SHARK NEWS

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Reproductive modes of elasmobranchs

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Introduction

Vertebrates typically nourish their developing offspring by one of three major methods. The first involves yolk reserves, the most familiar example being the chicken egg. The embryo relies exclusively on yolk for its nutrient needs during development. The second method involves uterine secretion of a nutrient substance termed histotroph or uterine milk, a kind of maternal milkshake. The embryo ingests and absorbs the histotroph for growth and development. The final method is a placenta. Fetal membranes form a connection with maternal tissues to establish a utero-placental complex that supplies the embryo with nutrients and oxygen and removes wastes. Generally a species utilises only one of these methods, but placental sharks sequentially utilise all three; progressing from reliance on yolk, to histotroph to a placenta.

The lemon shark *Negaprion brevirostris* is a viviparous species in which the yolk sac and stalk are converted into a placenta and umbilical cord. This pup, new-born in a shallow Caribbean lagoonal nursery ground, still has its placenta attached. The umbilical scar left after the cord drops off will heal over during the next few months. Photo: S. Gruber.

The elasmobranch fishes (sharks, skates and stingrays) display an enormous variety of reproductive specialisations to provision their developing young with nutrients. Reproduction is either oviparous (egg laying) or viviparous (live bearing, including 70% of all sharks).

All elasmobranchs undergo an initial period of development that is reliant on yolk reserves sequestered in the yolk sac. Embryos are either totally yolk-reliant and lay eggs enclosed in a thick egg case (oviparity), or are only initially reliant on yolk and subsequently receive supplemental maternal nutrients during prolonged uterine gestation prior to live birth (viviparity). Viviparous species differ in the manner of delivery and type of maternally derived nutrients they supply to their embryos. Viviparity may be aplacental, in which a definitive maternal-fetal vascular connection is lacking, or placental, in which a vascular organ composed of both maternal and fetal tissues mediates exchange of nutrients, gases and waste products.

The egg

All elasmobranchs employ internal fertilisation, in which the male's pelvic fins are modified to serve as copulatory organs termed claspers. Following fertilisation, eggs are transmitted through specialised anterior regions of the oviducts termed the nidamental or shell glands. These paired glands perform the dual functions of (a) sperm storage and (b) elaboration of mucus, albumen and egg coverings. The type of egg covering differs with the type of reproductive mode of a particular species. In oviparous species, including all skates and some sharks, the initially thick, pliable egg case hardens after being deposited to protect the embryos from predation and physical trauma. Egg case tendrils and sticky filaments attach the egg to some substrate where the eggs incubate, unguarded for several weeks or months until hatching. (Elasmobranchs are not known to display parental care after birth.) The amount of yolk initially in the yolk sac limits the size an oviparous embryo may attain, and they are therefore relatively smaller than aplacental species. Empty egg cases are frequently found on the shore as 'mermaid's purses'. Placental sharks form a thin egg covering the consistency of plastic wrap that is incorporated into the placenta. Egg coverings are transitory or non-existent in stingrays.

Utilisation of yolk occurs by two methods. Yolk is digested by enzymes in the yolk syncytium and metabolites are absorbed by the yolk sac endoderm and transferred to the fetal circulation. Additionally, ciliated cells in the ductus vitellointestinalis, a patent tube in the yolk stalk connecting the yolk sac with the fetal alimentary canal, move yolk platelets to the fetal gut where they are digested and absorbed.

Aplacental viviparity

Aplacental viviparous species are of three types. The first (aplacental yolk sac variety) are those that incubate embryos in the maternal uterus without making any other provision for supplemental nourishment other than that originally in the yolk reserves. This is the most common reproductive strategy employed by sharks and it affords protection from predation. Sharks displaying this mode of reproduction include the dogfishes, cow sharks, angel sharks, frill sharks and tiger sharks. The second type (aplacental with uterine villi or trophonemata) retains initially yolk-reliant embryos in the

uterus but supplements yolk stores by secretion of histotroph or uterine milk. This method is best exemplified by the stingrays. The final aplacental type (aplacental with oophagy and intrauterine cannibalism) is found in the lamnoid sharks, makos, threshers and sand tigers. The young hatch within the uterus in the first three months and feed on ovulated eggs. The sand tiger, however, is the only documented intrauterine cannibal. It develops functional dentition at an early age and consumes its siblings in addition to eggs.

Viviparous species retain developing embryos and fetuses in the dilated posterior portion of the oviduct, which serves as a functional uterus. Physical associations between the maternal lining and the developing young range from simple uterine retention of yolk reliant embryos to the establishment of a vascularised placenta rivalling that of mammals. The period of uterine retention may be from 2–3 months in some stingrays, 9–11 months in some placental sharks to 24 months in the aplacental spiny dogfish. The degree to which the mother provides nutrients to supplement yolk reserves varies greatly with the mode of reproduction. In the case of the aplacental dogfish, additional nutrient contribution from the mother is considered nil and the term fetus weighs 40% less than the fertilised egg. Recently the whale shark has been shown to be aplacental viviparous. A gravid female was examined that contained a staggering 300 uterine embryos. Many were enclosed in the egg case and still contained a yolk sac while most others were free in the uterus and possessed a vitelline scar, a remnant of the resorbed yolk sac.

Uterine milk

In some aplacental sharks, the uterus develops uterine villi that may elaborate a nutrient fluid that is absorbed and/or ingested by the embryos. The quantity and composition of the uterine secretions finds its zenith in the stingrays, where the embryo may show a weight gain in excess of 5,000%. The term 'trophonemata' was coined to refer to the highly elongate, richly vascularised uterine villi of stingrays. Throughout gestation, as yolk reserves diminish, trophonemata increase in size and progressively elaborate uterine secretions rich in protein and lipids, termed histotroph or uterine milk. The fetuses ingest and digest the milk for further growth. The high degree of vascularity of trophonemata serves to increase the surface area available for intrauterine gas exchange.

Figure 1. Stingray embyro, with yolk stalk (st) and yolk sac (ys) still attached, resides in the uterus (ut) adorned with secretory trophonemata (t). From Hamlett *et al.* 1993.

Oophagy

Among the lamnoid sharks, a particularly bizarre reproductive strategy is employed. The maternal ovary produces thousands of relatively small eggs about the size of a garden pea, each enclosed in an egg case. Embryo development rapidly exhausts yolk reserves. Sand tiger embryos precociously develop tooth buds by the time they are 30 mm in total length and by 60 mm they have multiple rows of erupted teeth. Embryos use their dentition to tear out of their egg case and feed on other uterine eggs in a process called oophagy (egg eating) and (in the sand tiger) cannibalise other smaller uterine siblings (intrauterine cannibalism or embryophagy). At term only one fetus survives in each uterus, achieving gigantic proportions of more than a metre in length.

Placental viviparity

Approximately 70% of all sharks are viviparous, giving birth to living young. Of these 30% are placental and develop a placenta resembling that of mammals. Other reproductive similarities to mammals include internal fertilisation, the presence of the same suite of reproductive hormones, uterine gestation *via* a placenta, and a prolonged pregnancy (generally 8–12 months). At birth the babies are capable of swimming and hunting independently.

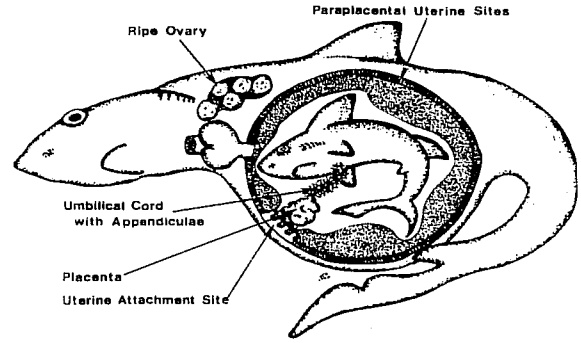

Figure 2. In placental sharks at term, the yolk stalk is transformed into an umbilical cord which may have appendiculae and the yolk sac contributes to the functional placenta. Specialized attachment sites for the distal portion of the placenta modulate metabolic exchange. From Hamlett 1993. *Environ. Biol. Fishes* **38**: 253–267.

Among humans, multiple births are considered unusual, whereas in placental sharks it is the rule. Placental sharks bear from four to 100 offspring, depending on the species. These impressive numbers are only modest when compared to the thousands of eggs a bony fish may lay at one time. Since shark embryos are safely harboured inside the mother's body, virtually all survive to birth. This affords protection of the embryos from predation during this early vulnerable period.

Characteristics of placental sharks include: 1) lengthy gestation period, 2) reduced number of offspring when compared to bony fish, 3) increased degree of maternal protection during development of the embryos and 4) increased chance of survival of the offspring due to their large size at birth.

In placental sharks, initial development is yolk-reliant but instead of retracting the yolk sac into the abdominal wall, placental species convert the yolk stalk and yolk sac into an umbilical cord and placenta respectively. The placenta is an amalgam of fetal and maternal tissues. In most placental sharks a thin, flexible egg covering encloses each fetus and fetal portion of the placenta, thus all metabolic exchange between mother and fetus is effected through the intervening egg covering.

In most placental sharks the umbilical cord is smooth, but in others it is festooned with branched, vascular extensions termed appendiculae. These structures have been demonstrated to absorb fluids from the uterine environment and thus may serve as a paraplacental nutrient-absorptive site that may function while the definitive placenta is forming.

Conclusions

Elasmobranchs are an ancient group that display an impressive variety of reproductive modes ranging from oviparity to placental viviparity. Viviparous development is the most diverse and includes species that drink a uterine 'milkshake', others that eat one another within the uterus, and others that form a placental connection similar in many ways to that of man. All of these means of reproduction are highly successful and are utilised by extant species.

Various reproductive characteristics of elasmobranchs, and sharks in particular, make them sensitive to perturbation by man. They are slow to mature sexually, have a large energy investment in relatively few young and some sharks only breed every other year. Because of these characteristics, rates of replacement within populations are very slow. In the face of the increasing pressures placed on elasmobranchs as a food source, from recreational fishing, as bycatch from other fisheries, and the enormous price that shark fins bring on the international market, their reproductive future must be considered carefully. It is, therefore, vitally important to be conservative in harvesting from these populations.

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Editorial

A message from the new Co-Chair of the Shark Specialist Group

I felt honoured when the SSG leadership asked me to consider taking over from Sarah Fowler (Acting-Chair) in the new Triennium and replacing Sonny Gruber as Chair of the SSG. Sonny is always a hard act to follow and I did not make a commitment immediately but gave my decision considerable thought over several months. When Sarah agreed to serve with me as Co-Chair, I accepted the position with enthusiasm. Sarah and Merry Camhi (Deputy-Chair) have kept the SSG on course for the last year, and have achieved a great deal though some contentious times.

The past year in review

In April 1996, the Species Survival Commission convened an important workshop in London for about 30 scientists from various Species Specialist Groups to evaluate the new IUCN criteria for inclusion in the Red List of Threatened Animals with respect to marine fishes. The last issue of *Shark News* (8: 4–5, December 1996) reviewed the discussions held and resultant elasmobranch Red List assessments published in the 1996 Red List, as well as subsequent revisions by the SSG. Presently, IUCN is re-evaluating its criteria, particularly for fecund, abundant and wide-ranging species, to address the current problems. Meanwhile, through the combined efforts of Sarah and Merry and able contributions from may SSG regional vice-chairs and members, the Shark Status Report and Action Plan is well on its way to completion. Those of you who have outstanding species status reports, please send them to Sarah or Merry ASAP.

Another major activity that occupied the SSG in 1996 was to evaluate various proposals and other supporting documents regarding elasmobranchs that were to be presented to the CITES Animals Committee. At our Brisbane meeting a US National Marine Fisheries Service (NMFS) Draft Discussion Paper *An Overview of Impact: the Biological Status of Shark Species*, facilitated by Andy Oliver for CITES, was reviewed, edited and approved by the SSG. A proposal initiated by Sid Cook and Madeline Oetinger and presented by the US Fish and Wildlife Service to list all sawfish species under CITES Appendix I (complete international trade restriction) was reviewed and approved. (The SSG defines all sawfish species as threatened with extinction in their species assessments.) In addition, an outline was developed to provide a more complete SSG review of shark ecology and population dynamics for the CITES Animals Committee, with helpful suggestions from Hank Jenkins, Chair of that Committee. This review was expanded and completed, mostly by Sarah Fowler and Merry Camhi, and presented as a report *The Implications of Biology for the Conservation and Management of Sharks* from the IUCN to the Animals Committee at their meeting in Prague, Czech Republic, in September. The CITES Animals Committee used the NMFS and IUCN documents, along with a paper on shark trade prepared by TRAFFIC and other contributions, as the basis for their own report *Biological and Trade Status of Sharks*, much of which was derived from the SSG document. Many of the SSG members have reviewed and commented on the CITES report, which will be presented to the Meeting of the Parties of CITES in Zimbabwe in June.

The year ahead

At the time of writing Sarah and I are preparing to travel to Harare, Zimbabwe, as part of the IUCN delegation to the CITES meeting, and Merry on behalf of the Living Oceans Program. We will be there to provide scientific support for the proposal to list sawfishes under Appendix I, and a proposed resolution from the US to establish a CITES Marine Fish Working Group.

After the CITES meeting, an SSG meeting will be held during the Annual Meeting of the American Elasmobranch Society in Seattle, Washington, at the end of June. The focus of the meeting will be to review progress of the Status Report and Action Plan, and specifically to work on the Action points for the latter. Please be thinking about what actions need to be taken, especially at a global scale, to ensure prudent management and conservation of chondrichthyan fishes. In addition we will discuss the FAO Experts Consultation on Sharks to be held in 1998 and recommended revisions to the IUCN Red List Criteria to make them more applicable to sharks and other marine fishes.

We plan to convene another SSG meeting at the Indo-Pacific conference in Noumea, New Caledonia in November 1997 to work further on Action Items and other issues. The SSG has met in conjunction with the Indo-Pacific Fish Conference at the last meeting in Bangkok. This year's meeting will provide an opportunity for SSG members from that region to provide their input to the Status Report and Action Plan.

Other SSG activities in the coming year include a regional shark management workshop to be held in Sabah, Malaysia, in early July, organised by Sarah Fowler with the Sabah Department of Fisheries and Institute for Development Studies. Sarah has been serving as the PI of a research program, supported by the Darwin Initiative (UK), on the biodiversity and conservation of elasmobranchs in Sabah. Several SSG members from the region and elsewhere will be participating.

The year 1997 is the beginning of a new triennium for all IUCN Species Specialist Groups. With this renewal comes a critical review of the SSG membership roles, deletion of inactive members, and addition of new members. Members who have not participated in the SSG efforts in recent years will not be reappointed, but will continue to receive *Shark News*. If you wish to retain your membership and plan to contribute actively to our work to the end of the century, please contact Sarah or Merry. I look forward to working with all of you in fostering the role of science in the conservation of sustainable chondrichthyan resources.

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Burning the candle at both ends

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Sharks and batoids (rays) have a reproductive strategy that is very different from the vast majority of most fishes. In general, bony fishes spew thousands of eggs and sperm into the water column where fertilisation takes place. For the larvae produced, there is a substantial mortality. Conversely, sharks produce a limited number of young after carrying the pups internally for a lengthy gestation period, which is analogous to mammalian reproduction. These precocious young receive no further parental care or protection, but they are of a size and developmental stage that allows them to avoid and bypass many of the natural mortality forces that affect their bony fish counterparts.

For example, viviparous species such as sandbar and blacktip sharks have a one-year gestation period, and a two-year reproductive cycle. Initial maturation and final reproductive tract development are apparently timed to occur just prior to the mating season. For most warm-temperate and sub-tropical species, pupping usually occurs in summer. However, some tropical sharks do not exhibit a particular seasonality to their cycle.

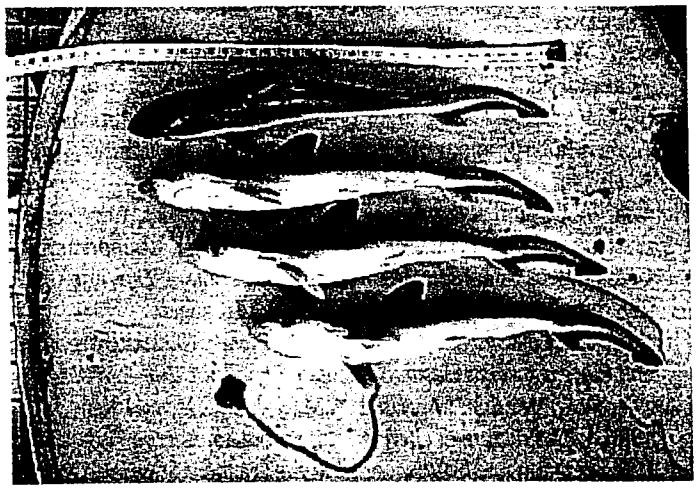
In the case of viviparous species of the Northwest Atlantic, four to eight eggs are ovulated (often in pairs) in June. They pass into the female reproductive tract where they are fertilised and encapsulated, and pass on to the two horns of the uterus, usually with equal numbers in each horn. The embryos are 10–20 mm in length by July, clearly visible, and attached to the egg yolk. By October the embryos are nearing half their birth length, and look very similar to miniature adults. By this time, a pseudoplacental connection has formed between the embryo and the uterine wall, most of the yolk is resorbed, and the embryos receive nourishment directly from the mother through the placental connections. By January, the embryos are nearly full length, but still need considerable development before being born. Birth occurs in May and June. After birth, the mother leaves the 'nursery' ground, and does not mate again for a year. This allows her to rebuild the energy reserves needed during pregnancy. Thus, the gestation period is one year, and the entire reproductive cycle is two years.

By contrast, other species, usually smaller and faster growing, have a one year reproductive cycle in which new ova begin developing during the final phases of pregnancy. Shortly after pupping, the female mates and starts the cycle again.

Because the pups are carried internally, there is a trade-off in the number of young that can be produced and their size at birth. Some species, such as the sand tiger, produce only two very large pups per cycle. By contrast, the blue shark may produce as many as 50 young at a much smaller size. More commonly among familiar shark species, the number of pups per litter ranges from six to twelve. In some cases, the number of young increase as the mother grows older; for example, her early pregnancies may only produce two or four young, but later in life she will produce a full complement of eight pups.

The young may or may not utilise nursery grounds, year-round or seasonally, during their first or first few years. By doing so, they avoid being preyed upon by larger fishes, including their own species. The length of time that they use these nurseries is somewhat dependent upon their growth rates. It has been suggested (by this author) that it may be necessary for an individual to attain a size of approximately one metre in order to successfully avoid or deter predators. In some cases this may be the maximum size of the species, and, in those cases, reproduction and growth rate are the highest.

These differences highlight the various strategies used to successfully maintain species and populations. Whether the young use a nursery or not, they are susceptible to mortality from both



Litter of near-term milk shark *Rhizoprionodon acutus* pups. Pregnant females and newborns regularly appear in Sabah fish markets, presumably taken as bycatch in fisheries targeted at other species. Photo: Sarah Fowler, Sabah Darwin Project.

natural and man-made (fishing) sources. The juveniles and adolescents tend to remain in shallower coastal waters, whereas the larger adults may be found in deeper coastal waters, but this nearshore existence makes the juveniles more vulnerable to a myriad of fishing efforts. They may be targeted by recreational and commercial fishers, or they may be inadvertently taken in recreational and commercial efforts that target other species. In some fisheries, in certain areas, the bycatch of young sharks may actually dominate the catch.

Large-scale shark fisheries have never been known to be successfully sustainable. In part, this is because of the sharks' general life history. It has been estimated that some shark species may only have a capacity to increase their population by 2% annually; at least for those species that have been mathematically modelled to determine such values, the maximum ability to increase may be only 10%–15% annually. Thus, given the biological constraints of the resource to rapidly replenish itself because of low fecundity, slow growth, and late maturation, populations have little natural flexibility to withstand excessive fishing mortality. Even if a directed fishery (no matter the source) were properly managed to allow for a sustainable harvest of adults, there would be little flexibility in that management strategy for other sources of mortality, such as bycatch of the juveniles. Thus, juvenile survival is critical to continuation of strong populations, and/or sustainable fisheries.

There is a growing concern about the exploitation of shark resources world-wide, especially because the primary product is only the fin, and there are increased efforts to apply management to various fisheries that target or interact with marketable sharks. Just as important, however, will be management to address fisheries that interact with juvenile sharks as a bycatch. Failing to address mortality on both the young and the old is analogous to burning a candle at both ends. There may be more immediate benefits, but in the long run ... well, in the case of sharks, there is no 'long' run.

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Status of shark conservation and fisheries in Hawaii

Chris Lowe and Brad Wetherbee, University of Hawaii, USA

Although there are no commercial shark fisheries in Hawaii, there has been intermittent fishing pressure on shark populations here for the past 40 years. In the past sharks were caught and killed in an attempt to reduce the risk of shark attack in Hawaii, but more recently large numbers of sharks have been taken as bycatch in tuna and billfish longline fisheries.

In response to concern for public safety, shark fishing was conducted systematically around the populated Hawaiian Islands between 1959 and 1976. During a total of six shark control programmes, nearly 5,000 sharks were removed from nearshore waters at a cost of over US $300,000. Following two fatal shark attacks, there were calls for reinstatement of shark fishing, and the state legislature considered a bill allocating $200,000 for shark eradication. However, evaluation of previous shark control programs indicated that shark fishing had no measurable effect on the risk of shark attack. These findings, coupled with cultural and ecological concerns about large-scale shark control, convinced legislators to appropriate funds for shark research and public education. Data collected during the resulting research programmes has provided the state with valuable scientific information upon which to base future public safety protocol. Because of the cultural and environmental concerns, the high cost of fishing, and improved understanding of shark behaviour, large-scale shark control is unlikely to occur again in Hawaii. This case provides a good example of how scientific data and public education on conservation issues can impact legislative decisions (Wetherbee *et al.* 1994).

The newest challenge in shark conservation may lie offshore. The recent development of offshore tuna and swordfish longline fisheries in Hawaii has resulted in a high shark bycatch, particularly for blue sharks. Unfortunately, at this point it is difficult to assess the impacts of these fisheries on shark populations. The only sources of data on the number of sharks taken are logbooks kept by the fishermen and reports of fisheries observers. In 1990, the National Marine Fisheries Service (NMFS) implemented the Federal logbook system for domestic longliners operating in the western Pacific. This programme was primarily designed for reporting interactions of longliners with endangered or threatened marine species. As such, the accuracy of the data collected on sharks caught in the Hawaii longline fishery is questionable. Logbooks, which are supposed to be filled out by boat captains during sets, are frequently not completed until after boats have returned to port. Therefore, the number of sharks caught is often only estimated. Observer data suggests that logbooks under-report shark catches by about 15%, which is considered low, but observers only monitor about 5% of the Hawaii fishing fleet. According to the 1995 NMFS logbook data, 70,000 sharks were taken as bycatch, and 33,300 were reported as landed. Only 3,300 of these were landed as whole carcasses while 30,000 of the sharks reported as being landed were finned and their carcasses discarded at sea. These data indicate that 43% of the sharks caught were finned (Western Pacific Regional Fisheries Council 1995).

Most of the sharks captured in the Hawaii fisheries are utilised for their fins. There has been a tremendous increase in the demand for shark fins world-wide for use in shark fin soup, and fins have achieved the highest value of any shark product to date. Imports of shark fins in Asian markets have increased by over 100% over the last 15 years. Hong Kong lies at the hub of the shark fin trade, followed distantly by Singapore and Taiwan. The Hong Kong market is supplied primarily by Japanese fisheries, of which many (such as tuna and billfish fisheries) are centred in the Pacific Ocean, including Hawaii (Rose 1996). Thus, Hawaii may be a bottleneck for the flow of fins to Asia, and Honolulu is likely one of the few US ports where this trade may be monitored. It has been estimated that as much as $12 million worth of shark fins pass through Hawaii on their way to Asia each year (Swenson 1996). Unfortunately, there are few data on how many sharks are taken in Hawaii waters, the species composition of the fishery, and how fishing impacts shark populations.

Shark fins on sale in Hong Kong markets. Photo: Brad Wetherbee.

Since there is currently no fisheries management plan for sharks in the Pacific, there are no restrictions on shark finning in any Hawaii fisheries. Although it is thought that many species of pelagic sharks are less susceptible to localised overfishing because of their cosmopolitan distribution, increased global fishing pressure may impact sharks populations on a large scale.

Development of a shark fisheries management plan for the Pacific and increased public education may be the best tools available for protecting shark populations from overfishing. More reliable landing data and improved understanding of the biology of the sharks caught are essential requirements for making reasonable management decisions regarding shark fisheries in Hawaii and elsewhere in the Pacific. Finally, better educated consumers can be very effective in reducing market demand for sharks in unstable fisheries, and for pressuring government agencies such as NMFS and the Western Fisheries Management Council to take appropriate steps to ensure that shark populations are not overfished.

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Sharks and CITES – an update

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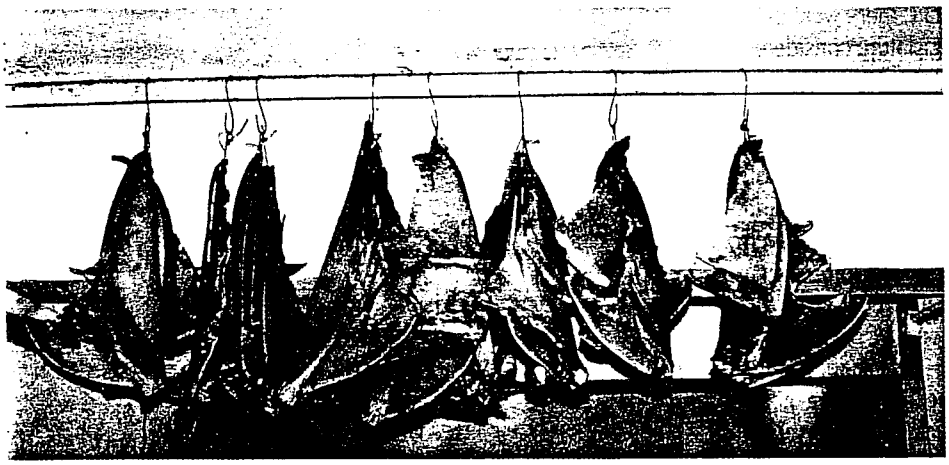
As we reported in the last issue of *Shark News* (8:1–2), sharks have been the focus of much attention within CITES (the Convention on International Trade in Endangered Species) following the passage of the shark resolution (Conf. Res. 9.17) at the 9th CITES meeting in 1994. Sharks will again be on the agenda at the 10th CITES meeting taking place in Zimbabwe in June 1997. Actions related to sharks that will be debated by CITES Parties will include:

- Adoption of the CITES Animals Committee report on the biological and trade status of sharks;
- Proposal to list all sawfish species on Appendix 1; and
- Resolution to establish a working group for marine fish species.



Shark fins on sale in Hong Kong. Photo: Brad Wetherbee

Sharks in CITES

No cartilaginous fish is currently listed on the CITES Appendices. However, a number of shark species are seriously depleted and international trade is one of the major contributors to shark declines throughout the world. Although marine fish have not received the attention they deserve by CITES, there is no *a priori* reason why sharks and other fishes would not fall under its purview: CITES is dedicated to the conservation of all wild animals and plants in international trade.

In a recent statement, *CITES and Marine Fisheries*, IUCN states that it "considers CITES an appropriate mechanism for the control of trade in commercially exploited marine fishes and other marine fisheries species" and that "the treaty was designed for and should be used to control trade in species whose survival is threatened or whose populations are subject to unsustainable exploitation as a result of international trade."

Some argue that the conservation of commercially valuable marine fishes should be left to domestic and regional fisheries management bodies. In many cases, however, these authorities have failed to prevent overfishing and, in the case of sharks, there are no international and few domestic management regimes in place.

It is important to understand that CITES is restricted to conservation issues involving international trade and has no management authority. Rather, management of listed species is the obligation of the appropriate domestic fisheries and wildlife agencies or of regional or international management authorities. Therefore, listing of species on CITES confers no direct management, other than requiring that countries involved in trade demonstrate that export of the listed species is not detrimental to the biological status of its population. The listing of species does, however, draw attention to the need for domestic management of declining populations. Appendix I prohibits trade in the listed species, whereas Appendix II requires that any trade be carefully monitored.

Animals Committee shark report

The shark resolution passed at the last CITES meeting (1994) mandated the CITES Animals Committee to undertake a study of the biological and trade status of sharks.

Three reports – from the SSG (*The Implications of Biology for the Conservation and Management of Sharks*), TRAFFIC, and the US government – were submitted to the Animals Committee at their meeting in Prague in 1996 in fulfilment of this resolution. These reports were subsequently combined by the Committee into a single document, *Biological and Trade Status of Sharks*, which will be presented for adoption by the CITES Parties in Zimbabwe.

The main recommendations of the Animals Committee report (see opposite) include the need for improved species-specific fishery, trade, and biological data by all Parties and UN FAO, and an increase in research and management efforts for elasmobranchs.

Sawfish and other listing proposals

A number of sharks were proposed for listing on CITES. The US received proposals to list the western North Atlantic populations of dusky shark (*Carcharhinus obscurus*) and spiny dogfish (*Squalus acanthias*) on Appendix II and all sawfishes on Appendix I. The United Kingdom received a petition to list the basking shark (*Cetorhinus maximus*) on Appendix II, and Australia was asked to list the white shark (*Carcharodon carcharias*) on Appendix I.

Of these, the only elasmobranch listing proposal that will be considered by CITES Parties in Zimbabwe is for the listing of sawfishes (all Pristiformes) on Appendix I. Although the US declined to support the proposals for *C. obscurus* or *S. acanthias*, they have publicly stated that the depleted status of these populations in the western Atlantic qualifies these species for listing on Appendix II.

The status of sawfish populations has been of concern to many SSG members. At the last formal meeting of the Shark Specialist Group in Brisbane, Australia (August 1996), an informal poll found unanimous support from those present for the listing of sawfishes on CITES.

Limited population and trade data are available for most sawfishes because they have not been of commercial importance and therefore few resources have been applied to their study. This lack of data may be used to block their listing on CITES, perhaps by inferring that trade is not a significant factor in their decline. However, for a species that qualifies biologically for an Appendix I listing (as sawfishes do), it is only necessary to demonstrate under the new CITES listing criteria that the species "is or may be affected by trade." There is clear evidence that sawfishes are still in trade. Some SSG members argue that there is little doubt that some sawfishes are in serious trouble and that any level of trade is unsustainable. In addition, they argue that the precautionary principle should be applied by CITES where there is strong scientific concern about the status of the species in question, as is the case for sawfishes.

Marine Fishes Working Group

The US has proposed a resolution, which will be debated in Zimbabwe, to establish a Working Group for Marine Fish Species. Listing marine fishes will pose unique challenges to CITES, which to date has focused on terrestrial species. This Working Group,

fashioned after the successful Timber Working Group, could – if approved – address the range of implementation issues that might arise with any future listing of marine fishes, including elasmobranchs. The Working Group could also help direct the Parties, FAO, and other fisheries bodies in improved data collection and standardisation for the purposes of CITES, and help to carry out the other recommendations of the Animals Committee's shark report (see page 7). The Marine Fishes Working Group is one way that CITES can fulfil its responsibility, much neglected until now, towards the conservation of over-exploited marine fishes in trade. IUCN endorses the establishment of a CITES Working Group for Marine Fish Species.

Action needed

Getting adequate attention for the conservation needs of overexploited elasmobranchs within the context of CITES is an uphill battle. Yet trade is a major contributor to the decline of many shark populations around the world. As we go to press, several SSG members are departing for Zimbabwe and will be available to delegates to provide data and other information supporting the above initiatives. The next issue of *Shark News* will report on the outcome of the conference and the activities which will take us up to the 11th Conference of Parties in the year 2000.

Copies of the CITES Animals Committee report and the SSG report are available (at cost) from Merry Camhi or Sarah Fowler.

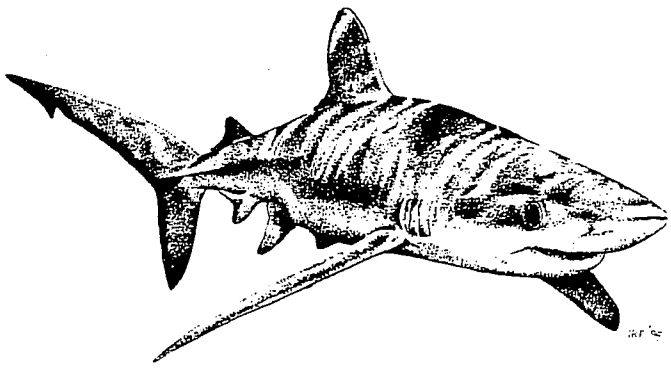


Illustration © I.K. Fergusson.

No sharks at Chagos

The Chagos Archipelago is a group of atolls, submerged reefs and coral islands in the central Indian Ocean. The Chagos is administered by Britain, and is uninhabited apart from a US military base on Diego Garcia. It lies 500 km south of the Maldives and over 1,500 km from anywhere else. A series of scientific diving expeditions to the Chagos in the 1970s found large populations of reef sharks there. On many dives dozens of sharks were seen, and it was often necessary to have one member of each diving team assigned as a 'shark guard' to ward off over-inquisitive sharks. After a break of 17 years another expedition visited the Chagos in 1996. Instead of the expected hordes of reef sharks, expedition members found minimal numbers. The cause of this dramatic decline is fishing. Mauritian reef fishermen visit the Chagos under licence from the British authorities. Sri Lankan fishermen also visit, illegally. This decline suggests that 'isolation' is no longer any protection for Indo-Pacific reef shark populations. A full report on this issue, with semi-quantitative data from divers' logbook records, will appear in the next issue of *Shark News*.

Charles Anderson

Recommendations of the CITES Animals Committee report *Biological and Trade Status of Sharks*

It is recommended that the Conference of the Parties endorse the following actions directed towards full implementation of Resolution Conf 9.17.

1. Improve methods to accurately identify, by species, record and report landings of sharks from directed fisheries and sharks taken as a bycatch of another fishery.

2. Parties which operate a shark fishery and/or trade in sharks and shark products should establish appropriate species-specific recording and reporting systems for all sharks that are landed as a directed catch or a bycatch.

3. In an effort to improve trade statistics of sharks and shark products, the Secretariat, in collaboration with FAO, should consult the World Customs Organisation to establish more specific headings within the standard 6-digit Customs tariff headings, adopted under the 'Harmonised System' tariff classification to discriminate between shark meat, fins, leather, cartilage and other products.

4. FAO should, as a matter of urgency, initiate a work program involving:
- the manner in which it requests members to record and report data on shark landings;
- a consultancy to design and undertake an inquiry on the availability of biological and trade data on sharks (commenced in 1996);
- update the Shark World Species Catalogue and the 1978 Shark Utilisation and Marketing Monograph, and
- finalise and publish the World Catalogue of Rajiformes.

5. FAO should transmit the results of the consultancy to the CITES Secretariat for circulation to and comment by the Parties to the Convention.

6. Parties which operate a shark fishery should initiate research and management efforts to:
- collect species-specific data on landings, discards and fishing effort;
- compile information on life-history and biological parameters such as growth rate, life span, sexual maturity, fecundity and stock-recruitment relationships of sharks taken in their fisheries;
- document the distribution of sharks by age, sex, seasonal movements and interactions between populations;
- reduce mortality of sharks captured incidentally in the course of other fishing activities, and [*sic.*]

7. Parties are encouraged to initiate management of shark fisheries at the national level and develop international/regional bodies to coordinate management of shark fisheries throughout the geographic range of species which are subject to exploitation in order to ensure that international trade is not detrimental to the long-term survival of shark populations.

8. The Conference of the Parties to the Convention should urge the FAO to encourage its member States that operate a shark fishery, or a fishery that takes sharks as a bycatch, to subscribe to and implement the principles and practices elaborated in:

i) the FAO Code of Conduct for Responsible Fisheries;

ii) the FAO Precautionary Approach to Fisheries, Part 1: Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions; and

iii) the FAO Code of Practice for the Full Utilisation of Sharks.

9. FAO in collaboration with the CITES Secretariat and the CITES Animals Committee should convene a consultative meeting comprising FAO representatives, fisheries biologists/managers, intergovernmental fisheries organisations and non-government organisations with expertise on shark management to develop a program for further implementing Resolution Conf 9.17.

10. The Secretariat should communicate the relevant recommendations to FAO and other intergovernmental fisheries management and/or research organisations and establish liaison with these bodies to monitor implementation.

Reproductive strategy of white sharks, *Carcharodon carcharias*

Malcolm P. Francis, NIWAS, New Zealand

Great white sharks are large, comparatively uncommon, difficult to catch and dangerous to handle. As a result, they are difficult animals to study. Before 1991, we knew next to nothing about the reproduction of white sharks. The few accounts of pregnant females or embryos that existed were largely anecdotal, second-hand, or lacked detail. Since 1991, pregnant females or aborted embryos have been caught in New Zealand, Japan and Australia and examined by scientists. These fortuitous captures have greatly increased our understanding of reproduction in the species, though many important gaps remain in our knowledge. This article is based on the reports by Uchida *et al.* (1987, 1996), Uchida and Toda (1996) and Francis (1996), unless otherwise stated.

Reproductive mode

White shark embryos are nourished by eggs ovulated from their mother's ovary (oophagy). Intermediate-stage embryos (100–110 cm total length) have abdomens that are enormously distended by large quantities of ingested yolk, whereas near-term embryos (135–151 cm) have either empty stomachs or contain smaller quantities of yolk. This developmental pattern appears similar to that in porbeagle sharks (*Lamna nasus*), in which maximum ingestion of ova occurs about halfway through gestation. Thereafter, the ova supply dwindles, and the embryos digest the yolk held in their stomachs and store the energy as lipids in an enlarged liver (M. P. Francis and J. D. Stevens, unpubl. data).

There is no evidence that white shark embryos cannibalise their siblings (embryophagy). In the embryophagous sand tiger shark (*Carcharias taurus*), only one embryo survives in each uterus, so litter size is never more than two embryos (Gilmore 1993). In white sharks, maximum litter size is at least ten (see below), which makes it unlikely that embryophagy occurs. White shark embryos have no placental attachment to the uterus, so their reproductive mode is aplacental viviparity, with embryos being nourished by oophagy.

Fecundity

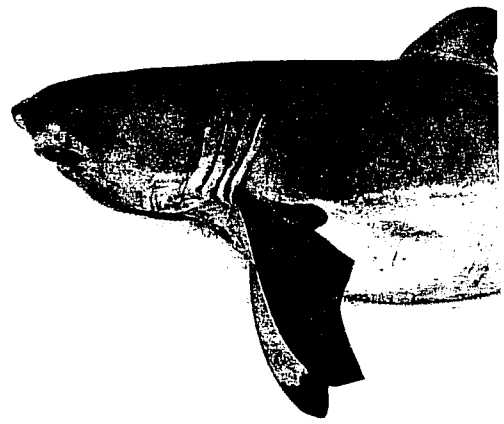
Litter sizes of 2–10 embryos have been observed, with unconfirmed reports of as many as 14 embryos. Some of the litters may have been incomplete, because abortion of embryos during capture is known in other shark species, and is suspected in white sharks. Average litter size is probably 5–10 young.

Length at birth

Length at birth can be estimated from the sizes of the largest embryos and the smallest free-living young. The largest reported embryo was 151 cm, and at least 20 embryos have been found in the length range 135–151 cm. The smallest reliably-measured free-living white sharks appear to be three 122 cm North American animals (Casey and Pratt 1985, Klimley 1985). There have been unconfirmed reports of free-living white sharks shorter than this, but to my knowledge none has been accurately measured. A considerable number of free-living white sharks in the size range 125–140 cm have been caught. Length at birth is therefore about 120–150 cm. This range will probably be extended at both ends as further information is obtained. There are insufficient data to determine whether length at birth varies regionally.

Parturition

Pregnant females carrying embryos longer than 127 cm have been caught from mid-winter to summer, indicating that parturition occurs in spring or summer. Most neonate white sharks (<155 cm) have also been caught in spring–summer (Casey and Pratt 1985, Klimley 1985, Fergusson 1996). However, pregnant females reputedly carrying small embryos have also been caught in spring or summer. There are several possible explanations for these observations: (1) the reported embryo lengths and/or capture dates were incorrect; (2) the reproductive cycle is non-synchronous, with females carrying embryos at different stages of development during spring–summer; or (3) the gestation period is longer than one year, resulting in two (or more) cohorts of embryos being present in the population at any given time. The second and third explanations seem more likely than the first.



White shark *Carcharodon carcharias*

Embryos and pregnant or post-partum white sharks have been reported from New Zealand, Australia, Taiwan, Japan and the Mediterranean Sea. New-born and 0+ young have been reported from New Zealand, Australia, Japan, South Africa, the north-east Pacific, the north-west Atlantic and the Mediterranean (Casey and Pratt 1985, Klimley 1985, Fergusson 1996). Therefore, parturition probably occurs in many distinct, mostly temperate, locations world-wide.

Length and age at maturity

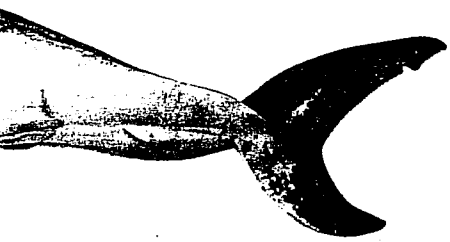
The length at maturity of male white sharks is difficult to determine, but is probably about 3.8 m (Pratt 1996). Most female white sharks do not mature until 4.5–5.0 m. There have been reports of smaller mature females, but these have not been confirmed. Based on the growth curve provided by Cailliet *et al.* (1985) for north-east Pacific white sharks, ages at maturity are tentatively estimated to be 8–9 years for males and 12–15 years for females.

Mating

Mating of white sharks has been observed only once, in spring. Other indirect signs can be used to infer recent mating, including semen or spermatophores flowing from the claspers, swollen siphon sacs, chafed claspers, and bite marks on females. For white sharks, most such observations have been made during spring–summer. Because parturition is also thought to occur in spring–summer, mating may occur soon after parturition, and females may carry successive litters of embryos with little or no resting period in between. However, this remains to be demonstrated.

Gaps in our knowledge

Although our understanding of white shark reproduction has advanced rapidly in the last six years, many important gaps still remain. We now have estimates of the length at maturity of both sexes, and the length at birth, but they are based on pooled, world-wide, data. In better-studied species of sharks, these parameters can vary substantially among populations. We should therefore expect regional variation in white sharks. The same is true of age at maturity, which is poorly estimated. Furthermore, the only available growth curve for white sharks does not distinguish between males and females, which may



cm. Photo: Malcolm Francis.

have different growth rates.

We don't have a good estimate of average litter size, and we don't know whether litter size varies with the size of the mother. Some or all of the reliably reported litters (only six of them) may have been incomplete, and reports of litter sizes greater than ten require confirmation.

More importantly, we have no information on the length of the gestation period, and whether females produce a litter every year. Gestation period in the related shortfin mako (*Isurus oxyrinchus*) is thought to exceed one year (H. Mollet, pers. comm.). If the gestation period of white sharks exceeds one year, and females have a resting period between pregnancies, they may only produce young every 2–3 years. At present, we can only speculate on this crucial element of the reproductive cycle.

Implications for management and conservation

Before humans began to catch white sharks, the white shark reproductive strategy was clearly adequate to maintain their populations. After all, it had served them well for millions of years. Because of their large size at birth, white sharks have few natural predators, even as juveniles. Consequently a low reproductive rate is all that is necessary to balance a probable low rate of natural mortality.

All fish species, including white sharks, have presumably evolved density-dependent mechanisms that compensate for natural fluctuations in abundance. Those mechanisms might include increased growth rate in response to reduced competition for food, reduced natural mortality rate, and increased reproductive output. For an apex predator with very low population density, it is difficult to imagine how reductions in population size could provide sufficient stimulus to initiate density-dependent changes in growth and mortality. Food supply is presumably not limiting for white sharks (except perhaps where humans have depleted marine mammal populations), and the probable low natural mortality rate appears to leave little room for downwards movement.

Fecundity could increase through earlier maturation, increased litter sizes or a shorter reproductive cycle. Earlier maturation would require faster growth rates, unless social cues, such as interaction rates with older animals, are important. There is probably little scope for increasing litter sizes unless length at birth declines correspondingly; the mother's body cavity can only hold so much embryonic biomass. A shorter reproductive cycle would require one or more of the following: faster embryonic growth; reduced length at birth; de-synchronisation of the reproductive cycle; removal or reduction of the resting period between pregnancies (if present).

We know virtually nothing about density-dependent responses to fishing pressure for any chondrichthyan, let alone white sharks. Nor do we have enough information with which to construct white shark demographic or age-structured population models. We therefore cannot predict whether the white shark's reproductive strategy is sufficient to maintain recruitment in the face of human exploitation. Intuitively, one would expect low fecundity and low natural mortality to result in low productivity and minimal capacity for density-dependent compensation. White shark populations are therefore likely to be vulnerable to recruitment overfishing.

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White shark protection agreed in South Australia

The South Australian government has approved the drafting of regulations to protect the great white shark, based on recommendations in a discussion paper issued in 1995. The proposed regulations will prohibit the deliberate capture, holding or killing of the species. It is expected that exemptions will be made for recreational fishers to catch, tag and release white sharks, subject to the approval of a code of conduct. Some researchers feel that tagging should be conducted by less stressful bait-luring rather than hook and line catching that may cause mortalities. The proposed regulations will also relate to hook sizes, burleying restrictions and management of some areas around conservation park waters where seal or sea lion colonies occur.

The species is already protected in New South Wales (since December 1996), Queensland and Tasmania. Victoria and Western Australia have yet to introduce specific white shark protection measures.

Tony Flaherty

NMFS takes aggressive stance to prevent continued overfishing

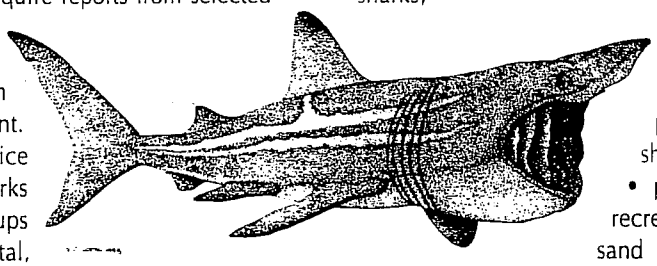
Michael Bailey, National Marine Fisheries Service, USA

In December's *Shark News*, Merry Camhi discussed US management of large coastal sharks. I would like to update her article and discuss the history and current state of US management of Atlantic sharks in general.

The idea began in 1989 when five fishery management councils asked the Secretary of Commerce to develop a Fishery Management Plan for Sharks of the Atlantic Ocean (FMP). FMP development proved to be a challenge and the final FMP was not implemented until April 1993. The objectives are to:

1) Prevent overfishing of shark resources;
2) Encourage management throughout their ranges;
3) Establish a shark resource data collection, research, and monitoring programme; and
4) Increase the benefits from shark resources to the US while reducing waste, consistent with the other objectives.

The most important accomplishments of the FMP were to establish commercial quotas and recreational bag limits, require permits and reports from all commercial interests, require reports from selected recreational tournaments, and expressly prohibit 'finning' of sharks. The FMP also established a Shark Operations Team to advise the agency on shark management.



The basking shark: protected from directed commercial fishing. ©1989 by Sid F. Cook. All rights reserved.

The National Marine Fisheries Service (NMFS) actively manages 39 species of sharks that are broken down into three major groups for management purposes: small coastal, large coastal and pelagic. More than 30 additional species are not in the management units but are included for data collection purposes. The large coastal group, comprising most commercially valuable species, is overfished. NMFS has taken an aggressive stance to prevent continued overfishing of large coastal sharks. Following implementation of the FMP a 'derby' fishery developed. NMFS responded by establishing a 4,000 lb trip limit and by implementing a control date of 22 February 1994 to discourage speculative entry into the fishery. NMFS has recently published a proposed rule that will, if implemented, significantly limit the number of participants in the fishery.

In March 1994, NMFS held a Shark Evaluation Workshop (SEW) to assess the state of the stocks. The SEW committee, comprising both NMFS and non-NMFS scientists, determined that stocks of large coastal sharks appeared to have been substantially depleted since the mid to late 1970s and that, at least in aggregate, large coastal sharks were well below the biomass associated with maximum sustainable yield (MSY). The committee felt that the projected quota increase for 1995 should be delayed indefinitely, and that the single most important supplementary measure that might be implemented would be a closure of nursery grounds to directed fishing during pupping season. NMFS indefinitely delayed projected quota increase.

Soon after the 1994 SEW Report was published, the SEW concerns over nursery grounds prompted the Highly Migratory Species Management Division of NMFS to establish the Integrated Shark Research and Management Program (ISHARK) to focus scattered agency resources on answering questions needed for successful management. NMFS scientists, along with scientists from industry, academia, and several marine laboratories, focused their efforts on locating and evaluating shark nurseries and pupping areas. As a result of the ISHARK programme's intensified efforts, NMFS has successfully located and evaluated numerous shark nursery and pupping areas and NMFS has generated two letters to state marine resource agencies' directors asking that they close their waters to fishing in critical nursery and pupping areas when juveniles and pregnant females are present.

The 1995 annual report, using updated data to the extent possible, again concluded that the projected quota increase should be delayed indefinitely. In May 1995, NMFS heeded the report's advice and capped the commercial quota for large coastal sharks at 2,570 metric tons dressed weight (mt dw) annually.

In June 1996, NMFS held a second SEW. The report concluded that additional reductions in fishing mortality would improve the probability of stock increases for large coastal sharks. The SEW Report also indicated that the greatest impediments to improving shark stock assessments continue to be the general lack of species-specific and size-specific catch and effort data, and fishery-independent measures of stock abundance and productivity.

The SEW report prompted NMFS to implement an even more aggressive management regime for Atlantic sharks. In April 1997, NMFS:

- reduced the commercial quota for large coastal sharks by 50%, down to 1,285 mt dw annually;
- established a commercial quota of 1,760 mt dw for small coastal sharks;
- reduced the recreational bag limit to two large coastal and/or pelagic sharks combined per vessel per trip plus two Atlantic sharpnose sharks per person per trip;
- prohibited directed commercial and recreational fishing for whale, basking, sand tiger, bigeye sand tiger and white sharks (but allowed recreational catch-and-release only fishing for white sharks);
- prohibited filleting of sharks at sea; and
- required species-specific identification of all sharks landed.

Multinational research and management efforts have been primary goals of NMFS since FMP implementation. The US and Canada have agreed to conduct joint research of shared stocks and continue to work together to devise bilateral management of those shared stocks. A joint US/Canadian age and growth study of porbeagle sharks, sponsored by ISHARK, is ongoing. The US and Mexico are planning to conduct a joint bioassessment research cruise this coming summer. A key goal of the cruise will be to identify and characterise shared stocks and to evaluate the extent to which these migratory shared stocks move between our respective countries.

The basic goal of fishery biology is to estimate the amount of fish that can be safely removed while keeping the fish population healthy. Management of the fishery is accomplished by considering these estimates, which may be modified by political, economic, and social considerations, thus management of any fishery is a complex endeavor. Since implementation of the FMP, NMFS has been very actively involved in managing sharks. Though there is much left to do, there has been progress toward curtailing the precipitous decline of shark stocks, and successfully managing the Atlantic shark resource. In addition, through its ISHARK program, NMFS has made significant contributions to the overall scientific research effort by channelling much needed financial support and scientific expertise to a wide variety of projects.

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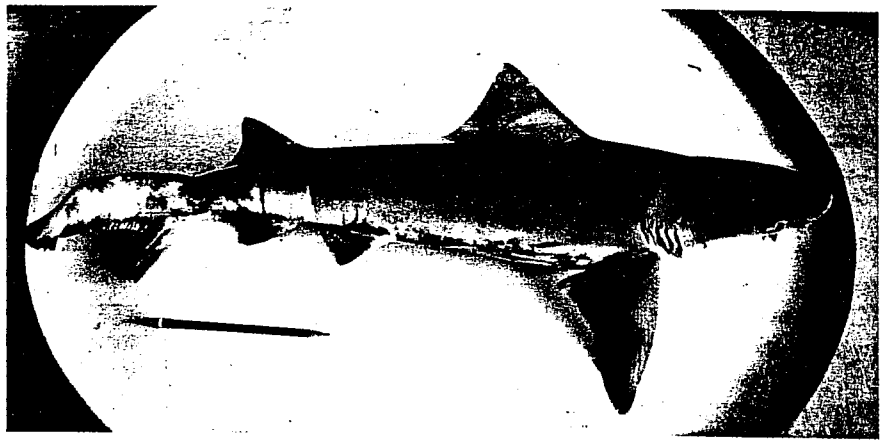
River shark discovered in Sabah

Sarah Fowler, Shark Specialist Group, UK



The first preserved specimen of river shark *Glyphis* sp. from the Kinabatangan River, kept by local fishermen for the Darwin project team in Sabah, Malaysia.

Specimens of one of the world's most elusive genera of sharks, the river sharks, *Glyphis*, have finally been obtained from Sabah's Kinabatangan River in Northern Borneo. They were discovered over a year after the start of the 18 month Shark Specialist Group's (SSG) Darwin project on Elasmobranch Biodiversity and Conservation in Sabah. This project, funded by the UK Darwin Initiative for the Survival of Species, is being undertaken in cooperation with the Sabah Department of Fisheries, and with help from WWF-Malaysia.

The river shark is the rarest of the very scarce freshwater species of sharks and rays for which the Shark Specialist Group survey team had been searching. The researchers were beginning to believe that the occasional reports of a freshwater shark whose description appeared to match that of the almost mythical Borneo river shark (see box) would never be substantiated. Heavy rainfall and continual river flooding had severely hampered fieldwork in 1996, preventing successful fishing for river sharks and rays. Only a single small specimen of the giant freshwater stingray (*Himantura chaophyra*) was obtained. But, as the river level eventually began to subside, the message came in from a small riverside kampong (village) on the Kinabatangan River that a shark had finally been caught.

It is extremely unlikely that the breakthrough could have been made without the invaluable help of local fishermen who offered their assistance. The villagers were provided with a tank of formalin and a single-use camera in case they caught any freshwater sharks or stingrays while carrying out their usual fishing operations. At last, some months ago, they found several juvenile River Sharks answering to the description of *Glyphis* in one of their nets and carefully preserved one for the researchers. Others were photographed before being discarded. Another four females, about 60 cm in total length (probably newborns) were taken at the end of May. This time all were kept.

The excitement of those who were shown the first shark had been intense. Darwin Project officer Mabel Manjaji and UK volunteers Rachel Cavanagh and Scott Mycock reported their delight over the find: "The family led us to the tank of formalin which they had been keeping locked up at the back of their stilt house, insisting that they had a shark for us in there. They looked on in bewilderment; we could barely contain ourselves – could it really be *Glyphis*? We all crowded round as the tank was opened, oblivious to the formalin fumes. There it was, black beady eyes, blunt snout, fins like we'd never seen before but just like those in the books – there was no doubt about it: this was *Glyphis*, at last!"

Shark Specialist Group expert, Dr Leonard Compagno (Curator of Fishes and Head of the Shark Research Center, South African Museum) has studied the few existing museum specimens of this group, most of which were collected in the 19th Century. He remarked: "We have very little idea of the geographic distribution of these sharks, much less their general biology. They show up like ghosts, few and far between, in a handful of scattered localities. Finding one is cause for celebration ... External differences between the known species are subtle, but body and fin shape shown in the photos suggest that the Kinabatangan shark may be closer to another undescribed species, *Glyphis* 'species A' from Queensland, Australia, than to the original Borneo river shark."

Fortunately the wet weather last year did not interrupt the remainder of the Darwin project's work programme. Regular visits to coastal fish markets have resulted in the collection and curation of a wide range of sharks and rays from the coastal waters of northern Borneo. Discoveries include some sharks which are completely new to science, as well as new species records for the region. This area has been confirmed as one of the international centres of shark and ray biodiversity.

The collection of sharks and rays made during the Darwin project will be retained in Sabah for future research. It represents a unique resource for biodiversity and taxonomic research in the region. Duplicate specimens will be housed in other international fish collections.

<u>Conservation footnote</u>: The River Sharks were caught as incidental catch in fishing operations targeted at other fish. They were found dead in the nets, not killed by the villagers to provide research specimens, and were not sold, but given to the project team. The Darwin project leaders are anxious that their research programme does not create an artificial market and fishery for these rare species, but educates the local fishermen about the rarity of their freshwater sharks and rays and encourages them to conserve these fish and their habitat.

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The genus *Glyphis*, river sharks

These are large sharks, probably reaching about 3 m in length, although most specimens known are juvenile or new-born (because of the difficulty of preserving large adults). The smallest from the Kinabatangan was just 60 cm long and had an open umbilical scar, indicating an age of only one or two months. River Sharks have characteristic small eyes and a relatively large second dorsal fin. Their small eyes and slender teeth suggest that they are primarily fish-eaters adapted to life in turbid river waters. Some may also enter seawater.

It is uncertain how many species of *Glyphis* exist, but there are at least four or five. The Ganges river shark *Glyphis gangeticus* is listed as Critically Endangered in the 1996 IUCN Red List of Threatened Species. It was known from only three museum specimens collected over 100 years ago, until a freshly caught adult female (280 cm long) and two fresh jaws were seen last year.

The speartooth shark *Glyphis glyphis* was originally known from eight specimens. One small stuffed fish is in a Berlin museum, two small preserved specimens have been destroyed by poor curation and the rest are dried jaws. Its original geographic origin is unknown.

There may be three undescribed species. The Bizant river shark, *Glyphis* species 'A', is known from two specimens, one lost, from Queensland, Australia. The Borneo river shark, *Glyphis* species 'B', is recognised from just one preserved specimen found in a museum in Vienna, taken from an unknown river in Borneo over 100 years ago. The New Guinea river shark, *Glyphis* species 'C', may possibly be identical to *Glyphis glyphis*. Of seven specimens collected, two whole young have been lost, and five are only represented by jaws.

Report reveals pressing international shark conservation needs

Sonja Fordham, Center for Marine Conservation, USA

Sharks around the world are falling prey to intense human predation and staggering unintentional catches, yet domestic management plans are rare and international shark management is non-existent. In order to address these issues, the Center for Marine Conservation (CMC) recently released a major study outlining a blueprint for action by international and national fisheries and wildlife authorities to promote conservation of sharks on a global scale. Entitled *Managing Shark Fisheries: Opportunities for International Conservation*, the report is a joint project of CMC and TRAFFIC International, the wildlife trade monitoring program of The World Conservation Union and the World Wide Fund for Nature, and serves as a companion volume to TRAFFIC's 1996 shark trade study.

The report, prepared by Michael Weber and Sonja Fordham, evaluates the potential to promote shark conservation under six existing international fisheries agreements and three wildlife conservation regimes against standards set forth by the recent United Nations agreement on highly migratory and straddling fish stocks. Incorporating the findings of the TRAFFIC Network's study of the world trade in shark products, CMC's analysis reveals glaring gaps in international management for shark and related species while highlighting opportunities for improvement.

The report concludes that several existing international fisheries management agreements can be applied to benefit sharks, but must be strengthened to reflect a precautionary approach and other principles of sound resource management. In addition, countries should seize opportunities to promote shark conservation through international wildlife treaties. Specifically, CMC recommends:

- Among the most immediate priorities is the initiation of programmes to collect, evaluate, and disseminate information on the direct and indirect catch of sharks, as well as basic life history characteristics;
- Countries should ratify and adhere to the UN Agreement on highly migratory and straddling fish stocks, and become active members of treaty organisations relevant to sharks;
- Existing regimes for the conservation of living marine resources should be strengthened to reflect the precautionary approach and other elements of sound fisheries management;
- Where treaty organisations have the authority to conserve other fish and marine resources, they should begin formulating management programs to address the incidental take and discard of sharks;
- For areas where there are gaps in coverage, new agreements to conserve sharks should be concluded;
- Parties to the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) should identify populations of sharks that would benefit from international agreements among range states, and convene negotiations to develop necessary agreements under the Convention;
- As Parties to the Convention on Biological Diversity draw up their national strategies, they should take the opportunity to develop better information and domestic management structures for sharks;
- Parties to the Convention on International Trade in Endangered Species (CITES) should carefully consider proposals to list species of sharks (and related species) that may qualify under CITES criteria.

The report contains profiles of ten diverse shark species important to fisheries and trade, several useful tables detailing shark fishing and trade information by country, and membership of international management regimes by countries landing sharks.

As this and many other reports have demonstrated, sharks (and their close relatives) are vulnerable to rapid, global changes in fishing pressure and increased demand for shark products. Effective international conservation will rely on elevating the research and management priority of sharks on a global scale. Countries around the world must recognise the vulnerability of sharks and manage their fisheries accordingly, using comprehensive, cooperative tools. A number of such tools already exist, such as the UN Fish Stocks Agreement. Others can be created, such as new shark conservation agreements under the Bonn Convention. Now it is a matter of using those tools to ensure a brighter future for shark populations worldwide. Copies of the report are available by contacting the author.

Sonja Fordham
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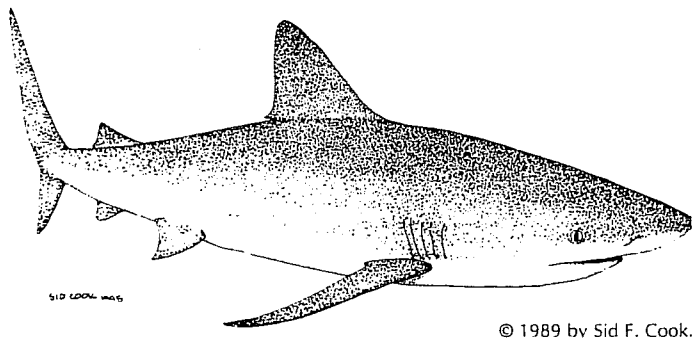
1725 DeSales St. N.W., Washington, D.C. 20036 USA.
Fax: + 1 202.872.0619. Email: <sonja@cenmarine.com>



Shark Specialist Group meetings

1 July 1997, during the AES Meeting, Seattle

The SSG will meet on Tuesday 1 July, from 8 to 11 am, during the 13th Americal Elasmobranch Society Annual Meeting (see p. 16). The meeting will be held in the Conference Room on the Lower Level of the Faculty Center. All SSG members are urged to attend this important meeting. We will focus on developing conservation action points for the Chondrichthyan Action Plan, but will also discuss species status accounts, CITES actions, revision of the IUCN Red List criteria, and the upcoming FAO 'expert consultation' on sharks. Non-SSG members are also invited to attend as observers. Other events taking place include symposia on Elasmobranch Endocrinology and Captive Elasmobranch Biology.

7–10 July 1997, Darwin Project workshop, Sabah

An International Seminar and Workshop on shark and ray biodiversity, conservation and management is being held near Kota Kinabalu, Sabah, Malaysia. It will disseminate the results of the Shark Specialist Group and Sabah Fisheries Department Darwin project to other Malaysia states and countries in the Region, raising awareness of the importance of considering aspects of elasmobranch biodiversity in the context of nature conservation, commercial fisheries management and for subsistence fishing communities. For more information, contact Sarah Fowler, *Shark News* Editor.

November 1997, 5th Indo-Pacific Fish Conference

A meeting of the Shark Specialist Group will be taking place during the Conference being held in Noumea (see p. 16). There will also be a Chondrichthyan Fishes symposium, chaired by Peter Last (email: peter.last@ml.csiro.au), and a workshop on "Elasmobranchs as Contemporary Biological Models", co-chaired by Ramon Munoz-Chapuli and William Hamlett. Abstract deadline is 15 August 1997.

British Columbian spiny dogfish stocks are doing fine

Ramon Bonfil, Fisheries Centre, University of British Columbia, Vancouver, BC, and Mark W. Saunders, Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, BC, Canada

Two recent notes in *Shark News* (issues No. 7, p. 13, and No. 8, p. 8) raised some concern over the status of the spiny dogfish fisheries in the Pacific Northwest, by highlighting a supposed crash in the landings of this species in British Columbia, Canada. According to the Canadian Department of Fisheries and Oceans, reported landings of *Squalus acanthias* in BC during 1994 totalled 1,739 t. Moreover, the total catch of spiny dogfish in BC, including additional catches by joint venture and other fisheries and the discards of trawl fisheries, amounted to a grand total of 4,416 t during 1994.

When discussing fisheries status, it is important not to confuse landing crashes with population crashes; equating both terms can be misleading. A population crash is a decrease in the size of a population relative to the historic or virgin population level. In some cases a decline in landings is associated with a decline in population size, but in others, including spiny dogfish in BC, a decline in landings can be driven by a host of market and management factors. In the spiny dogfish fishery of the Pacific Northwest, the dynamics of the fish landings are largely determined by market forces. The present spiny dogfish fishery of British Columbia is a marginal fishery that is primarily serving the US export market of dogfish meat to Europe, as there has been no substantial demand for dogfish in Canada for many decades. The majority of spiny dogfish caught in BC are processed by companies in the Puget Sound area of Washington in the USA and it is the dynamics of price and demand in Europe, together with the production costs and ex-vessel prices, that govern how much of BC's spiny dogfish is caught and landed in a given year. Furthermore, Puget Sound facilities processing some of this dogfish were limited in recent years due to a fire damage at a major processor (Thomson, in press). Thus, the ups and downs in spiny dogfish landings are currently not a function of stock size but rather determined by the whims of the market.

Finally, it should be noted that stocks of spiny dogfish in BC are currently at a very healthy level. Total abundance estimates for the different stocks of spiny dogfish in BC range between 210,000 and 260,000 t for 1995. While the total catch of 4,416 t in 1994 represented 87% of the 1979–1993 catch average, it did not come close to the recommended total allowable catch (TAC) for spiny dogfish in BC for that year, which was 3,000 t for the Straight of Georgia and 15,000 t offshore. Clearly, current levels of exploitation are much below any level that could raise conservation concerns and it is actually expected that the stocks of *S. acanthias* in this region continue to increase in size due to limited exploitation (Thomson, B.L. In press. Groundfish stock assessments for the west coast of Canada in 1995 and recommended yield options for 1996. *Can. Tech. Rep. Fish. Aquat. Sci.*).

ERRATA

The editor apologises on behalf of the author of the above-mentioned article in *Shark News* 7, p.13, based on inaccurate information provided to him in an early release of fisheries data. Additionally, a glitch removed the last section of boxed text on p. 8, *Shark News* 8. Referring to developing dogfish fisheries along the Washington, Oregon and California coast and the lack of for stock assessment data collection or fisheries management proposals in US waters (in contrast with the present situation in BC described above), this should have concluded: "A similar boom-and-bust pattern was seen in British Columbia during a fishery for vitamin-A rich dogfish livers that, six years after its 1943 peak, had reduced fishable biomass 75%."

Australian Shark Conservation Foundation established

The ASCF is a non-profit sponsorship organisation dedicated to the conservation of all Australian elasmobranch species and ecosystems. It was founded to inspire positive action and encourage member involvement and participation in shark conservation issues, and its primary objective is to increase awareness, understanding and protection of elasmobranch species and their environment.

Priorities are to address the poor image of sharks (hence the lack of enthusiasm for their conservation) and to highlight their importance as a critical element of the ocean's food chain, on which depends much of the health of the oceans. The Foundation will seek to become a 'reference point' for the media, particularly in the case of shark attacks when a rational side of the debate is needed to deliver facts, not fiction. Education of the public is of primary importance.

The ASCF is seeking supporters for the Foundation and its education and research programs. Standard Membership is $25 ($20 for students) a year. Members receive a quarterly newsletter, *The Fin Review*, and an official Supporter card. Sponsors are also needed for its active research programme, presently targeting grey nurse sharks in New South Wales and great white sharks in South Australia.

To join or to obtain more information, contact the ASCF at PO Box 72, FORESTVILLE, NSW 2087, Australia. Tel: (+61) (0)2 9975 1044.

Sharks in Patagonia

In coastal Patagonia, Argentina, an unknown number of species of sharks are caught in bottom trawl nets, and are discarded dead at sea. Seven species of sharks were caught in 264 of 454 trawls, made by Patagonian coastal fisheries (41° to 52° South) that we analysed between 1993 and 1996. We are interested to exchange information, experience and ideas on sharks and coastal fisheries. Please contact Guillermo Caille <diztw@ internet.siscotel.com>

This message appeared on the Academic Fish-Ecology forum <FISH-ECOLOGY@SEGATE.SUNET.SE>

1st AGM held of European Elasmobranch Association

The 1st Annual General Meeting of the European Elasmobranch Association was held in Amsterdam, The Netherlands, on 7 February 1997. There are presently five European member organisations: the Deutsche Elasmobranchier Gesellschaft (DEG) in Germany, the Gruppo Italiano Ricercatori Sugli Squali (GRIS) in Italy, the Associacao Portuguesa para o Estudo e Conservacao de Elasmobranqueos (APECE) in Portugal, the Netherlands Group of the EEA, and the Shark Trust (about to be set up in the United Kingdom), with a sixth in France to follow shortly. Representatives of all organisations attended, and an observer from Belgium. Dr Paddy Walker (NL) was appointed to Chair the Board of Directors, Dr Bernard Séret (Fr) to Chair the Scientific Advisory Committee, and Sarah Fowler (UK) as Executive Director.

The registered objectives of the EEA are: advancing the conservation of sharks, rays and chimaeras in European and international waters for the public benefit, through education, promoting and disseminating research, and seeking to achieve their sustainable management. It is a non-profit organisation.

Contact Paddy Walker (email: paddy@nioz.nl), or Sarah Fowler (email: sarahfowler@naturebureau.co.uk) or view the web site at http://alfa.ist.utl.pt/~apece/eea.htm for more information.

Mexico/Guatemala: a collaboration in shark fisheries

Fernando Márquez, National Fisheries Institute, Mexico

Professional advice and a training programme to monitor the shark fishery on Guatemala's Pacific coast was provided in November 1996 as part of the technical and scientific cooperation framework between Mexico and Guatemala. The project was developed by request of the Government of Guatemala through the Dirección General de Servicios Pecuarios (DIGESEPE) and Dirección Téchnica de Pesca (DITEPESCA), because of the growth of the shark fishery in this area of the Pacific.

Advisory services were provided by the Programma Tiburón (PT) at the Instituto Nacional de la Pesca (INP), Mexico. Mexico's main interest in participating in the programme arises from the fact that one of the most important ports landing shark catches on the Mexican Pacific coast is located in the state of Chiapas, and both countries are therefore exploiting the same population. Because of the experience gained at the PT in the evaluation of artisanal (low scale) fisheries, their future management could be well coordinated. Training programme activities included field sampling with emphasis on the identification of species, observations of reproductive organs, and recording maturity characteristics of specimens. For desk work, basic methodologies were recommended to process and analyse information. A database in the same format as that used by PT for artisanal fishery research was installed at DITEPESCA. Thus, these databases will be able to exchange compatible information.

Field sampling was carried out in San Jose, on the west coast of Guatemala. This has a small-scale shark fishery; small wooden boats and fibreglass 'pangas' with outboard motors. Bottom longlines are set daily. Incidental catches are sail fish *Istiophorus platypturus* and dolphin fish *Coryphaena hippurus*. Catches are made up of silky *Carcharhinus falciformis*, punta *Nasolamia velox*, thresher *Alopias vulpinus* and hammerhead sharks *Sphyrna lewini*. Shark by-products are fully utilised; oil in the national market, skin salted and exported to Guadalajara, Mexico, and the meat used for human consumption.

Most common problems

There is a lack of academic staff and of fishery officers studying shark biology and fishery behaviour. Resources to purchase hardware, software and field trips are scarce. Logistic support, including a transportation unit, was provided by Programma Regional de Apoyo al Desarrollo de la Pesca del Istmo Centramericano (PRADEPESCA), financed by the European Union.

Proposals

A second phase of coordination was suggested in order to follow up this first cooperation program, including data analysis. The Mexican government, through the Mexican embassy, was requested to establish guidelines to develop the second phase of the program. A joint collaboration agreement was reached to present the results of sampling the Guatemalan shark fishery at specialist international meetings.

This paper is intended to: 1) inform the scientific community focused on shark fishery research and related associations about this event, and 2) request your collaboration to send related literature to our colleagues in the Republic of Guatemala, who are enthusiastically initiating the long process of achieving the evaluation and management of the shark fishery in their country.

For further information please contact: Fernando Márquez, Programa Tiburón, Instituto Nacional de la Pesca, Pitágoras # C.P. 03310. Mexico, D.F. or Claudia Ruíz, Proyecto Tiburón, Depto. de Investiogación, DEGESEPE, DITEPESCA, Km. 22, Carret. al Pacífico, Rep. Guatemala, C.A.

Shark Specialist Group to have web homepage

A Shark Specialist Group homepage to be placed aboard the World Wide Web has recently been constructed by webpage editor George Burgess and his staff at the Florida Museum of Natural History and is now accessible through the Florida Museum's Ichthyology homepage: <http://www.flmnh.ufl.edu/natsci/ichthyology/ichthyology.htm>.

The page is intended to serve as the SSG's window to millions of viewers currently utilising the electronic information exchange network. The Florida Museum's Ichthyology homepage, where the SSG site resides, already draws more than a thousand viewers a day, ensuring that a large audience will seek access to the new site.

Initially, the site will provide breaking information about SSG activities, furnish a membership list, and will include electronic versions of the organisation's newsletter. When completed, the Action Plan will also be posted. Our intention is to use the site to present scientifically accurate, visually interesting copy to the non-scientifically trained sector as well as to fellow scientists.

The Web is a powerful medium that, if used in an enlightened manner, can help influence the mindset of thousands of viewers. We therefore seek the input of all SSG members in developing material for inclusion on the page. Burgess has penned a short review of shark conservation, the status of western North Atlantic shark populations, and regional fishery management which has appeared on that region's homepage (which will be incorporated into the larger site). It would be nice to receive similar reviews from our other regional groups for posting. News of upcoming international or regional meetings, breaking situations regarding immediate threats or regulatory hearings, newly appearing publications, announced SSG deadlines etc. are all appropriate additions to the site.

A home page is only useful if it is current and growing – we will need the cooperation of SSG members to really make it work. Electronic versions are the preferred means of submittal because they greatly reduce expenditures of time. These may be submitted by email to the webpage editor at <gburgess@flmnh.ufl.edu> or on disks by mail to the Florida Museum of Natural History, University of Florida, Museum Road, Gainesville, FL 32611, USA. Hard copies, if only available in this format, also may be submitted and will be scanned. Authors will be duly credited. Colour photographs, figures and other graphics are essential additions to any text submission, offering visual relief and drawing in viewers. These may be submitted electronically or as slides or prints.

We also independently solicit the submission of colour photographs/slides of any shark species, shark-related activity, shark researcher, etc. These will be digitised and archived, and the originals returned to the photographers. Any photograph used aboard the page will credit the photographer and note that the images are copyrighted. If we don't get enough good shark photos we will be forced to use Burgess' own photographs, which have never been compared favourably with those of leaders in the field.

Please help make the page a success by contributing to it.

Shark cartilage ineffective as cancer treatment

On 19 May 1997, results of a study presented at the annual meeting of the American Society of Clinical Oncology in Denver, CO, concluded that shark cartilage was inactive in patients with advanced stages of breast, colon, lung, and prostate cancer. [Midwestern Regional Medical Center press release.]

Obituary: Donald R. Nelson

Scientist, teacher, founder and recent past President of the American Elasmobranch Society

After a two-year battle with melanoma, Donald Richard Nelson, 59, passed away at home on the morning of 7 March 1997.

Don did his graduate work at the University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, and was a Professor in Animal Behavior at California State University, Long Beach, for 32 years. He was an early voice for changing the negative attitudes about sharks. His pioneering research was featured on television in the 1970s, long before the Discovery Channel was even a dream! Don's productive and well-funded research career was based on trying to understand the behaviour of sharks. Early on, he realised that telemetry would be the most reasonable way to make progress. He was also interested in shark senses, especially hearing. Possibly, his most important single finding was that sharks are naturally attracted by low frequency, pulsed sounds. The 1963 study was published in *Science*. Perhaps his most enduring finding and certainly one of his most interesting was the demonstration that provoking a gray reef shark will release an obvious agonistic display—a kind of fight or flight reaction. To physically survive the study, Don personally designed and constructed a research submersible he called the SOS (shark observation sub). Don delighted in showing the many places where gray reefs bit off parts of the sub. Today, the SOS, one of several vessels Don designed and built, is on permanent display in the Los Angeles County Museum's (NSF funded) travelling shark education show.

Don was teacher to hundreds of college students and mentor of many fine graduate students. Several have followed in Don's footsteps and are continuing his work as professional shark biologists. Will Rogers said "I never met a man I didn't like". I say "I never met a man (or woman) who didn't like Don!"

Samuel H. Gruber
Miami, Florida
10 April 1997

Obituary: Sidney F. Cook

Fisheries biologist, artist, poet, Senior Editor of *Chondros*, and Shark Specialist Group Northeast Pacific Regional Vice Chair

Our friend and colleague, Sid Cook, had been battling serious health problems with great courage for a long time. We knew he was very ill, but always thought he would win through because of his boundless optimism and active plans for the future. It was a great shock when he passed away in hospital in the morning of 2 May 1997.

As we go to print, I am unable to provide a biography for Sid. However, I do know that he was an exceptionally talented, generous and loyal friend and colleague who gave his help and knowledge unstintingly to those of us who struggled to achieve his understanding. Nothing was too much trouble; any request for advice would be answered immediately (and usually in staggeringly comprehensive detail). Sid used every method of communication available to him, and until very recently we could be sure of hearing regularly from him by email (usually several times a day), phone and fax, regardless of time zones and intervening continents or oceans. He seems such a close friend that I feel we used to meet and talk face to face every week, although we actually only met twice in person. On both occasions he demonstrated his talents as a speaker and advocate for sharks.

I, and his many other colleagues with whom I have spoken recently, have found that the sudden silence from Sid leaves a huge gap in our lives. We miss him greatly. *Sarah Fowler, UK*

Eulogy for Sid: A rare combination of compassion, generosity, brilliance, artistic skill, lateral thinking, rationality, sheer honesty, openness, courage, cheerfulness and conviction. A fighter who kept fighting and kept working against odds that few of us have had to face, for most of his life. An inspiration for all who worked with him, he was always open to discussion, to suggestion, and to reason. His ilk are few and far between, and his passing leaves a gap that will never be filled. In living and keeping his life alive within our minds, we celebrate his life and times and works. Goodbye and hello, Sid.

Leonard Compagno, South Africa

Subscribers to *Shark News*

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

We greatly welcome all personal contributions towards the cost of printing, mailing, and other Shark Group work, although we cannot presently afford to manage a formal subscription for the newsletter (this would probably cost more to administer than we will receive, particularly when handling foreign currency). Invoices for subscriptions (£5.00 per issue) can be sent to organisations or libraries unable to contribute without a formal request for payment.

Donations may be made as follows:

1. by cheque or Bankers Order in US$ to Sonja Fordham at the Center for Marine Conservation (marked payable to "CMC – Shark Specialist Group, account number #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).

I would like to continue to receive *Shark News*:

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

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

I enclose a donation for the Shark Specialist Group: .....
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Please check here if you would like to remain anonymous: .....

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

My number is .....

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

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

National Audubon Society's Living Oceans Program is pleased to sponsor the ninth 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 Status Report and Action Plan. As Deputy Chair 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 1994 CITES shark resolution and helped to draft and coordinate the reports submitted to the CITES Animals Committee in fulfillment of the resolution (see page 6).

For more information about our 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 gratefully acknowledges the sponsorship of the National Audubon Society's Living Oceans Program and donations towards the production of *Shark News* and its other work received from the following individuals and organisations: Columbus Zoo, Brian Bowen, Richard N Cinderey, Rod Collings, João Pedro S. Correia, Rachel Cunningham, Tony Flaherty, Suzanne Gendron, Jean-Pierre Herber, Harro Hieronimus, Brett Human, Thomas Lisney, Richard Lord, Kenneth J. Mackenzie, Todd Menzel, Alison Ross, Pamela Roth, Bernard Seret, Jeremy Stafford-Deitsch and Terry Walker.

Meetings

American Elasmobranch Society 13th Annual Meeting

Seattle Campus, University of Washington. 26 June–2 July 1997. For more information: web page at http://artedi.fish.washington.edu or contact Dr Sandford Moss, Department of Biology, University of Massacchusetts Dartmouth, 285 Old Westport Road, N. Dartmouth, MA 01747-2300, USA. Fax: (+1) 508 999 8196. Email: smoss@umassd.edu

1st Meeting of the Sociedade Brasileira para o Estudo de Easmobrânquios (SBEEL)

7th Congress Nordestino de Ecologia, Universidade Estadual de Santa Cruz, Ilheus (BA). 27 July–2 August 1997. Contact Organising Commission, Universidade Estadual de Santa Cruz, Departamento de Ciencias Biologicas, Rodovia Ilheus-Itabuna, CEP 45650-000, Brazil. Fax: (073)212-2195, email: conecol@jacaranda.uescba.com.br

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.

5th Indo-Pacific Fish Conference (and Shark Specialist Group meeting)

ORSTOM Centre and South Pacific Commission Headquarters, Noumea (New Caledonia). 3–8 November 1997. Contact the Conference Secretariat in Noumea by fax (687) 26 43 26 or email: ipfc5@noumea.orstom.nc; view web page at http://www.mnhn.fr/sfi/Congres/IPFC5.html; or contact Bernard 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. *(See p. 12 for more information)*

Editorial details

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

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

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

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

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

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

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