and 13 have been at liberty between 5 and 10 years (scalloped hammerhead, shortfin mako, blacknose *C. acronotus*, bignose, porbeagle, blue, thresher *A. vulpinus*, nurse, Atlantic sharpnose, blacktip, silky, bull *C. leucas*, and bigeye thresher shark).

Data from tagging programmes, such as the NMFS CSTP, provide valuable information on migration. The need for international cooperation is underscored by the fact that many shark species have wide ranging distributions, frequently traverse national boundaries, and are exploited by multinational fisheries. The CSTP is also an important means to increase our biological understanding of sharks and to obtain information for rational resource management. The tagging of sharks (and other aquatic animals) provides information on stock identity, movements and migration (including rates and routes), abundance, age and growth (including verification/validation of age-determination methods), mortality, and behaviour.

For more information on the NMFS Cooperative Shark Tagging Program, please contact:

Apex Predator Investigation
NOAA/NMFS/NEFSC
28 Tarzwell Drive
Narragansett, RI 02882 USA

Communicating with the Shark Specialist Group

Would all Shark Specialist Group members please send their email address to the editors and tell us whether you are a subscriber to Elasmo-L. This information will help us to improve our regular communication with you, reduce our high international postage costs, and let us know what proportion of members see our postings on Elasmo-L.

Basking shark tagging and telemetry in the UK

A number of research groups based in the UK are hoping to undertake tagging studies of basking sharks this year. Various techniques are planned, including the use of satellite, radio and visual tags. Study locations range from the south-west of England, to the Isle of Man (where visual tagging studies have now been under way for several years) and the west coast of Scotland.

The Marine Conservation Society (MCS) is also continuing its sightings scheme, with members of public, fishermen and yachtsmen being encouraged to record all sightings of basking sharks. The data recorded are put on the MCS database, which already holds several thousand records from previous years.

Registers of tagging programmes

Sarah Fowler, Shark Specialist Group

While collating just the small amount of information on tagging programmes which appears in this issue of *Shark News*, it became apparent that there are a very large number and varied range of tagging programmes in operation, with several new initiatives starting up in different countries this year alone.

The question immediately arose: how are these coordinated so that the data which is obtained from tag returns is not lost? Is there a central register of tag and release programmes, which ensures that tag returns eventually make their way back to the appropriate organisation and are matched with the original release data? No doubt these are very obvious questions to all those who have been actively involved in tagging programmes for some time, but this information appears not to be generally available to individuals who are setting up new tagging initiatives for the first time.

My enquiries have resulted in information being provided on just two such registers.

International Game Fish Association Register

The IGFA reportedly publish a world-wide list of fish tagging programmes. This list is updated annually and appears in their World Game Fish Yearbook. Unfortunately, details of programmes contained in this register and when it is updated had not been obtained by the time *Shark News* went to print. However, if we obtain more information, we will publish this in the next issue.

The address of the International Game Fish Association is: 1301 East Atlantic Blvd., Pompono Beach, FL 33060, USA.

Tag and release data circulation in Europe

An international system has been set up within Europe for the exchange of both release information and recaptured fish data. In theory, all organisations and individuals contributing towards tagging programmes should send details of the fish they have tagged (e.g. release date and position, species, length, sex, condition and liveliness when released) to their national coordinating body (usually a marine laboratory). For England and Wales, the Fisheries Research Laboratory, Lowestoft, of the Ministry of Agriculture, Fisheries and Food, not only keeps the national release list, but also summarises and copies it to all MAFF port offices around the UK and to similar establishments in other European nations. Each national office then pays a reward for the recapture of each tag returned within that country (plus market value of the fish if the body is also surrendered), and ensures that the recapture information is forwarded to its country of origin. This reciprocal arrangement, whereby the cost is born by the country of recapture rather than origin, minimises administrative costs and balances out in the long run. However, each country's tags must be identifiable for the system to work! The Fisheries Laboratory at Lowestoft has quite a few untraceable tags which were recovered from elasmobranchs tagged in unattributable tagging programmes!

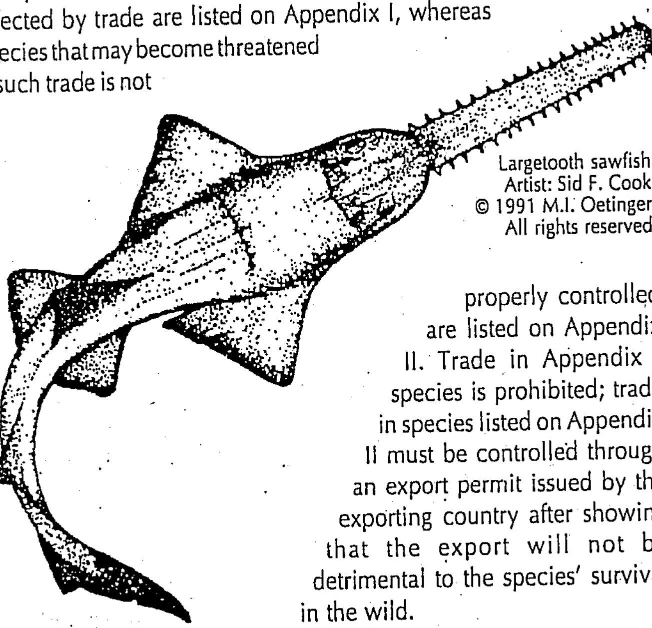
Contact Martin Vince, Ministry of Agriculture, Fisheries and Food, Directorate of Fisheries Research, Fisheries Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK, for more information on tagging programmes in England and Wales.

It is obviously essential for all tagging programmes to be fully integrated in a major national or international tagging scheme to ensure that the return rate of recaptured tags is maximised. New taggers should take note and make appropriate arrangements. At the very least, it is essential that each country's tags have an identifying national prefix code! Researchers setting up new tagging projects should ensure that they obtain details of the appropriate national tag prefix and use it.

Sawfishes considered for CITES – advice sought

As we have reported in previous issues of *Shark News*, there is concern among many Shark Specialist Group members over the decline of sawfishes (Family Pristidae) throughout the world. Sawfish are exploited for their rostral saws, meat, oil, fins, and skins. International trade in sawfish products may be contributing to the continued decline of sawfish species. For example, it has been recently reported that Chinese distributors may be supplying souvenir shops and biological supply companies in the US with rostra from *Anoxypristis cuspidata*. Therefore, listing sawfish species on CITES (Convention on International Trade in Endangered Species) may be a valuable conservation tool for monitoring and/or controlling international trade in these already threatened species.

Species that are threatened with extinction and that are, or may be, affected by trade are listed on Appendix I, whereas species that may become threatened if such trade is not properly controlled are listed on Appendix II. Trade in Appendix I species is prohibited; trade in species listed on Appendix II must be controlled through an export permit issued by the exporting country after showing that the export will not be detrimental to the species' survival in the wild.



Largetooth sawfish. Artist: Sid F. Cook. © 1991 M.I. Oetinger. All rights reserved.

In March 1996, the US government published a Federal Register notice soliciting recommendations for species to be considered for listing on Appendix I or II of CITES at the Tenth CITES Conference of the Parties in June 1997 (COP10). A proposal to list all species of sawfishes on Appendix I was submitted to the US Fish and Wildlife Service (FWS) by SSG members Sid Cook and Madeline Oetinger. The US is currently reviewing this proposal and will ask for public comment on it in a Federal Register notice to be issued near the end of August. The US government will then decide whether or not to sponsor a listing proposal for sawfishes at COP10 based on feedback from the scientific and conservation communities and the public at large. Other CITES Parties may also be sought as sponsors for the sawfish proposal.

One of the roles of the Specialist Groups is to advise IUCN on CITES listing proposals and resolutions. The Shark Specialist Group must decide whether to endorse the sawfish listing proposal should the US or other CITES Party decide to sponsor it for COP10. Shark Group members will be discussing the sawfish proposal and other potential CITES listing proposals and resolutions at the SSG meeting on 3 August, at the World Fisheries Congress in Brisbane.

We invite all SSG members to review the sawfish listing proposal and advise the SSG on its merits. If you would like to receive a copy of the proposal by email or post, please contact Merry Camhi (mcamhi@audubon.org or fax: (516) 581-5268). Any thoughts concerning sharks and CITES should be forwarded to Merry Camhi or Sarah Fowler as soon as possible.

Marine fish added to list of world's most threatened animals

Elodie Hudson, Zoological Society of London, UK

The conservation of marine species, especially fish, has long taken second place to terrestrial conservation concerns. Little is known about the health of the marine environment, and whether the risk of extinction is a real threat to fish species, many of which are a major source of food to the world's growing human population.

A first attempt to assess threats to species in the seas was made by 31 leading scientists at a workshop held by the Zoological Society of London (ZSL), the World Wide Fund for Nature (WWF) and the World Conservation Union (IUCN) in April this year. Using the new IUCN categories and criteria for assessing threat, they evaluated 148 species of marine fish, ranging from seahorses and coral reef fish, to sharks and tunas. The aim of the meeting was twofold. First to assess the threat status of the candidate marine species, and second to assess the applicability of the new IUCN categories to marine fish.

The threat classification system of the IUCN recently underwent a major revision. The new system is intended to be flexible, objective and systematic. It operates on a system of five criteria which reflect the biological and environmental factors which can cause extinction. Only one of these five criteria needs to be met for a species to qualify for threatened status, and quantitative thresholds are given for each criterion to define the category of threat (Critically Endangered, Endangered, or Vulnerable) the species will fall into. There are also categories for species at low risk, not evaluated, or for which data is insufficient (Data Deficient), so effectively all animals can be placed somewhere in the system.

The workshop participants evaluated a candidate list of 148 species of marine fish and found 118 of them to be threatened. Of these, ten were classified in the highest threat category, Critically Endangered. Among the threatened fishes were several species of shark (including the great white), tuna, groupers, cod, haddock, swordfish, halibut, many coral reef fish, and seahorses. The major threat to these fishes is chronic overfishing, be it for food, shark fin soup, aquaria, the Chinese medicine trade, the live food trade or for sport. Habitat destruction is also a problem, especially for fishes living in coastal habitats such as coral reefs or mangrove swamps. These fish will appear alongside other threatened animals in the IUCN Red List of Threatened Animals, which will be published in October at the World Conservation Congress in Montreal. Their presence on the list will hopefully elevate the importance of protecting the marine environment in the minds of decision makers and conservationists alike. The list has no specific legal force, but is used by governments and other organisations as a guide to setting priorities for conservation.

From the evaluation process emerged guidelines to help future evaluators to use the IUCN categories – these continue to be developed. In most cases, the criteria were felt to be appropriate for assessing the threat status of marine fish. In some cases they were not, and these are the focus of continuing work. The overriding problem with applying the criteria is that scientists are hampered by a lack of knowledge o[f] marine ecosystems and their component species. Hopefully thi[s] stimulating and interactive workshop will act as a catalyst for furthe[r] efforts in the current climate of growing concern over the oceans an[d] the valuable resources they contain.

(The above was originally commissioned for *Living Oceans News.*

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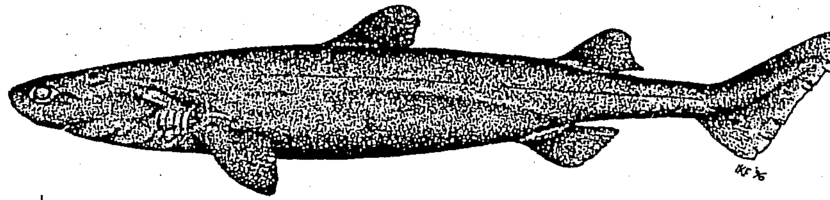
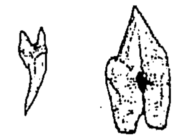
Status of the kitefin shark

Dalatias licha (Bonnaterre, 1788)

Compiled by Leonard J.V. Compagno and Sid F. Cook





Adult female kitefin shark *Dalatias licha*
S.E. Sicilian Channel, Mediterranean Sea.

Taxonomy

The kitefin shark is a monotypic species in the genus *Dalatias*, order Squaliformes. The family Dalatiidae [formerly part of Family Squalidae] includes the tail-light, pygmy, cigar and cookie-cutter sharks.

Distribution

A relatively common, but unevenly distributed, deeper-water dogfish found on continental and insular shelves and slopes in warm-temperate and tropical areas, from 37 m down to 1800 m depth in the north and central Atlantic, western Indian Ocean, and western and central Pacific Ocean. It is an epibenthic species, but often ranges well-off the bottom.

Ecology and reproduction

The kitefin shark is an adept and powerful deep-sea predator feeding on a broad variety of bony fishes and elasmobranchs. It also consumes cephalopods, crustaceans, and annelid worms. Harvest records from Mediterranean fisheries indicate that this is not a schooling species, but primarily a solitary shark.

An ovoviviparous species, giving birth to 10–16 pups per litter. Size at birth is about 30 cm. Maximum size of adult males is at least 1.2 m, and adult females at least 1.6 m. Little, if anything, is known about growth, age at maturity, or life span in the wild.

Threats

This shark has long been exploited commercially. Among products derived from it were or are: denticle-intact skin for use as "shagreen" for polishing in cabinet and jewelry making; fishmeal; leather (considered excellent for the manufacture of "boroso", a durable, almost armor-like denticle-intact polished leather in Spain); human consumption (eastern Atlantic and Japan); and squalene oil (Portugal and Japan).

The Portuguese have developed a limited deep-water fishery that harvests several hundred tons a year. This fishery appears to be extremely limited in its potential, with rapid degradation of stocks noted when more than around 900 mt are taken in a fishing season (J.G. Casey, personal communication).

Because of the generally great depth at which this species appears to spend most of its time, historically it was taken primarily in deep-water directed fisheries efforts. However, with recent trends in development of deep fishing gear (especially trawl gear) and the increasing need for commercial fisheries to fish deeper in attempts to sustain harvest levels, this species and other deep-sea elasmobranchs will undoubtedly come under increased pressure in the future from new multi-species fisheries.

IUCN threatened species assessment

Vulnerable (A1d, A2d) throughout its range. This assessment of a 20% population reduction world-wide within an estimated three generation period is based on rates of stock and CPUE reduction from present and former directed fisheries (see Portuguese example above) and the likely continuation or acceleration of this trend in future as deep water fisheries effort increases.

Editor's note: The above is a greatly abbreviated version of the draft account supplied by the compilers for the Shark Action Plan. The original, including many references, is available from the Editor.

Population genetics: an accessory to tagging studies

Ed Heist, Center for Biosystematics and Biodiversity, Texas A&M University

Many species of sharks span vast geographic ranges but may be divided into isolated breeding populations. If conservation efforts are to succeed, these individual populations need to be identified so that we can determine whether locally-depleted regions can be replenished from other areas. One way to do this is to examine movements of individual sharks through traditional tag and recapture. Another, more recent, technique involves analysis of population genetics using polymorphic characters. The purpose of this article is to discuss the relationship between traditional tagging and genetic studies, and to demonstrate how both kinds of research can add to our understanding of shark populations.

While tagging studies detect movements of individuals within a single lifetime, genetic studies track movements of genes over many generations. When two populations become isolated reproductively, gene frequencies change over generations through random genetic drift. Ultimately isolated populations become fixed for alternate alleles; for many generations however only frequency differences will exist. Reproduction between individuals from different regions results in gene flow, homogenising gene frequencies between regions. By examining frequencies of polymorphic genes from different geographic regions we can estimate the amount of gene flow that has taken place over past generations.

Both techniques, tagging and population genetics, have strengths and weaknesses. Genetic homogeneity between regions is not proof that separate fishery stocks do not exist: populations may not have been isolated long enough for differences in allele frequencies to develop; or an exchange of only a few individuals per generation is sufficient to maintain the same alleles in different populations. Tagging studies may thus reveal significant stock structure in the absence of any genetic structure. On the other hand, genetic studies may reveal details about reproductive life-histories of organisms not detectable by tagging studies. Some marine organisms, sea turtles and whales for example, have separate breeding populations that overlap during part of the year. Studies in these organisms have revealed significant population structure despite the fact that individuals from separate breeding units intermingle. Many species of sharks deliver their pups in coastal nursery areas distant from the locations where adults are usually found. Genetic studies may tell us whether female sharks return to the same nursery area from which they came, and therefore whether local depletion of juvenile sharks in a coastal nursery area will have a long-term effect on future generations of pups.

Population genetic studies have been published on sandbar sharks in the US and on the gummy shark, spot-tail shark, and Australian blacktip shark in Australia. Other projects under way include studies on the great white and whale shark. Recently, John Graves, Jack Musick and I published a paper on population genetics in the shortfin mako (Heist *et al.* 1996). We examined mitochondrial DNA genotype frequencies in makos from the North Atlantic, South Atlantic, North Pacific and South Pacific. We found there was a highly significant difference in genotype frequency between the North Atlantic and other samples, suggesting little or no exchange of makos between the North Atlantic and other oceans. This finding is also consistent with the tagging data of Casey *et al.* (1992) that shows long-distance movement of tagged makos within the North Atlantic, but no recaptures south of the equator or in other oceans. Both population genetics and tagging can thus provide important information for the conservation of shark populations.

References

Casey, J.G., and Kohler, N.E. 1992. Tagging studies on the shortfin mako shark (*Isurus oxyrinchus*) in the western North Atlantic. *Aust. J. Mar. Freshwater Res.* 43: 45–60.

Heist, E.J., Musick, J.A., and Graves, J.E. 1996. Genetic population structure of the shortfin mako (*Isurus oxyrinchus*) inferred from restriction fragment length polymorphism analysis of mitochondrial DNA. *Can. J. Fish. Aquat. Sci.* 53: 583–588.

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WANTED

Whale shark *Rhyncodon typus* samples

Researchers at the Hubbs-Sea World Research Institute and the University of Florida (USA) are conducting a global genetic survey of whale sharks *Rhyncodon typus*. They need help to collect tissue samples from throughout this species' range.

Strandings, incidental catches, fishery products and nondestructive tissue samples are all acceptable sources of material. Just a gram or two of tissue is required from each specimen. Samples can be stored in saturated salt (NaCl) solution without refrigeration and shipped by air mail. Previously frozen samples are acceptable.

For more information please contact: Dr Brent Stewart, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, CA 92109 USA. Email: bstewart@sunstroke.sdsu.edu, fax: 619-226-3944; or Dr Brian Bowen, BEECS Genetic Analysis Core, 12085 Research Drive, University of Florida, Alachua, FL 23615 USA. Email: bowen@icbr.ifas.ufl.edu, fax: 904-462-0875.

Tracking sharks by videocamera – *Crittercam*: the video parasite

Ian K. Fergusson, European Shark Research Bureau, UK

'Traditional' methods of telemetry, developed from simple tagging programmes, have provided shark biologists with a plethora of spatio-temporal, behavioural and physiological data about their subjects that have greatly advanced our understanding of these fishes. However, while telemetry provides important information on the short and medium term movements and behaviour of elasmobranchs, it fails to offer the researcher a real-time view of the study animal's second-by-second behaviour. Thanks to the expanding science of manufacturing compact, miniaturised video technology, the detailed recording of such behavioural information is now becoming attainable.

One of the most remarkable developments is the *Crittercam*, brainchild of National Geographic Television's Greg Marshall. This camera is designed for parasitic attachment to a shark's (or other large aquatic animal's) dorsum by means of a corrodable or other temporary link causing minimal harm to the host's skin. For sharks, standard stainless-steel Floy darts have been used which are detached from the camera either by a magnesium wire (which severs in saltwater after a pre-determined soak-time) or by using an ultrasonic trigger mechanism. The camera, towed smoothly behind the shark at about the level of the first dorsal fin, has a forward-looking wide angle view and records all activity in real time from the moment of attachment to release (about two hours or full tape duration). As the *Crittercam* also contains ultrasonic telemetry gear, the shark can be tracked, followed by boat and its precise movements mapped by researchers using a hydrophone, thus allowing the time-coded video to be continually cross-referenced with its precise location.

White shark towing Crittercam. Photo: Ian K. Fergusson, 1993.

Precise details of the *Crittercam's* construction are confidential, but a brief description can be provided. The camera housing is custom-made from metal and synthetics and its contents carefully configured to provide hydrodynamic stability, perfect balance and minimal drag. It is compact and torpedo-shaped, containing an adapted HI-8 Sony camcorder chassis and recorder section powered by integral battery. The optically corrected semi-wide angle lens films through a toughened, hemispherical port on the front of *Crittercam* and is focused on infinity. The rear of the 'hull' contains ultrasonic telemetry equipment and a surfacing radio pinger to enable retrieval of the camera following release from the host. A more extensive array of data-logging recorders, including those sampling sea temperature, depth and swimming speed, can be attached to the hull.

The writer viewed Greg Marshall's use of *Crittercam* on white sharks off South Africa in 1993–1994 (Fergusson 1995), during the filming of a co-funded BBC Natural History Unit/National Geographic TV film, "Great White Shark" (Prog. No. NBS-50-604Y, first transmitted in the US and UK in March and April 1995). Successful deployments of the *Crittercam* system were accomplished at Dyer Island (near Gansbaai) and Struisbaai, Cape Province. All cameras were recovered and a number of useful video tape records collected. Full results are unpublished, but several interesting events were recorded, including cruising and patrolling behaviour between surface and seabed; short-duration, opportunistic pursuits of fish and small sharks; and interactions with other white sharks and cape fur seals *Arctocephalus pusillus pusillus*. Topside tracking offered useful information on the spatial habits of white sharks.

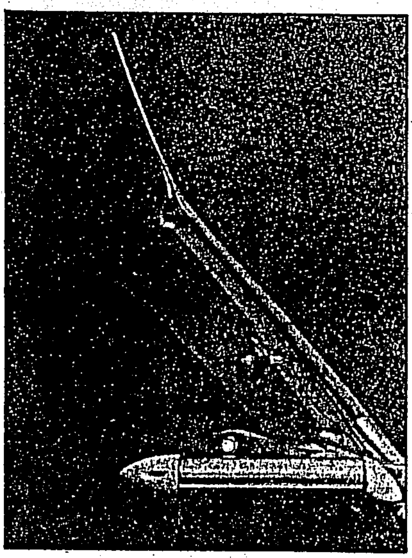
Greg Marshall has revised attachment and retrieval methods. This work will greatly advance the simplicity and durability of field-use for both commercial cinematography and research.

Fergusson, I.K. 1995. Great White Lies. *BBC Wildlife Magazine*, 13 (4): 32–37. April 1995.

Satellite tracking blue sharks

Andy Kingman (formerly Woods Hole Oceanographic Institution)

In 1993 Frank Carey (Woods Hole Oceanographic Institution) built four ARGOS satellite tracking devices for a study on blue sharks *Prionace glauca*. In 1994 three of them were deployed on adult male blue sharks off Cape Hatteras, North Carolina, USA. They have provided information on depth, water temperature, swimming speed and location. One (shark #1) transmitted only once, on the first day; another (shark #2) transmitted 93 times over the course of 17 days; and shark #3 approximately 300 times over the course of 36 days.



Satellite transmitter on the back of a blue shark. Photo: F.G. Carey.

The transmitters are modifications of a design developed by the Sea Mammal Research Unit (SMRU), Cambridge, UK. Two aluminium pressure tubes house a transmitter, a microprocessor, two lithium "D" cell batteries and depth, temperature and speed recording equipment. The tubes are cast in a urethane saddle, which is attached directly to the shark's back. A rotor for measuring swimming speed, a wet/dry transmission switch and the antenna are mounted on an eighteen inch (45 cm) mast. Transmissions are initiated when the mast breaks the surface. At the latitude of the study area (approx. 35°N), satellite coverage is close to 110 minutes/day, during which period approximately 5% of the possible total number of transmissions were successfully completed.

Track taken by transmitting blue sharks overlain on false colour satellite image showing surface water temperature. Graphic: J. Bisagni.

Data received included temperatures ranging from 8.4° to 22.2°C, and depths ranging from the surface to over 500 m. During the 17 days it was tracked, shark #2 covered more than 400 nautical miles, and shark #3 covered more than 1,100 nautical miles over 36 days. Both of these study animals received a significant boost in speed from the Gulf Stream; mileages were higher than 30 mile day during periods when swimming was highly directional ar parallel to the current. At speeds like this, the sharks could easi accomplish a trans-Atlantic migration over the course of a fe months.

Capsule tag studies have provided point-to-point da demonstrating that blue sharks will cross oceans, but these studi provide no information on course and behaviour between tagging ar recapture. Sonic tracking experiments have provided detaile information on behaviour over a short time, but are impractical f periods of more than one week. Satellite tracking offers a means collecting detailed data over an extended period of time. After ironir out some of the technical difficulties experienced in this trial, and wi newer, more compact transmitters already available, tracking duratio of several months are easily within reach. Unfortunately, Dr Carey death in December 1994 has precluded the continuation of this stud but the stage has been set for more satellite tracking of fish.

A paper on this study is currently in preparation, possibly f *Marine Ecology Progress Series*, authors: F.G. Carey, A. Kingman, N Kohler, J. Bisagni and C. Hunter or M. Fedak.

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Manta tagging starts in the Maldives

Manta rays *Manta birostris* are common in Maldivian waters, whe they are a major attraction for tourist divers. Mantas are known undertake seasonal migrations from side to side of the Maldivian atc chain, in synchrony with the changing monsoons. They also undertak daily migrations between cleaning and feeding areas, apparently phase with the tides. Although this broad picture is known, the detai of the migrations are not.

A proposal to carry out a tagging study of manta movements wa made to the Marine Research Section of the Maldivian Ministry Fisheries by an Austrian dive base operator, Mr Norbert Schmidt, late 1995. A joint proposal was formulated and tagging trials hav now started. Tags used are 'Floy' spaghetti tags of about 40 cm lengt each individually coded with four colour segments. The tags can b identified underwater by divers, so the movements of individu manta rays can be monitored over long time periods.

Initial tagging trials were carried out in February 1996 (during th north-east monsoon season) in Ari Atoll on the west of Maldives b Norbert Schmidt and Herwarth Voightmann, another dive bas operator. It was found that the tag head had to be slightly modifie but once that was done one manta was successfully tagged by a div in the water. No resighting has been reported to date. Subsequent trip to tag mantas in the same area were unsuccessful, either because n mantas were present, or because other divers were in the water wi the mantas at the same time. An article on the initial tagging trial ha appeared in a popular German diving magazine (*TAUCHEN*, Hambur May 1996).

Further trials are to be carried out on the eastern side of th country, near Malé, in September 1996 (during the south-west monsoo season). If they are successful, larger scale tagging will be carried o and extensive publicity will be given to the programme in order maximise reporting of resightings. An interesting feature of th tagging programme is that it is being funded entirely by a divin base operator, because of his interest in manta rays.

R. Charles Anderson, Marine Research Section, Ministry Fisheries and Agriculture, Malé, Republic of Maldive

Catch/tag-and-release: the conservation option for recreational shark fishermen

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

More and more, sport fishermen around the world are choosing to practice catch-and-release of sharks, often tagging their catch for science. What has turned anglers away from the old attitudes of catch-and-kill of sharks, leading to the demise of many of the traditional shark kill tournaments? At least three factors have been involved. First, the conservation movement in sport fishing has slowly changed the ethic in recreational shark fisheries by educating fishermen about the value of all marine resources, including sharks. Second, the proliferation of shark-tagging programmes has given anglers a satisfying alternative to killing or just releasing their catches. And third, and perhaps the most profound reason, the alarming depletion of large sharks in many coastal regions has sharply reduced the number of sharks available to sport fishermen. As depletions have been documented, a number of jurisdictions have instituted management measures, setting restrictions on shark landings by recreational fishermen. So whether it is by choice or by rule, anglers are electing for live release of a greater proportion of their shark catch.

This attitude shift has benefited tagging programmes around the world. Prominent among these has been the US National Marine Fisheries Service's Cooperative Shark Tagging Program (see page 1), which began in 1963 and currently involves about 6,000 volunteer fishermen (Casey *et al.* 1995). Although there are many pluses to the growing interest in tagging by fishermen, there are minuses as well, and both should be considered when assessing the value of angler shark-tagging programmes.

The pluses

Obviously, catch-and-release, with or without tagging, can decrease recreational fishing mortality on shark stocks, a desirable objective in this era of shark overexploitation. The embracing of catch-and-release and tagging by recreational shark fishermen can be a powerful conservation tool. This is because the inherent conservation message is disseminated among the fishing community and out to resource managers and the public. The results are an impression on management that the recreational sector is 'doing its part', increased pressure on the commercial sector to follow suit, and a more enlightened public concerning the resource value of sharks. An example of this effect has been seen in Florida with the annual Gulf Coast Shark Census, a 100% catch-and-release sport tournament for shark research coordinated by Mote Marine Laboratory. Over the eight years of this tournament, nearly 1,000 anglers – many of them formerly shark killers – have caught, collected data on, and released over 4,500 sharks, 530 of them with tags applied by Mote biologists. Media coverage of this tournament has magnified its message, helping to accelerate the fall of shark kill tournaments in Florida (Hueter 1991a, b).

Proper tagging of the shark catch can provide basic biological information on shark migration, age and growth, natural mortality, behaviour and habitats, as well as applied information for shark fishery managers (Casey and Taniuchi 1990). Volunteer taggers can cover a much broader geographic range, at a greatly reduced cost, than can fishery-independent scientific tagging programmes. The over 113,000 sharks tagged in the NMFS programme from 1963 to 1993 (Casey *et al.* 1995), for example, would no doubt be far less if it had depended solely on federally funded boats and personnel. This participation has important educational value in that fishermen become active partners in the search for scientific truth, benefiting all involved.

The minuses

Despite these benefits, there are pitfalls to angler catch/tag-and-release of sharks. The most obvious is post-release mortality. As sport fishermen like to say, a shark has a much better chance of surviving if it is released than if it is lying on the boat's deck. But if the stress of capture is mortally damaging the sharks, catch-and-release is not accomplishing what the fishermen may think it is. There have been a number of studies on post-release mortality of hook-and-line-caught fish (see pages 8–9). In general, sharks caught-and-released on recreational tackle have a much better chance of surviving than on most commercial gear. However, if the allure of tagging is attracting significant numbers of new shark anglers, rather than simply altering the behaviour of those already in the fishery, then post-release mortality becomes more important.

Closely related, but subtly different, is tagging mortality and other, sublethal effects of tagging on the sharks. Fishermen, as well as biologists, require training to apply tags properly. Tags improperly applied or placed in the wrong types of sharks can fall out, kill the animals, or affect their growth. Bad tagging technique or poor choice of tag type, then, can be far worse for the shark than simple release. These problems can also affect the scientific objectives of tagging: tag retention can go down, affecting quantitative measures of population parameters; tags can affect sharks' behaviour, altering normal migratory patterns; and tags can stunt growth, seriously biasing estimates of age and growth in these species.

Scientists can address these issues by conducting rigorous studies of tag design and technique before deploying tags in either a fishery-independent or cooperative angler programme. The specific size and style of tag can be matched to the shark being caught-and-released. For example, young or small adult sharks cannot accommodate tags designed for larger, tougher animals (Manire and Gruber 1991). To reduce mortality from large tags, the juvenile shark-tagging programme at Mote Marine Laboratory uses biologists to tag the sharks with appropriate tags and concentrates on recreational fishermen to recapture them.

Finally, the quality of the data – shark species, sex, size etc. – is lower in a cooperative angler programme. This can be accounted for in data analysis, but it can never be corrected. In other words, the data collected in an angler tagging programme must always be weighted differently than the data collected by the biologists themselves. But as with the other pitfalls, this drawback can be outweighed by the many practical and conservation-oriented benefits of tagging. Properly implemented, the tagging of sharks by sport fishermen provides a wealth of new information and immeasurably adds to global efforts to conserve shark species.

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Release mortality studies in Massachusetts

Gregory Skomal and Bradford Chase, Massachusetts Division of Marine Fisheries, Vineyard Haven, Massachusetts

Extensive recreational fisheries for tunas, billfish and sharks occur off the coast of New England from June through October each year. Those species commonly targeted by offshore anglers include: bluefin tuna *Thunnus thynnus*, yellowfin tuna *T. albacares*, albacore tuna *T. alalunga*, bigeye tuna *T. obesus*, skipjack tuna *Katsuwonus pelamis*, Atlantic bonito *Sarda sarda*, false albacore *Euthynnus alletteratus*, white marlin *Tetrapterus albidus*, blue marlin *Makaira nigricans*, blue shark *Prionace glauca*, and mako shark *Isurus oxyrinchus*.

In recent years, there has been an increasing trend in the release of angled gamefish by the offshore recreational fishing sector. Catch and effort data compiled by the Massachusetts Division of Marine Fisheries from 60 big game fishing tournaments held in Massachusetts from 1987 to 1995 show that 5,821 large pelagics were caught by tournament anglers during 29,345.5 boat hours of fishing effort. Overall, 75.7% of these fish were released and 21.4% were tagged before release. Notably, 78.9% (8.4%) of the bluefin tuna, 96.7% (74.5%) of the white marlin, and 92.0% (20.8%) of the blue sharks were released (tagged).

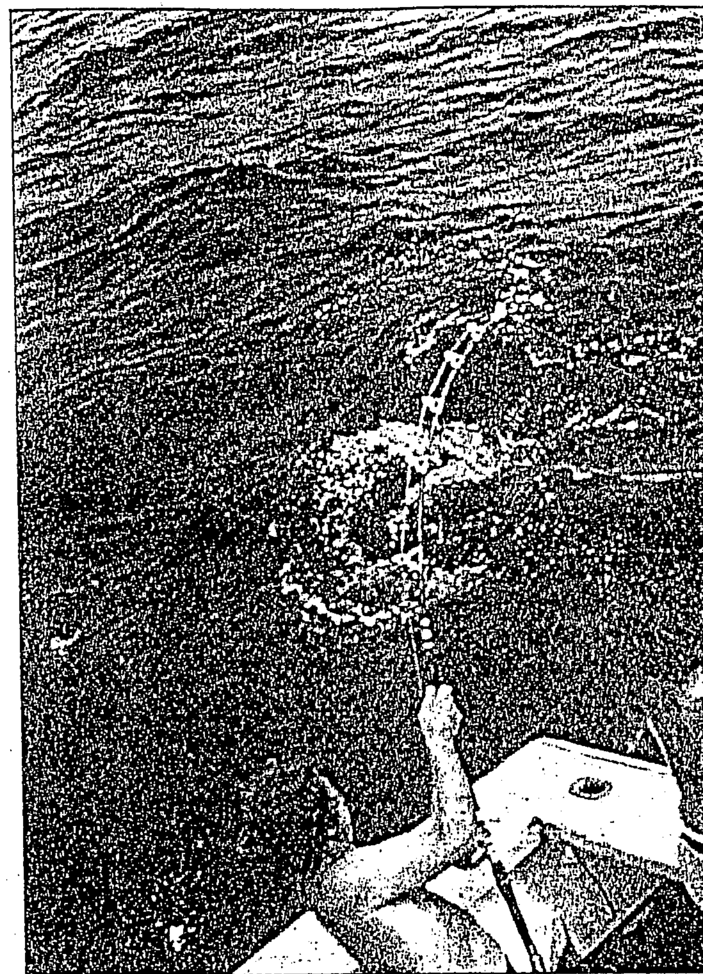
While some of this is due to the imposition of management measures such as minimum sizes and bag limits designed to reduce mortality on immature fish, there have also been changing attitudes among recreational anglers and tournament organisers. Cooperative tagging programmes have contributed greatly to the education of fishermen relative to fish conservation and the importance of biological study. The angler that tags and releases fish now feels a sense of contributing to causes that will enhance the fishery. Discussions about numbers of fish tagged have slowly replaced those about numbers of fish killed among the sport fishing community.

Little is known of the mortality associated with the release of pelagic gamefish. Evidence from National Marine Fisheries Service (NMFS) Cooperative Tagging Programs shows a higher recapture rate for sharks (4%) (N.E. Kohler, NMFS, NEFC, pers. comm.) than billfish (1.1%) (Bayley and Prince 1994) and non-bluefin tunas (2.6%) (D. Rosenthal, NMFS, SEFC, pers. comm.). Although low recapture rates can be attributed to tag shedding, emigration, stock size, natural mortality, and reporting failure, mortality associated with angling stress cannot be discounted.

In general, fish react to the acute stress of capture, severe exercise, and handling with more exaggerated disruptions to their physiology than those seen in higher vertebrates (see reviews by Wood 1991 and Milligan 1996). Nearly all species of fish have a substantial proportion of their myotomal muscle mass (80%–95%) as anaerobic white swimming muscle which reflects an ability for high work output in short bursts (Driedzic and Hochachka 1978). Angling practices cause increased anaerobic activity, muscular fatigue, and time out of water, resulting in marked respiratory and metabolic changes (Wood 1991; Ferguson and Tufts 1992).

Since fish blood comprises only 3%–6% of the body weight and white muscle over 30%, changes in muscle biochemistry will be reflected strongly by the composition of the blood (Wells *et al.* 1986). Therefore, measuring the changes in various haematological parameters relative to the degree of physical exhaustion can provide useful indices of stress.

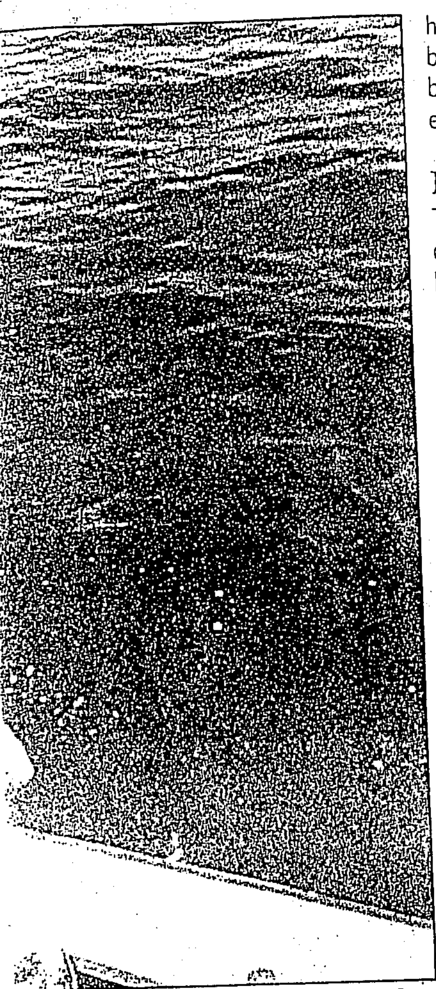
The objective of our ongoing study is to elucidate the physiological effects of angling-induced stress on the survivor-ship of pelagic species commonly caught offshore of New England. In contrast to previous studies, fish are captured, tagged, and released utilising standard angling practices and equipment. Field-collecte blood samples provide a 'snapshot' of the physiological status of eac animal taken. The response of each blood constituent to varying leve of stress is quantified. While it is understood that this study, like i predecessors, cannot overcome the difficulty of obtaining blood fro stress-free fish, we do attempt to measure sub-lethal and leth disturbances due to the effects of the various angling practice Hypotheses on release mortality are tested using acoustic telemetr



Anglers may apply tags without bringing the shark into the boat. This should he

To date, we have sampled 289 gamefish comprised of 12 speci of sharks, tunas and billfish. Due to sample size limitations, the bu of our analyses have been confined to bluefin tuna, yellowfin tuna a blue sharks. Preliminary findings show that these fish exhil fluctuations in blood pH and blood levels of hormones, electrolyt and metabolites due to the fight associated with rod and reel anglir Each species was found to have a different physiological response angling. For example, the metabolic by-product of anaerobic glycoly is lactic acid. We found that blood lactate levels in angling-stress tunas were significantly higher than those in sharks and marl Moreover, bluefin tuna possessed extremely high levels of blo lactate relative to other species sampled. Since blood lactic a readily dissociates into the lactate anion and hydrogen protons, amount of this metabolite in the blood contributes to the acidity of blood. By measuring the pH of the blood, we can determine the ext of the acidosis. Extreme acidosis can cause more complex physiologi disturbances which may severely impede normal behaviour ultimately compromise survivorship (Wood *et al.* 1983).

For each species, changes in blood chemistry can be compare several variables which are associated with the fight such as ta type, fight time, water temperature and fish size. Most of correlations we have conducted to date are associated with f time. The following gives a brief preliminary synopsis of w



…ess and improve survivorship. Photo: H. Wes Pratt.

happens physiologically to bluefin tuna, yellowfin tuna and blue sharks during the angling event.

Bluefin tuna

This species exhibits immediate drops in blood pH due to the build-up of carbon dioxide and metabolic by-products in the blood. This acidosis seems to drive the pH to its lowest level in fish that have been fought for 20 to 25 minutes.

Yellowfin tuna

The blood pH measurements made on yellowfin tuna fought on rod and reel are much lower than those reported as 'normal' by other researchers for this species. Although the degree of acidosis fluctuates greatly with fight time, lowest pH levels are reached after as little as 10 minutes of fighting.

Blue shark

The magnitude and nature of blood disturbances appear to be less dramatic in the sharks when compared to the tunas. Blood gas measurements indicate that the blue shark is not hampered by respiratory problems when fought on rod and reel; blood oxygen levels remain relatively high. Blood pH does decrease slowly to a low at a fight time of about 40 minutes. This can probably be attributed to the slow increase in metabolic by-products like lactate. Nonetheless, pH levels remained appreciably higher in this species relative to the tunas fought for similar durations.

Survivorship

Can these species recover from this physiological disturbance? Short and long term recovery from the acute stress associated with exhaustive exercise was evaluated from tag-recapture and ultrasonic tracking studies. Both methods allow for inferences on the effects of tagging. We have tracked two blue sharks, three bluefin tuna, and one yellowfin tuna after exposure to prolonged fights on rod and reel, blood sampling, and tagging. Minimum tracking periods for these fish were eight hours, with the exception of one blue shark which was followed for four hours. All fish survived this tracking and appeared to recover from the physiological effects of exhaustive exercise.

Tag recaptures of two blue sharks and one yellowfin tuna that were previously blood-sampled, by the study provided long term evidence that these fish were not physiologically compromised by the angling experience or the tagging.

It is very important to emphasise the scope of this study. We are specifically attempting to quantify and assess the physiological effects of rod and reel angling. In doing so, we encounter varying degrees of physical trauma as well. The rough handling of fish, the use of gaffs, internal hook damage, poor tagging, and excessive time out of water can cause irreparable damage to a fish which is released. Recovery may take days or months if the fish survives. While some degree of physical trauma can be assessed in this study, short term ultrasonic tracking may not be sufficient to measure the long term effects of such trauma. Tag recaptures of our sampled fish do help to rectify this. Physiological stress can be minimised by reducing fight and handling time. However, physical trauma can only be reduced through the conscious efforts of anglers when choosing to tag and release a fish. Hook design, handling methods, tagging tools, and experience all play a major role in the proper tag and release of gamefish.

The importance of tagging large pelagic species of sharks, tunas and marlin cannot be over-emphasised. These are species of fish which cannot easily be maintained in captivity for biological studies. What we know of their complex biology, we must derive from dead specimens or from tagging studies. A single recapture can provide important information on migration, distribution, age, growth, longevity and reproductive biology without killing the fish. The recreational angler has been an integral component of our tagging programmes for decades and has thus contributed to the pool of knowledge that scientists now have to work with. Only through these efforts can scientists provide a valid foundation on which wise measures of conservation and utilisation of these species can be built.

Photo: H. Wes Pratt.

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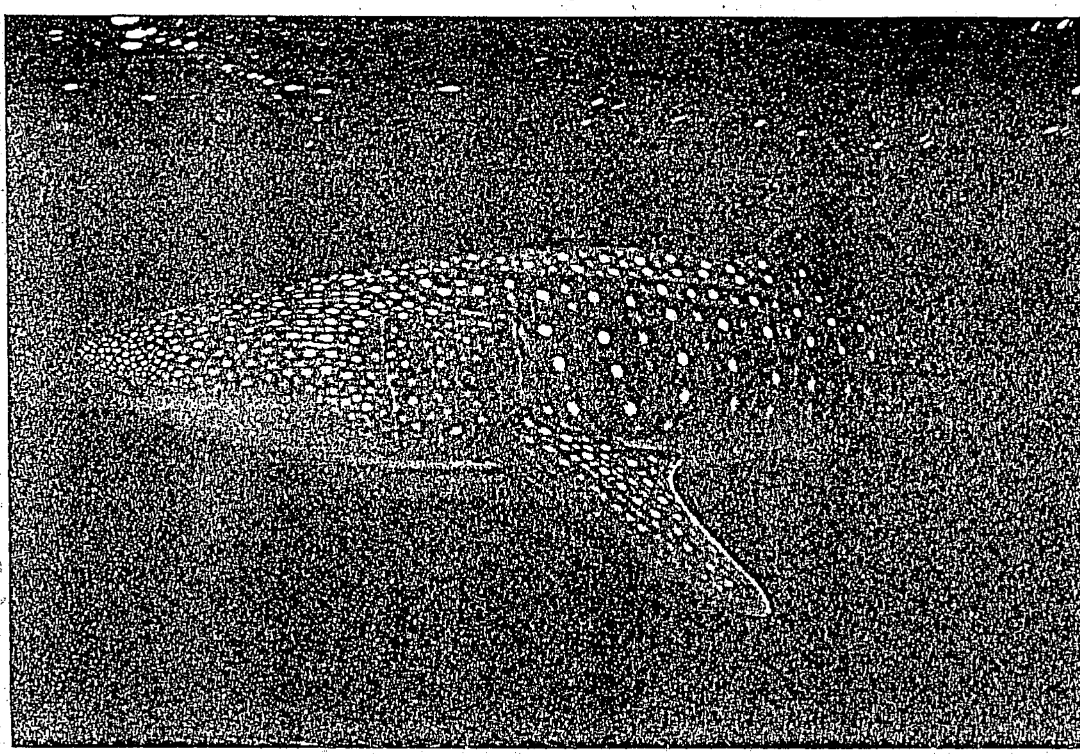
Archival tagging of sharks in Australia

John Stevens, CSIRO Marine Laboratory, Tasmania, Australia

Archival tags developed by CSIRO and Zelcon Technic Ltd have been used successfully on southern bluefin tuna to provide continuous records of long-distance fish movements, diving and feeding behaviour.



Whale shark. Photo: Jeremy Stafford-Deitsch.

These mini computers weigh 25 g, have 1 megabyte of flash RAM and contain an accurate time clock and depth, temperature and light sensors. Diel changes in light are used to calculate longitude and day length is used to calculate latitude. The tags can log data at predetermined intervals for nine years and store it for 20 years.

We have recently received funds to use this technology on both school *Galeorhinus galeus* and whale sharks *Rhyncodon typus*. School sharks are a target species in the $15 million/year Southern Shark Fishery. CSIRO and The Victorian Fisheries Agency (VFRI) play a major role in the assessment of school shark stocks and in researching the biology and population dynamics of this species. School sharks spend much of their time on the continental shelf where they are fished by demersal gillnets and longlines. However, they also occur on the upper slope and at times extend into the oceanic pelagic zone, with conventional tagging showing a number of trans-Tasman migrations to New Zealand. Archival tagging will be used to provide information on their swimming depth and longer-distance movements. A question of particular interests to scientists and industry is whether pupping grounds for the whole stock are restricted to Victoria and Tasmania. Archival tagging of pregnant females may provide the answer. We (CSIRO and VFRI) have trialled different attachment methods and tag designs using 'dummy' tags. Internal tags (as used on the tuna) are surgically implanted in the body cavity; the light sensor being mounted on an external streamer. Two external fin-mounted designs have been used; the rectangular shape of the standard tag and a torpedo-shaped hydrodynamic version with low drag. Perhaps surprisingly, most returns have been of the internal dummy design.

Snorkelling with whale sharks is an important ecotourist industry at Ningaloo Reef in northern Western Australia. Aggregations of whale sharks appear each year in March and April close to the coast, probably in response to increased productivity associated with mass coral spawning. We have received a grant under the National Ecotourism Program to use standard telemetry, archival tags and satellite tags to study the short and long term movements of whale sharks at Ningaloo. Three years ago we successfully tracked two sharks (one for 26 h) and obtained interesting data on their swimming depth and diving behaviour. We also attached six archival tags and, although we retrieved one from a shark after 24 hours, none have been seen subsequently, However, at least some individuals are known to return each year (recognised from distinctive wounds or markings) so by choosing some of these sharks we are hopeful of success with further tagging. Whale sharks have been successfully tracked for several months using satellite tags by a group in California and we will also try similar tags at Ningaloo. While archival tags can be used to obtain positional data underwater (providing the fish does not go below 100–150 m, the depth of usable light levels) satellite tags must be at the surface for transmission.

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Data storage tags: individual behaviour-based approaches to migration

Nick Dulvy and Julian Metcalfe, MAFF Fisheries Research, UK

Traditionally fish movements have been followed by mark-recapture methods or by analysis of catch data (e.g. Pawson and Nichols 1994, Rousset 1990). The former type of study can provide estimates of speed and direction of movement during different seasons, as well as growth rates, mortality estimates, rates of stock interchange, yield, and stock replacement values (e.g. Smith and Abramson 1990, Holden 1972).

The disadvantages of simple studies are that large numbers of fish must be tagged (1,000+), recaptures should be followed for as many years as possible (2–15 years) and the data quality depends on the level of cooperation by fishermen. More problematic, the estimates of some of the above variables can be flawed. Mark-recapture methods only indicate net movement; for instance in a recent study an electronically tagged plaice showed a net movement of 80 km over 56 days, when in actual fact the fish had travelled 800 km and was recaptured on its return migration. The key problem with conventional tagging studies is that if any condition varies, e.g. size- or age-selectivity of the fishery, fishing pressure or environmental change, then the parameters of the population will change, necessitating costly re-estimation of parameters.

New methods of following fish movements

The Fisheries Laboratory of the Ministry of Agriculture, Fisheries and Food at Lowestoft, UK, have developed an electronic "Data Storage Tag" consisting of pressure and temperature sensors and

1 megabyte chip to store the data. The tag can record data for over nine months and store this data for five years. When the tag is returned by fishermen the data is extracted using an infrared link.

The tag records vertical movement of the fish, which can be translated into horizontal movements using a hydrographic simulation model. The whole system is based on the knowledge that many coastal benthic fish species rise into the water column to catch a 'tidal conveyer', a form of movement known as "Selective Tidal Stream Transport". It is assumed that horizontal movement is a function of the period of time spent in the water column and the rate of tidal flow and the vector of tidal current which the fish uses. Temperature profiles can be used to validate broad scale movements, as can the tidal profiles when the fish is at rest on the bottom.

One hundred of these tags were put on plaice in 1993 and I have just put 100 tags on the thornback ray *Raja clavata* in the Irish Sea. Preliminary results from the 20 returned plaice tags have demonstrated surprising results (Mackenzie 1994). For the first time we can follow the movements of individual fish in the wild for longer than a week or so. Not only do these fish move ten times faster than previously thought, but a number of distinct behaviour patterns have been identified from this study, including:

- vertical movement linked to the night time period only
- vertical movement using both tides in the daily cycle
- vertical movement using night tides in one direction only.

These vertical migrations have direct consequences for geographical movement.

Progress is currently being made towards determining the cues triggering these vertical movements. Once this can be determined, then individual behaviour-based predictive models can be constructed to simulate population movement and distribution. The beauty of these data are that the individual cues to migrate are independent of fishing or environmental shifts, therefore such models could be used to predict the spatial and temporal effect of changes in fishing effort or habitat loss on fish populations (Sutherland 1996).

Relatively large numbers of electronic tags are required, as we are dependent on returns from the fishery. Nonetheless, cost is comparable to if not cheaper than the cost of large-scale conventional tagging studies. In the future it is hoped that this basic form of tag will be modified to download data to passing aeroplanes or even satellites, avoiding the problem of obtaining fishery returned tags.

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Sharks and Man

This workshop on shark management and conservation will be held on 2nd August at the Brisbane Convention and Exhibition Centre following the World Fisheries Congress. The three sessions will cover Shark Control (including gear technology and bycatch reduction, sonic "avoidance" beacons, and electric field barriers), Shark Fisheries, and Shark Conservation. Draft agendas for the latter two sessions are:

Session 1. Management of Shark Fisheries

Information needs for management of shark fisheries: Terry Walker (Convenor, Victorian Fisheries Research Institute).

Overview of world's shark fisheries: Ramon Bonfil.

Management of the artisanal shark fishery in the Gulf of Mexico: Fernando Mârquez and Leonardo Castillo.

Shark fisheries of Africa: Warwick Sauer.

Recreational and industrial shark fisheries of North America: Greg Cailliet, David Holts and Pamela Mace.

Stock assessment and risk analysis for school shark off Southern Australia: André Punt.

Shark fishery management in Australia – Keeping the fish in "fish 'n' chips": Trysh Stone.

General discussion & summing up.

Session 3. Shark Conservation

Organisers: John Stevens (CSIRO Fisheries, Australia), Merry Camhi (National Audubon Society, USA) and Sarah Fowler (Nature Conservation Bureau, UK).

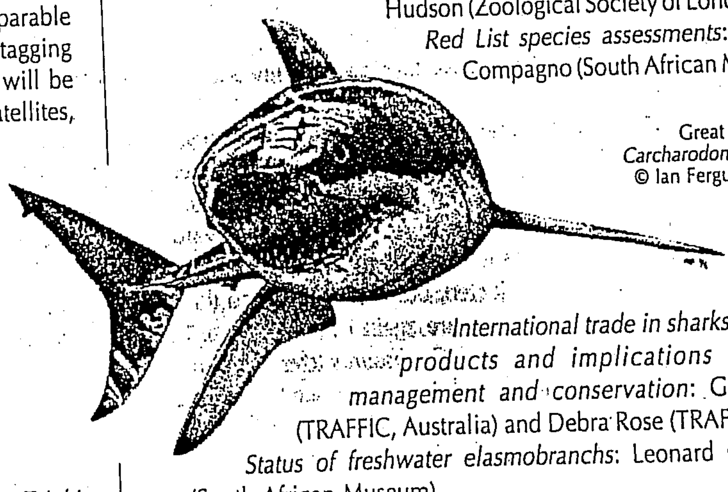
Introduction: John Stevens (CSIRO Fisheries, Australia).

Shark Specialist Group update – action plan and report to CITES: Sarah Fowler (Nature Conservation Bureau, UK) and Merry Camh (National Audubon Society, USA).

CITES and sharks – summary of the CITES discussion paper by the U. government: Andrea Oliver (NMFS, USA).

IUCN Red List – applying the criteria to elasmobranchs: Elodi Hudson (Zoological Society of London, UK

Red List species assessments: Leonar Compagno (South African Museum



Great white sha
Carcharodon carchari
© Ian Fergusson, 199

International trade in sharks and sha products and implications for sha management and conservation: Glenn Sa (TRAFFIC, Australia) and Debra Rose (TRAFFIC, US

Status of freshwater elasmobranchs: Leonard Compag (South African Museum).

Protected species status – white shark and grey nurse: Jon Pres (South Australian Fisheries) and Dave Pollard (Fisheries Resea Institute, Australia).

Options for international shark management: Sonja Fordham (Ce for Marine Conservation, USA).

Elasmobranch bycatch monitoring: Ramon Bonfil (UBC, Canada

Public attitude to shark control in Queensland – results of a prelimi survey: Clyde Wilde (Griffith University, Australia) or John Ste (CSIRO Fisheries, Australia).

Summation: Shark conservation in the 21st Century: Mic Sutton (WWF, UK).

General discussion.

Tagging at the Natal Sharks Board

Sabine Wintner, Natal Sharks Board, South Africa

The South African National Tagging Program is administered by the Oceanographic Research Institute (ORI). Since its inception in 1984 it has recorded over 100,000 fish (more than 350 species) tagged by 3,350 registered members. The Natal Sharks Board (NSB) joined the programme in 1984, tagging free swimming raggedtooth sharks *Carcharias taurus*. A pole sling is used by NSB snorkel divers to insert a yellow "Hallprint" dart tag with stainless steel head and plastic streamer. By the end of 1995, 535 *C. taurus* had been tagged this way.

Of the annual average of 1,440 sharks caught in the nets, 15% are found alive, and since 1978 the percentage of sharks released has increased steadily. This development was a result of a gradual acceptance that many sharks caught pose little threat to swimmers and the increasing reluctance of those servicing the nets to kill live sharks (Cliff and Dudley 1992). From 1978 to 1986, 462 netted sharks were marked with NSB rototags. In 1987 the NSB changed to dart tags, and over 1,300 sharks from 14 species have been tagged to the end of 1995. The majority of these sharks were *C. taurus* (over 670), followed by the tiger shark *Galeocerdo cuvier* (over 160) and dusky shark *Carcharhinus obscurus* (over 100) and including 37 white sharks *Carcharodon carcharias*. The NSB tags only one batoid species, the giant guitarfish *Rhyncobatus djeddensis*; 330 have been marked. Average annual recapture rate of sharks is around 3% and for *R. djeddensis* over 6%. It is interesting to note that the recapture rate of *C. taurus* tagged by divers, where there is no capture stress, is higher (5%) than that of *C. taurus* tagged in the nets (3.4%).

Opportunistic tagging by NSB staff has increased the number of tagged *C. carcharias* to over 50. Based on the combined ORI and NSB tagging databases, first estimates of mortality and population size for *C. carcharias* on the South African coast were calculated. The overall estimate was 1,279 sharks, $F = 0.055\ yr^{-1}$ and $Z = 0.53\ yr^{-1}$ (Cliff *et al.* in press). Based solely on the NSB tagging data, analysis commissioned by the Board has estimated netting mortalities for various species: *C. carcharias* 0.07–0.15 yr^{-1}, *Carcharhinus leucas* 0.02–0.03 yr^{-1}, *C. taurus* 0.03–0.06 yr^{-1} and *G. cuvier* 0.02–0.04 yr^{-1}, given different scenarios of natural mortality, tag loss, tagging mortality and under-reporting of recaptures.

In 1993 an additional programme was started, the Tetracycline Tagging Program. In addition to being tagged the sharks are injected with the chemical oxytetracycline and marked with an orange tag, instead of the conventional yellow one. The NSB offers a 'reward' of R 100 (23 US$) for the return of such a shark. Between 1993 and May 1996 nearly 400 sharks were injected, both in the nets and through opportunistic tagging. The majority are again *C. taurus* (over 160), followed by *G. cuvier* (over 55) and *C. obscurus* (over 35), and 18 *C. carcharias* have also been injected. Recapture rate to date is 2%, with most sharks caught within the first month after tagging. The NSB is continuing with this project and it is hoped that the future will see more valuable recaptures of tetracyclined sharks.

References:

Cliff, G., and Dudley, S.F.J. 1992. Protection against shark attack in South Africa. *Australian J. Marine and Freshwater Research*, 43: 263–272.

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Sabine Wintner, Natal Sharks Board, Private Bag 2, Umhlanga Rocks, 4320, South Africa. Tel: +27 31 561-1001, fax: +27 31 561-3691, email: wintner@shark.c.. za

Elasmobranch biodiversity and conservation in Sabah

The Shark Specialist Group's collaborative study with the Sabah Fisheries Department, funded by the UK government's Darwin Initiative and announced in *Shark News* 4, has now been underway for five months, with another year still to run until the final workshop. The project commenced in January with the appointment of a Darwin Project Officer, Mabel Manjaji, in the Fisheries Department and an initial field and market survey by Fisheries Department staff and Shark Group members Leonard Compagno, Sid Cook, Sarah Fowler and Frances Dipper.

Elasmobranchs in Sandakan market, Sabah. Photo: Sarah Fowler.

This initial brief visit determined that the chondrichthyan fauna o Sabah is more diverse than formerly believed (the elasmobranchs o Borneo have not previously been recorded in any detail). Of the 1 species of shark and 21 species of ray recorded during the Januar visit, ten species and one genus (*Mustelus*) were new records for th whole of Borneo. The *Mustelus* sp. may be new to science. Stingray were more diverse, had a higher biomass than sharks in marke surveys, and included some poorly known species. Some shark which are common and widespread in the region are surprising under-represented. (Several additional species have since bee recorded.) Representative specimens are being purchased durir market surveys and preserved to provide a reference collection f future taxonomic research and as voucher specimens.

Particularly interesting freshwater records were obtained in t form of photographs of the giant freshwater stingray *Himantu chaophraya*, a fin set of the bull shark *Carcharhinus leucas* and sa of *Pristis microdon*, all apparently from freshwater reaches of t Kinabatangan River. There were also reports from fishermen of ve large guitar fish being caught in the same area, and the identity of oth large river stingrays described is still unknown. Unfortunately, flo conditions have persisted since the start of the project and attempts obtain specimens of these river elasmobranchs have, so far, be unsuccessful. There have been no signs or reports of the very r Borneo river shark *Glyphis* sp.

The project has continued with a programme of market surve field surveys on the Kinabatangan and Segama Rivers, and intervie with fishermen in river and estuarine kampongs, occasionally also collaboration with WWF-Malaysia. Assistance with surveys a specimen identification has been provided by several SSG memb some during holidays in Sabah (Gordon Yearsley, CSIRO, Austr and John Denham, UK), others by correspondence.

Future work will include a survey of the socio-economic cultural importance of elasmobranchs to traditional subsiste fishing communities, to be started by Patty Almada-Vilella in July. Frances Dipper will be developing a survey programme for marine protected areas and an elasmobranch reporting and identification programme for divers, the latter in collaboration with dive tour companies in Sabah. Any SSG members interested in participating should contact Frances Dipper for more information (7 Rutland Green, Hilton, Cambridgeshire, PE18 9NT, UK. fax (+44) (0) 1480 830507, email 101331.663@compuserve.com). We may be able to arrange local accommodation and transport for volunteers.

Sarah Fowler, Darwin Project Coordinator, Nature Conservation Bureau, Newbury, UK.

Spiny dogfish landings crash in British Columbia

After 35 uninterrupted years of recording commercial spiny dogfish *Squalus acanthias* landings in British Columbia, the Canadian Department of Fisheries and Oceans did not report any commercial landings in 1994. This followed a 58% decline in reported catches from 1990 to 1993. Landings in Washington and Oregon have increased greatly since the end of the 1980s (when salmon stocks collapsed and local fishing efforts were retargeted) and the small Californian fishery is stable. Nevertheless, there has been an overall declining trend in total Pacific Northwest landings of this species since 1990. If catch trends observed in other areas are followed, a rapid decline in total spiny dogfish catches from Pacific North American waters may be anticipated in the near future.

Sid Cook, Shark Specialist Group vice chair, Northeast Pacific region.

Philippine whale shark and manta ray fisheries

A traditional, seasonal (April/May) whale shark fishery in Mindanao and the Visayas, Philippines, was studied during a 15 day WWF field trip in 1996. Three hunting communities were visited and several key fishermen interviewed. These individuals know from experience exactly when and where they can expect to encounter their prey, which range in length from 14 to 40 feet. They also reported that female sharks occasionally contain egg-like structures with blood vessels, which they believe are fertilised whale shark eggs.

Although local whale shark hunting practices are still very traditional, a large number of fish are taken each season by just a small group of hunters. However, landings in 1996 were by far the lowest recorded in a hunting season (about 90 whale sharks in total were taken by all hunting communities interviewed). Most hunters agreed that the population and catches of whale sharks in their locality have been declining. One hunting community with about eight hunting groups/boats (each boat has five fishermen on board) reported their annual landings as 100 whale sharks during the 1994 hunting season, 80 last year (1995) and about 40 this year (1996). While external factors may (even partly) be responsible for this trend, it is possible that even this traditional fishery is unsustainable.

Whale shark skins, fins, jaws and meat were seen being dried for market (it was not possible to interview traders, who are concerned about the possibility that the whale shark hunt could be banned).

One manta ray with an approximately 12-foot wing span was seen being caught on one of the islands. Fishermen on this single island had, by end of May, reportedly landed about 1,000 rays since last December. Their flesh is also dried and traded.

Romy Trono, Director of Conservation, WWF-Philippine Program.

Obituary: Mike Holden, OBE

Well-known fisheries scientist and Shark Specialist Group member Mike Holden died unexpectedly at the end of last year.

Mike's career had ranged from the West African Fisheries Research Institute, Nigeria, to the UK Fisheries Laboratory in Lowestoft, culminating in the positions of principal administrator and then Head of the Conservation Unit of the European Union's Directorate General of Fisheries (DGXIV), retiring in 1990. He is possibly best known in the international fisheries management and research community for dogfish research and as author (in the early 1970s) of the first paper to draw attention to the potentially unsustainable nature of long-term elasmobranch fisheries. However, he more recently achieved notice in Europe for his post-retirement criticism of the TAC/quota system underpinning the Common Fisheries Policy. He argued in *The Common Fisheries Policy: Origin, Evaluation and Future* (1994) for their replacement by a Brussels-run licensing scheme which would provide the basis for a regime which would conserve stocks and provide a profitable European industry.

Mike was always willing to provide valuable advice to the Shark Specialist Group; we will miss his contributions greatly.

European news

European Elasmobranch Society

There is good news to report on progress with the establishment of the proposed UK-based European Elasmobranch Society (mentioned in a previous issue of *Shark News*). The UK government nature conservation agencies, Scottish Natural Heritage, English Nature and the Countryside Council for Wales, have just announced that they will be providing a grant towards the initial costs of establishing this organisation. The grant is smaller than that initally applied for, and only covers the period until end March 1997, rather than for the three years initiall requested. However, we are confident that this grant will enable th Society to be set up on a firm footing and enable us to raise th additional funds necessary to match this grant and to support it activities in future years.

The Society will be launched at the Third European Shark and Ra Workshop (see below).

Anyone interested in membership details should write to: Sarah Fowler, The Nature Conservation Bureau Limited, 36 Kingfish Court, Hambridge Road, Newbury, Berkshire, RG14 5SJ, UK. Fa (44) (0)1635 550230, email: sarahfowler@naturebureau.co.uk 100347.1526@compuserve.com

Third European Shark and Ray Workshop

The third European Shark and Ray Workshop will be held at t National Sea Life Centre, The Waters Edge, Brindley Place, Birmingha on 25–27 October 1996.

Generous sponsorship from the UK Sea Life Centres means th in addition to interesting presentations from a number of UK a European speakers, participants will hear talks from South Afri based great white shark researchers Mark Marks and Leon Compagno, and John Morrissey from New York. The meeting promi to be a very interesting and stimulating occasion.

If you would like more information on this meeting, ple contact Gordon Croft, St Andrews Sea Life Centre, The Score Andrews, Fife, KY16 9AS, UK. Fax: (+44) (0)1334 472950.

News

Reproduction in the whale shark

Joung *et al.* (1995) have recently provided the first firm evidence of ovoviviparity in the whale shark *Rhyncodon typus*, based on the dissection of a 7–8 m, 16,000 kg female harpooned in the eastern waters of Taiwan in July 1995. Although previous literature on the species has considered this type of reproductive strategy likely, the unexpected aspect of this report is that about 300 embryos were revealed in the uteri. Several size classes were present, suggesting a long breeding season. Most embryos were in eggcases with yolk sac, but the largest (60–65 cm TL), presumably virtually full term, were outside their eggcases. Some of these survived dissection and transfer to aquaria. A report of these observations will also be presented at the New Orleans American Elasmobranch Society Meeting in June 1996.

Joung, S.J., *et. al.* December 1995. Ovoviviparous whale shark. (Abstract of Symposium paper, Tokyo, November 1995.) *Report of the Japanese Society for Elasmobranch Studies*, **32**, p.32.

Sawfish in the Mekong River

Shark Specialist Group member Tyson Roberts has drawn the editor's attention to reports of sawfish in a 1993–1994 study of fisheries in southern Laos and north-eastern Cambodia. Roberts and Warren (1994) note that sawfish (likely *Pristis microdon* and/or *P.clavata*) caused considerable damage to gillnets and were occasionally caught as recently as ten years ago just below the Lee Pee Waterfalls, Laos. One fisherman used to see two or three of up to 10 kg in weight in February–March each year, presumably following other migratory fish. Sawfish are now absent or very rare in the Great Lake of Tonle Sap; the most recent known capture was 40 years ago. One *Pristis* was reported landed at Ban Wernkam towards the end of 1993. Overall, the 1993/94 season was the worst ever experienced by local fishermen, representative of a long-term basinwide decline of Mekong fisheries, where gillnets are intensively used.

Roberts, T.R., and Warren, T.J. 1994. Observation on fishes and fisheries in southern Laos and northeastern Cambodia, October 1993–February 1994. *Nat. Hist. Bull. Siam Soc.* **42**: 87–115.

Proposals for protection of sharks in Australia

The Australian Nature Conservation Agency has recently received a nomination for protection of the white shark *Carcharodon carcharias* and the grey nurse shark *Carcharias taurus* under the Endangered Species Protection Act. The grey nurse is already protected in New South Wales, and the white shark protected in Tasmanian waters and proposed for protection in South Australia, but listing under the Endangered Species Protection Act would have the effect of protecting these species throughout commonwealth waters. The federal government will also be required to consult states and territories to develop and provide funds for national recovery plans for the species.

Sharks were noted as being potentially vulnerable in Australia's first State of the Marine Environment report, released last year. The whale shark has recently received protection in Western Australia.

Sharks highlighted in UK biodiversity report

The basking shark *Cetorhinus maximus*, tope *Galeorhinus galeus*, porbeagle *Lamna nasus* and blue shark *Prionace glauca* have all been listed in the recently published UK Steering Group Biodiversity Report *Meeting the Rio Challenge*. They appear on a long list of some 1,250 species which are considered to be of conservation concern (however, this is not considered to be a comprehensive listing). The report notes that monitoring of these species is important in establishing a review of the health of biodiversity in the UK, and should take place within five years.

The Marine Stewardship Council initiative

A major new initiative to halt the serious decline in global fish stocks was announced in February by WWF International and Unilever Plc/NV, one of the world's largest buyers of frozen fish. They have agreed to create a Marine Stewardship Council (MSC) following a wide-ranging consultation of all those involved with fisheries (from scientists to regulators and environmentalists).

The MSC will be a wholly-independent body, setting out the broad principles of sustainable fishing and laying down specific standards for individual fisheries. Products made from fish caught in accordance with these standards will receive an MSC 'on-pack' logo. This will allow consumers to select fish products that come from a source certified as sustainable. Not only should this approach enable declining commercial stocks to recover, with associated benefits for the marine environment, but it should also help coastal communities dependent on fishing to avoid economic and social collapse.

The aim is for the MSC to adopt a similar approach to that which has successfully promoted sustainable forestry; uniting the efforts of industry and the consumer to promote market-led incentives for sustainable fishing. This approach seems more likely to succeed than the repeatedly unsuccessful political efforts to tackle the problem of declining fish stocks (e.g. by setting catch quotas and other regulations).

Conservation of chondrichthyans in the Maldives

1995 was an important year for shark and ray conservation in the Maldives, with a number of new regulations coming into effect.

Whale sharks *Rhincodon typus* have been protected under the Fisheries Law which prevents the catch of all types of *bodu mas* (a local term for true whales and other large 'fish' including whale sharks). However, this term is ambiguous; some consider it refers to true whales only. A couple of whale sharks were reportedly caught in 1994 for their liver oil and/or fins, both of which commodities are of very low value in this species. Whale sharks are recognised as a significant attraction for tourist divers. The Ministry of Fisheries and Agriculture announced a specific regulation in June 1995, banning all fishing for whale sharks, to reinforce the existing Law.

Rays, particularly manta rays (Mobulidae) and stingrays (Dasyatididae) are a major attraction for tourist divers in the Maldives. There is a small traditional and sustainable catch for rays for their skins (used on drums), oil and shark bait. However, any increase in fishing effort to support an export fishery would likely prove non-sustainable damaging both traditional users and the tourism sector. To forestal and avoid such problems, the Fisheries Ministry banned export of ray from June 1995, and of ray skins from 1 January 1996.

On World Environment Day (5 June) 1995, the Ministry o Planning Human Resources and Environment declared 15 top divin sites as Marine Protected Areas. Nine of these are or were famous fo their sharks, but there have over the years been a number of incidence of fishermen catching sharks at these sites. Since a grey reef shar *Carcharhinus amblyrhynchos* may be worth up to 1,000 times mor alive as a source of diving revenue than dead on a fishing boat, makes sense to protect sharks within tourism zones.

Although these regulations provide significant protection for som chondrichthyan fishes in the Maldives, there is a need for further actio For example, reef sharks are not confined to particular reefs and, in th Maldives at least, do show some seasonal migratory behaviour associate with the changing monsoons. Therefore, protecting particular dive sit will not give these sharks complete protection. Plans are therefore bei considered to protect more dive sites as well as much larger reef are where tourism development is concentrated.

R. Charles Anderson and Maizan Hassan Maniku, Mari Research Section, Ministry of Fisheries and Agriculture, Ma Republic of Maldiv

Bibliography

Please send us the complete citations and, if possible, abstracts of any new papers or reports which you have published or produced, and which you feel may be of interest to other readers. We will endeavour to provide details in future issues. Reports do not have to be formally published – indeed those with a restricted distribution which will not make their way into standard citation lists are often of particular interest, since they may not otherwise come to our attention.

The following are useful sources of information on elasmobranch or other marine animal tagging programmes and techniques.

Proceedings of the second European shark and ray workshop. Tag and release schemes and shark and ray management plans. S.L. Fowler and R.C. Earll (eds.). 1994. Unpublished.

Includes papers and abstracts of presentations ranging from individual tag and release research programmes to larger cooperative programmes in Europe. Available from Dr Clare Eno, JNCC, Monkstone House, City Road, Peterborough, PE1 1JY, UK.

The Shark Tagger Summary. Newsletter of the Cooperative Shark Tagging Program.

Distribution of this semi-annual newsletter is limited to active participants in the National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program. It reports on tagging and return results and also on ongoing research projects being undertaken by the NMFS. The newsletter is published by the US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI 02882, USA.

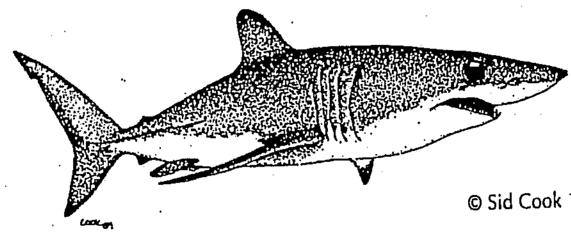
Wildlife Telemetry: Remote monitoring and tracking of animals. Priede, I.G., and Smith (eds.). 1992. Ellis Horwood Ltd, London.

Handbook of biotelemetry and radio tracking. Amalner, C.J., and MacDonald, D.W. (eds.). 1980. Pergamon Press, Oxford.

Nelson, D.R. 1990. Telemetry studies of sharks: a review, with applications in resource management. *In*: Pratt, H.L., Gruber, S.H., and Tanuchi, T. (eds). *Elasmobranchs as a living resource: advances in biology, ecology, systematics and the status of the fisheries. Proc. 2nd US-Japan workshop NOAA Technical Report* 90. NMFS. 239–256.

Nelson, D.R., *et al.* 1991. An acoustic tracking of a megamouth shark, *Megachasma pelagios. In*: Abstracts of the American Society of Ichthyologists and Herpetologists 71st Annual Meeting, and American Elasmobranch Society 7th Annual Meeting, 1991.

NOAA/National Marine Fisheries Service 1993. Workshop on tagging and tracking technology. Reference Document 93-08.



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Meetings *(continued from page 16)*

5th Indo-Pacific Fish Conference

ORSTOM Centre, Noumea (New Caledonia). Early November 1997.

A symposium will be devoted to Chondrichthyan fishes. Contact the URL at http://www.mnhn.fr/sfi/Congres/IPFC5.html, or B. Séret, Antenne ORSTOM, Muséum National d'Histoire Naturelle, Laboratoire d'Ichtyologie, 43 Rue Cuvier, 75231 Paris cedex 05, France. Fax: (33) 1 40 79 37 71. Email: seret@mnhn.fr.

IX Societas Europaea Ichthyologorum Congress Theme: Fish Biodiversity

Maritime Station, Trieste, Italy. 24–30 August 1997. Contact Pier Giorgio Bianco, Dipartimento di Zoologia, Via Mezzocannone, 8, I-80134 Napoli, Italy. Fax: + 39 81 552 64 52.

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 welcome all personal contributions towards printing and mailing costs, 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 #3060"), 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).

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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.

National Audubon Society's Living Oceans Program is pleased to sponsor the seventh issue of *Shark News* because we believe that *Shark News* has become the most valuable and substantive communication tool among shark scientists around the world. Living Oceans has been a major financial supporter of *Shark News* since its inception and underwrites some of the printing and postage costs for each issue, as well as other Shark Specialist Group materials and operations.

Living Oceans is the marine conservation programme of the National Audubon Society, a non-profit environmental conservation organisation dedicated to protecting wildlife and wild places. A primary goal of the Living Oceans Program is the conservation and restoration of the oceans' giant fishes, particularly sharks, tunas, and billfishes. We use science-based policy analysis, education, and grassroots advocacy to improve the national and international management of marine fisheries.

Living Oceans has been involved in shark conservation and management at many levels, from efforts to improve the US Atlantic shark management plan, to raising awareness about illegal exploitation of sharks in the Galapagos and the cartilage industry in Costa Rica, to assisting in SSG initiatives, such as the Global Shark Action Plan. As Deputy Chairs of the SSG, we assist in editing and distributing *Shark News*, confer with scientists from around the world concerning SSG projects, and manage many of the day-to-day functions of the SSG. We played an important role in securing the CITES shark resolution and are now helping to draft and coordinate the reports that will be submitted to CITES in fulfillment of the resolution.

For more information about Living Oceans' shark conservation activities, please contact: Merry Camhi at National Audubon Society, 550 South Bay Ave., Islip, NY 11751, USA; tel: 516-581-2927; fax: 516-581-5268; email: mcamhi@audubon.org

The Shark Specialist Group also gratefully acknowledges generous funding provided for its work by: WWF's Endangered Seas Campaign (Red List assessments), Sir Peter Scott Fund (compilation of the Action Plan), UK Department of the Environment's Global Wildlife Division (CITES and related issues) and Darwin Secretariat (elasmobranch biodiversity conservation, Sabah, East Malaysia). Donations for *Shark News* production were also received from: M.B.G. de Anaijo, W. Burns, A.P.C. Carvalho, J. Casey, M. Chadwick, E. Clark, G.R. Filho, J.G. Furio, M.M.B. Gonzalez, D. Hax, A. Henningsen, G. Knowles, K. Kooros, J. Morón, T. O'Connor, S. Rapoport, L. Segedy, S. Siciliano, J. Stafford-Deitsch, R. and V. Taylor, C. Thorburn, B. Wetherbee, C. Wilkins (National Coalition for Marine Conservation), and K. Yano.

Meetings

Second World Fisheries Congress. Developing and Sustaining World Fisheries Resources: the state of science and management

Brisbane, Queensland, Australia. 28 July–2 August 1996. Contact: Congress Secretariat, PO Box 1280, Milton, Brisbane, Qld 4064, Australia. Fax: +61 7 3369 1512. Email: im@cc.qu.oz.au. Congress home page is http://www.ml.csiro.au/~bradford/WFC_page.html.

Includes the one day symposium: **Sharks and Man – Worldwide Management and Conservation** on 2 August. See p. 11.

1996 Shark Specialist Group meeting

Country Comfort Lemmons Hotel, Brisbane, 3 August 1996.

IUCN World Conservation Congress

Montreal Conference Centre, Canada. 14–23 October 1996. Contact IUCN, 28 rue Mauverney, 1196 Gland, Switzerland.

Third European Shark and Ray Meeting

National Sea Life Centre, Birmingham, UK. 25–27 October 1996. Contact Gordon Croft, Sea Life Centre, The Scores, St Andrews, Fife KY16 9AS, Scotland. Fax: +44 (0)1334 472950. See p. 13.

(continued on page 15)

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 chimaerid 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 publish original scientific data, but aim to complement scientific journals.

Publication dates are dependent upon sponsorship and receiving sufficient material for publication, but the target is three to four 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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