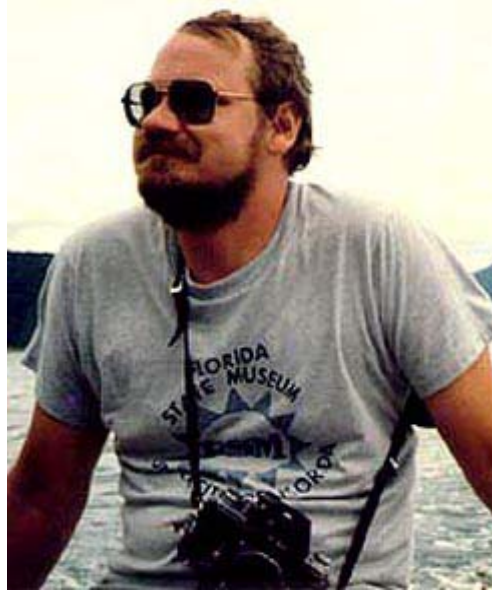


Sharks In Perspective: From Fear to Fascination

George Burgess, Coordinator of Museum Operations
Director, Florida Program for Shark Research and International Shark Attack File
Florida Museum of Natural History, University of Florida*



George H. Burgess
gburgess@flmnh.ufl.edu

* George H. Burgess is the Coordinator of Museum Operations at the Florida Museum of Natural History, University of Florida in Gainesville, FL. He received his undergraduate education at the University of Rhode Island and did graduate work at the University of North Carolina and the University of Florida. George has studied fishes throughout the southeastern United States, Gulf of Mexico, and Caribbean region. He serves as Director of the International Shark Attack File and is Editor of the Museum's Ichthyology web site. Although his photos have appeared in many books and magazines, his photographs are taken primarily for scientific purposes utilizing fishes posed to reveal their anatomical characters

George is a founding member and a past president of the American Elasmobranch Society (AES). AES is the professional scientific society of international researchers studying sharks, skates, rays, chimaeras and their near-relatives. AES publishes the American Elasmobranch Society Quarterly Newsletter and actively promotes the conservation and enlightened fishery management of elasmobranchs. He is a longstanding member of AES's Conservation Committee, chairs the Shark Attack Committee, and serves on the Board of Governors. He also serves as Vice Chair of the IUCN/SSC Shark Specialist Group (SSG) and has memberships on the Gulf of Mexico Fishery Management Council's Special Shark Scientific and Statistical Committee and NMFS's Sawfish Status Review Team. He is actively involved in the management of U.S. East Coast shark fisheries as leader of the CSFOP and as an invited participant in NMFS's shark stock assessment workshops.

Perspectives on Sharks

People both fear and are fascinated with sharks. More than 375 described species of sharks inhabit the world's oceans, however new species are being described all the time. They come in all sizes and shapes – from the huge [whale shark](#) (*Rhincodon typus*) that grows up to 40 feet long to the deepwater dogfish shark (*Etmopterus perryi*) that reaches only 7.9 inches. The fastest shark is the [shortfin mako](#) (*Isurus oxyrinchus*). It has been recorded to reach swimming speeds of up to 20 mph (32 km/h). It can chase down some of the fastest fishes such as tuna and swordfish.

In the Atlantic and Gulf regions, more than 40 species of sharks live in the temperate waters, as well as the colder seas. Many shark species use the coastal bays and estuaries as pupping and nursery groups. Much still remains unknown about the shark's migration patterns. These may be short or long, depending on food availability, environmental conditions, and reproductive rates.

Sharks play an important role in the ocean and are among the “top predators” of the marine food web. Sharks are considered apex predators because they prey on many species lower on the food chain, have few natural predators themselves, and are less abundant than their prey. Sharks have adaptations allowing them to be apex predators. These adaptations include teeth that are replaced throughout their life; sensitive smell receptors; eyes that adapt quickly to low light levels; lateral line receptors that sense movement in the water; and electroreceptors that detect electrical fields due to the presence of prey. Sharks primarily eat fishes. Some sharks also eat crabs and other invertebrates and other dead animals.

A number of sharks are also commercially important as seafood for consumers. Most recently, commercial fishing and its regulations have sparked fierce debate. Today, sharks and their relatives, the skates and rays, are in serious worldwide decline as a result of overfishing and habitat destruction, with some species even facing endangered or threatened species status. Sharks are vulnerable to fishing pressure because they grow slowly, take many years to mature (12 to 18 years in some species), often reproduce only every other year, have few young per brood (only 2 pups in some species), have specific requirements for nursery areas (bays and estuaries), and are caught in many types of fishing gear (hook and line, gillnet, trawl).

Exploitation of shark resources in the United States has greatly increased over the past twenty-five years, mirroring international trends. Recent National Marine Fisheries Service (NMFS) assessments of Atlantic stocks have concluded that shark mortality from a combination of fishing efforts has exceeded the reproductive capacity of certain species to the detriment of overall stock sizes. These conclusions were corroborated by substantial declines in shark abundance, as measured by catch-per-unit-effort over time, in fishery-dependent and fishery-independent longline efforts, and recreational tournament data.

Given the biological constraints of the resource to support viable large-scale sustainable fisheries, coupled to recent intensified fishing efforts and concurrent increased mortality, the NMFS examined strategies for the continued, but measured, utilization of the resource. A federal shark fishery management plan was implemented in May 1993 for the U.S. Atlantic and Gulf of Mexico waters. Implementation of this plan, in development for nearly a decade, was hampered by a lack of adequate data that could withstand the rigors of a detailed stock assessment. Management of elasmobranch resources is a complex task that requires species-specific biological and fishery information. Management measures, including subsequent adjustments to yearly landing quotas, have proven contentious, resulting in litigation initiated by several interest groups.

During the same time period, human population growth and a concurrent rise in aquatic recreational activity have resulted in an increase in the number of shark attacks. Shark attacks are an international phenomenon, but the United States leads the world in the number of attacks. Public and media interest in the phenomenon has risen as well, with media coverage of attacks higher in the United States than in most countries.

The level of media and public interest in sharks reached an all-time high in 2001. Termed the “Summer of the Shark” by one national magazine, shark attacks were intensely covered by the press until September 11. The prevailing perception was that 2001 was a banner year for shark attacks. By contrast, International Shark Attack (ISAF) data indicates that the attack numbers in the U.S. and Florida were almost identical to those of the previous year (which did not draw particularly high media attention) and the international total was 11% lower than that of 2000. More importantly, the number of serious attacks, as measured by fatality rate, was less than half that over the last decade.

Nevertheless, shark attacks increasingly have been inter-linked with fishery management and conservation initiatives by some members of the media and

interest groups. For example, one recently circulated notion suggests that U.S. East Coast fishery regulations enacted in 1993 have resulted in the blossoming of shark populations, leading to more attacks. The ISAF notes that the number of shark attacks has been rising throughout the past century, mirroring the rapidly growing human population and increased interest in aquatic recreation, and that recent rises in attacks additionally reflected greater efficiency in ISAF recording. Although East Coast shark populations probably are in the early stages of recovery as a result of federal and state management measures, it is biologically impossible for these populations to have returned to their pre-fishing levels of the early 1980's after only eight years of management.

Such misunderstanding of the basic biological attributes and scope of fishery management of sharks strongly indicates a need for the development and distribution of better science-based educational materials to inform the public about the realities of sharks. It is clear that shark management and conservation issues, reported shark attacks, and the public's knowledge and perceptions about these matters are interrelated in complex ways.

There is an increasing need for scientifically accurate information addressing shark biology, fisheries, attacks, and other interactions with humans. This need spans all age and socioeconomic groups, from elementary students first learning about sharks to representatives of the print and electronic media who so heavily influence public opinion on sharks. The effective dissemination of interpretive scientific information is especially important in highly charged matters involving shark attacks, shark fishery regulations, and conservation of diminishing stocks of these highly migratory species.

In 2002, the Florida Museum of Natural History's Florida Program for Shark Research (FPSR) and Florida Sea Grant held a national conference aimed at placing shark attack, management and conservation in perspective. (For speaker

abstracts and other information on the conference please see

<http://www.flmnh.ufl.edu/fish/Sharks/sharkperspective/sharkperspective.htm>)

The conference followed a NOAA/Sea Grant sponsored briefing to National Media at the National Press Club in Washington, D.C. (For information and video of briefing, see http://www.seagrantnews.org/news/020520_sharks/index.html)

Information on sharks and shark attacks are posted on the Florida Museum of Natural History's highly utilized shark web site. The shark section <http://www.flmnh.ufl.edu/fish/Sharks/sharks.htm> of the Florida Museum of Natural History's Ichthyology web site is a rich source of information on sharks and their kin. It is the largest and most frequently accessed elasmobranch site aboard the World Wide Web.

There are a number of excellent reference webpages on this site. It also provides links to a number of organization that focus on sharks. These include the **International Shark Attack File** which is a compilation of all known shark attacks that is administered by the American Elasmobranch Society and the Florida Museum of Natural History. More than 3,200 individual investigations are currently housed in the File, covering the period from the mid-1500's to present.

The **American Elasmobranch Society** is a professional scientific society of international researchers studying sharks, skates, rays, chimaeras and their near-relatives. AES publishes the American Elasmobranch Society Quarterly Newsletter and actively promotes the conservation and enlightened fishery management of elasmobranchs.

The IUCN **Shark Specialist Group** (IUCN/SSG) is composed of biologists and conservation experts which promote action to arrest the loss of the world's biological diversity and to restore threatened species to safe and productive

population levels. If you're interested in sharks, the Shark News newsletters are must sees for many expert articles on sharks and shark conservation.

The **National Shark Research Consortium** (NSRC) is a cooperative initiative involving four leading shark research organizations, the Florida Museum of Natural History, Moss Landing Marine Laboratories, Mote Marine Laboratory, and Virginia Institute of Marine Science. Ongoing independent and cooperative research projects gather data on the biology, ecology, and behavior of elasmobranchs needed for enlightened fishery management.

The **Commercial Shark Fishery Observer Program** (CSFOP) places fishery observers on cooperating commercial shark fishing vessels to observe the composition and disposition of the catch. Two members of the FLMNH Ichthyology Dept. tell what it's like to live on a commercial fishing vessel for three months.

In the **Image Gallery** you'll find a wide variety of shark species photographed by world renowned underwater photographers. The Gallery also contains the work of several skilled scientific illustrators.

The **biological profile section** of our page contains species profiles on fishes in our image gallery. New species are being added continually. The **education section** is geared toward middle school ages and up. There is something here for everyone from the novice to the advanced. **In the news** is an archive of fish stories that made the news. Many of the news articles deal with conservation, management, and environmental issues.

The National Oceanic and Atmospheric Administration (NOAA) also has some excellent resources on sharks. Information can be found at the **NOAA Fisheries Shark Web Site**. NOAA is currently conducting research, implementing restrictions and working with fisherman domestically, and pursuing international

conservation for many shark species. These steps have been undertaken to ensure that those shark populations that are healthy remain so and those shark populations that are overfished recover. For more information on NOAA's shark research and management efforts, see

<http://www.nmfs.noaa.gov/sharks/index.htm>

The Truth about Shark Attacks

Say the word "shark" and the first image most people conjure up is a Jaws-inspired white shark devouring unsuspecting bathers while well-meaning authorities and scientists helplessly stand by. Shark attack is probably the most feared natural danger to man, surpassing even hurricanes, tornadoes and earthquakes in the minds of most beach users and sailors. Among the earth's large animals implicated in the attack and consumption of humans, only sharks have not been "controlled" by man.

Even the fiercest of terrestrial predators, the large cats and bears, are extremely susceptible to a rifle and "problem" animals simply have been eliminated, leaving many of these species endangered. Some crocodilians, especially the Nile and saltwater crocodiles, are certainly as dangerous as sharks, but these reptiles have never captured as much "press" in part because their populations are largely limited to Third World countries and they, too, are vulnerable to human hunting pressure.

The sea's only other creatures with the capability of consuming a human, killer and sperm whales, are not normally considered threats to man. Sharks, on the other hand, have been documented attackers (and sometime consumers) of humans around the world throughout recorded history and have remained relatively immune from human intervention.



Photo: © George Burgess



Photo: © Steve W. Ross

Shark attack did not become a subject of particular public interest until the twentieth century. Several factors have contributed to the upswing in public awareness of shark attack during the last sixty years.

First and foremost has been the evolution of the press from a parochial to a cosmopolitan news-gathering system that covers a larger portion of the world in a more rapid and comprehensive manner. Increased competition and a shift of journalistic values in certain quarters additionally has contributed to more active searches for "shock" stories, i.e. those that titillate the public and promote sales. Needless to say, an examination of current weekly tabloids confirms that "shark eats man" is a best-selling story line.

World War II, with a plethora of air and sea disasters never before encountered during previous confrontations or in peacetime, regrettably spawned large numbers of shark attacks and spurred research to find an effective shark repellent. The general worldwide trend towards more intense utilization of marine waters for recreational activities during this time period has also increased the chances of shark-human interactions with a resulting increase in the total number of attacks. Add in fictionalized shark accounts in the popular press and movies and it's easy to see why shark attack is a hot topic.

Shark attack is a potential danger that must be acknowledged by anyone that frequents marine waters, but it should be kept in perspective. Bees, wasps and snakes are responsible for far more fatalities each year. In the United States the annual risk of death from lightning is 30 times greater than that from shark attack.

For most people, any shark-human interaction is likely to occur while swimming or surfing in nearshore waters. From a statistical standpoint the chances of dying in this area are markedly higher from many other causes (such as drowning and cardiac arrest) than from shark attack. Many more people are injured and killed on land while driving to and from the beach than by sharks in the water. Shark attack trauma is also less common than such beach-related injuries as spinal damage, dehydration, jellyfish and stingray stings and sunburn. Indeed, many more sutures are expended on sea shell lacerations of the feet than on shark bites!



Photo: © David B. Snyder

Nevertheless, shark attack is a hazard that must be considered by anyone entering the marine domain. As in any recreational activity, a participant must acknowledge that certain risks are part of the sport: jogging offers shin splints, camping brings ticks and mosquitoes, tennis may result in sprained ankles, and so on. Beach recreation has its inherent risks as well, and shark attack is simply one of many that must be considered before entering the water. Most people agree, however, that the extremely slim chance of even encountering a shark - much less being bitten - does not weigh heavy in their decision-making. *[Reprinted, with emendations, from: Burgess, G.H. 1991. Shark attack and the International Shark Attack File, pp. 101-105. In: Gruber, S.H. (ed.). 1990. Discovering Sharks, American Littoral Society, Highlands, New Jersey]*

Shark Basics

How many species of sharks are there?

- Currently there are approximately 375 described species of sharks, however new species are being described all the time. In addition, there are around 400 species of rays, a close relative of sharks. For detailed information on individual species, check out our [bioprofiles!](#)



Shark diversity!

©Photographers at FLMNH

How long have sharks existed?

- Fossil records indicate that ancestors of modern sharks swam the seas over 400 million years ago, making them older than dinosaurs! They are considered to be the first vertebrate with a complete jaw. Throughout time sharks have changed very little.



Do sharks have bones?

- No, sharks and all other fishes belonging to the class Chondrichthyes lack true bone, but rather have cartilaginous skeletons.



How long do sharks live?

- While longevity data are not available for many sharks, maximum ages do vary by species. Some sharks like the smooth dogfish (*Mustelus canis*) may only live 16 years, while others such as the porbeagle shark, (*Lamna nasus*) may live as long as 46 years. Whale sharks (*Rhincodon typus*) the largest fish in the world may live over 100 years.



What does a shark's skin feel like?

- Shark skin feels exactly like sandpaper because it is made up of tiny teeth-like structures called placoid scales, also known as dermal denticles. These scales point towards the tail and helps to reduce friction from surrounding water when the shark swims. Because of this, if someone rubbed the skin from the head towards the tail, it would feel very smooth. In the opposite direction it feels very rough like sandpaper. As the shark grows, the placoid scales do not increase in size, but rather the shark grows more scales. The silky shark (*Carcharhinus falciformis*) has small scales giving it a "silky" feel to the touch.

Do sharks sleep?

- It was once believed that all sharks had to swim constantly in order to breathe and could not sleep for more than a few minutes at a time. Oxygen-rich water flows through the gills during movement allowing the shark to breathe. While some species of sharks do need to swim constantly, this is not true for all sharks.



Some sharks such as the nurse shark have spiracles that force water across their gills allowing for stationary rest. Sharks do not sleep like humans do, but instead have active and restful periods.

Can sharks hear?

- Sharks have an excellent sense of hearing with ears located inside their heads on both sides rather than external ears like humans. Sharks can hear best at frequencies below 1,000 Hertz which is the range of most natural aquatic sounds. This sense of hearing helps shark locate potential prey swimming and splashing in the water. Sharks also use their lateral line system to pick up vibrations and sounds.

Why do sharks have so many teeth?



Finetooth shark

© George Burgess

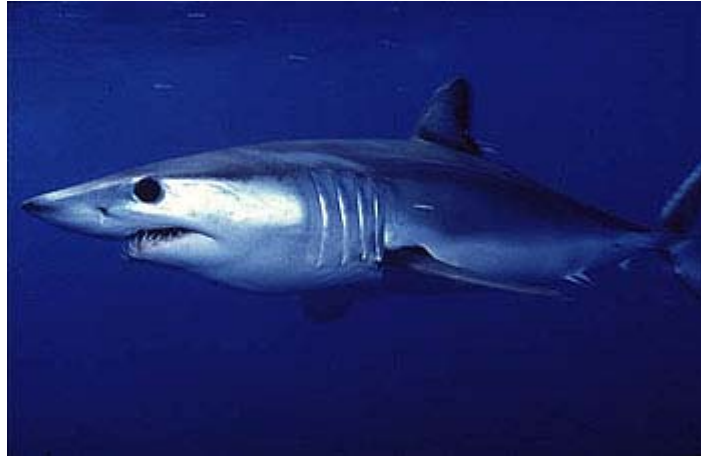
- Sharks have lots of teeth arranged in layers so if any break off, new sharp teeth can immediately take their place. Sharks can shed thousands of teeth during their life, this is why sharks teeth can be found washed onto beaches. Shark teeth also fossilize easily while the rest of the shark decomposes.

Is shark meat found in supermarkets safe for human consumption?

- Although shark flesh contains high levels of urea and methylamine, any residual toxins that are not washed away when the carcass is cleaned will quickly dissipate when cooked. However, sharks may contain high concentrations of heavy metals, primarily in larger, older individuals. Shark meat is low fat and provides a good source of protein for people living in many parts of the world.



What is the fastest shark?



The shortfin mako is the fastest shark

©Jeremy Stafford-Deitsch

- The fastest shark is the **shortfin mako** (*Isurus oxyrinchus*). It has been recorded to reach swimming speeds of up to 20 mph (32 km/h). It can chase down some of the fastest fishes such as tuna and swordfish.

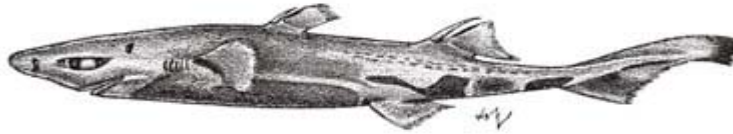
What is the largest shark? What is the smallest shark?



Whale shark: largest fish in the ocean

©Jeremy Stafford-Deitsch

- The largest shark, and also the largest fish in the ocean is the [whale shark](#) (*Rhincodon typus*). This massive plankton-feeder reaches lengths of over 20m (60 feet).



Etmopterus perryi

©Wendy Zomlefer

- The smallest shark is a deepwater dogfish shark known as *Etmopterus perryi*. This species which is found in the Caribbean Sea is mature at under 20cm (~8 inches).

The Florida Program for Shark Research

The **Florida Program for Shark Research (FPSR)** at the **Florida Museum of Natural History, University of Florida** is widely recognized as a leader in the fields of international elasmobranch conservation, shark fishery management, life histories studies of coastal elasmobranchs, research on the systematics and evolutionary relationships of deepwater sharks, shark attack studies, and web-based education. The Commercial Shark Fishery Observer Program (CSFOP), in its ninth year, monitors the U.S. East Coast commercial longline fishery, providing needed fishery and life history data for resource managers, especially those involved in the developing NMFS shark fishery management initiatives.



The International Shark Attack File (ISAF), a compendium of scientific investigations of all known shark attacks on humans, is maintained at the FLMNH and is operated in cooperation with the American Elasmobranch Society (AES), the international scientific organization of researchers studying sharks and their kin. The ISAF serves as a primary source of scientifically accurate information to the non-scientific public and media. The lines of distinction between this endeavor and conservation/fishery management educational initiatives often are blurred. For example, in the July to September 2001 period ISAF Director Burgess answered more than 900 media queries concerning shark attack, fishery management, and conservation, with multiple subjects almost always being addressed in single interviews or conversations. In addition, each year the ISAF staff answers hundreds of emails and letters from secondary school and university students seeking information and/or data for class projects.

The shark section <http://www.flmnh.ufl.edu/fish/Sharks/sharks.htm> of the Florida Museum of Natural History's Ichthyology web site is a rich source of information on sharks and their kin. It is the largest and most frequently accessed elasmobranch site aboard the World Wide Web. In addition to providing information on the Museum's own programs (CSFOP and ISAF) and sharks in general, the site hosts the web pages of the American Elasmobranch Society and the IUCN/SSC Shark Specialist Group, the world's foremost scientific society and conservation group, respectively, dedicated to elasmobranchs.

The ISAF pages are the site's most highly utilized pages owing to the public and media's almost insatiable interest in shark attack. Viewers drawn to the site by fascination with shark attacks find complementary explanatory material dealing with shark biology and ecology, conservation, and fishery management. In addition, the site also includes informational pages focusing on great white and megamouth sharks, current shark news items, educational programs, reference lists, announcements for meetings and conferences on sharks, and links to other shark-related sites. We have found that providing a combination of web-based

educational materials plus direct interplay with the media results in a very positive approach to educating the public about elasmobranch issues.

General Shark References

Allen, Thomas. 1999. *The Shark Almanac*. Lyons & Burford Publishers, New York, 274 p. [A popular account of sharks].

Allen, Thomas. 1996. *Shadows in the Sea*. Lyons & Burford Publishers, New York, 354 p. [Update of McCormick et al (1963)].

Baldrige, H.D. 1974. *Shark Attack*. Berkley Publishing Corp., New York, N.Y., 263 p. [The best popular account of shark attack].

Bannister, K. 1989. *The Book of the Shark*. The Apple Press, London, 128 p. [A well-written look at shark biology and ecology].

Budker, P. 1971. *The Life of Sharks*. Columbia University Press, New York, 222 p. [A somewhat dated overview of shark biology and ecology].

Castro, J.I. 1983. *The Sharks of North American Waters*. Texas A&M University Press, College Station, 180 p. [A good identification guide to sharks].

Compagno, L.J.V. 1984. *Sharks of the World. An Annotated and Illustrated Catalogue of Shark Species Known to Date. Part 1 - Hexanchiformes to Lamniformes*. FAO Fisheries Synopsis 125, Vol. 4, Pt. 1. pp. 1-249. [THE definitive source for information on species and distributions of sharks].

Compagno, L.J.V. 1984. *Sharks of the World. An Annotated and Illustrated Catalogue of Shark Species Known to Date. Part 2 - Carcharhiniformes*. FAO Fisheries Synopsis 125, Vol. 4, Pt. 2. pp. 251-655. [THE definitive source for information on species and distributions of sharks].

Cousteau, Jacques-Yves and Philippe Cousteau. 1970. *The Shark: Splendid Savage of the Sea*. Doubleday & Company, Inc., New York, 277 p. [Popular account of sharks with dated misconceptions].

Ellis, R. 1976. *The Book of Sharks*. New York; Grosset & Dunlap, 256 p. [Great illustrations].

- Gilbert, P.W. (ed.).** 1963. *Sharks and Survival*. D.C. Heath and Company, Boston, 578 p. [Technical articles on sharks].
- Gilbert, P.W., R.F. Mathewson, and D.P. Rall (eds.).** 1967. *Sharks, Skates, and Rays*. Johns Hopkins Press, Baltimore, 624 p. [Technical articles on sharks and their kin].
- Gruber, S.H. (ed.).** 1991. *Discovering Sharks*. American Littoral Society, Highlands, New Jersey, 122 p. [Twenty review chapters on shark biology and conservation].
- Hodgson, E.S., and R.F. Mathewson (eds.).** 1978. *Sensory Biology of Sharks, Skates, and Rays*. Office of Naval Research Dept. of the Navy, Arlington, Virginia, 666 p. [Technical articles on shark sensory biology].
- Last, P.R. and J.D. Stevens.** 1994. *Sharks and Rays of Australia*. CSIRO Australia; East Melbourne, Australia, 513 p. + 84 pl. [The finest regional treatment of sharks available].
- Lineaweaver, T.H. and R.H. Backus.** 1984. *The Natural History of Sharks*. Nick Lyons Books, New York, 256 p. [A good popular review of sharks].
- MacLeish, W.H. (ed.).** 1981. *Sharks*. *Oceanus* 24 (4): 1-79. [Eleven good review articles on aspects of shark biology and behavior].
- McCormick, H.W., T. Allen, and W.E. Young.** 1963. *Shadows in the Sea*. Weathervane Books, New York, 415 p. [A popular account of sharks].
- Server, L.** 1989. *Sharks*. Crescent Books, New York, 128 p. [Good photographs of sharks].
- Springer, V.G., and J.P. Gold.** 1989. *Sharks in Question*. Smithsonian Institution Press, Washington, D.C., 187 p. [The best source for answers to most shark-related questions].
- Stafford-Deitsch, J.** 1988. *Shark, A Photographer's Story*. Sierra Club Books, San Francisco, 200 p. [Fantastic photographs of sharks].
- Steel, R.** 1985. *Sharks of the World*. Blandford Press Ltd, New York, 192 p. [Decent overview of shark biology and ecology].
- Stevens, J.D. (ed.).** 1987. *Sharks. Facts on File Publications*. New York, 240 p. [A very good review of shark biology and ecology, plus lots of great photos].
- Stevens, J.D. (ed.).** 1999. *Sharks 2nd edition..* Check Mark Books, New York,

240 p. [A very good review of shark biology and ecology, plus lots of great photos].

Young, W.E. and H.S. Mazet. 1933. *Shark! Shark!* Gotham House, New York, 287 p. [A fisherman's perspective on sharks and shark fishing].

Zahuranec, B.J. 1983. *Shark Repellents From The Sea - New Perspectives.* American Association for the Advancement of Science, Washington, DC, AAAS Selected Symposium 83, 210 p. [Ten technical papers on shark repellents].

Conservation-Oriented References on Sharks

Applegate, S.P., Soltelo-Macias, F. and Espinosa-Arrubarrena, L. 1993. An overview of Mexican s for shark conservation in Mexico. U.S. Natl. Mar. Fish. Serv. NOAA Tech. Rep. NMFS 115, 31-37.

Barnett, R. 1996. Shark Fisheries and Trade in East and Southern Africa, pp. 329-339. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Barnett, R. 1996. The Shark Trade in Mainland Tanzania and Zanzibar, pp. 375-411. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Bentley, N. 1996. Australia Overview, pp. 661-749. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Bonfil, R. 1998. Elasmobranch bycatch monitoring, pp. 85-87. In: Gribble, N.A., McPherson, G. and Lane, B., eds. *Shark Management and Conservation.* Brisbane, Australia: Queensland Dept. of Primary Industries, pp.85-87.

Bonfil, R. 1998. Pattern and trends in world shark fisheries, pp. 2-4. In: Gribble, N.A., McPherson, G. and Lane, B., (eds). *Shark Management and Conservation.* Brisbane, Australia: Queensland Dept. of Primary Industries.

Boyd, E. 1997? Putting the bite on shark fishing. *Rodale's SCUBA Diving*, Aug.9.

Branstetter, S. 1991. Shark early life history - one reason sharks are vulnerable to overfishing, pp. 29-34. In: Gruber, S.H., (ed). *Discovering Sharks.* Amer. Littoral Soc.

Branstetter, S. (ed.). 1993. *Conservation Biology of Elasmobranchs.* U.S. National Marine Fisheries Service, NOAA Technical Report NMFS 115, 99 p. [A compendium of nine technical articles].

Broan, W.J. 1997. Shark is efficient, but picky eater. *New York Times*, July, 15 C1-C2.

Camhi, M., Fowler, S., Musick, J., Bräutigam, A. and Fordham, S. 1998. Sharks and their relatives Ecology and conservation. Occasional paper of the IUCN Species Survival Commission. Cambridge: IUCN No. 20, 39

Carrier, J.C. and Pratt, H.L. 1998. Habitat management and closure of a nurse shark breeding and nursery ground. *Fish. Res.* 39(2): 209-213.

Casey, J.M. 1997. Potential extinction of a large, widely ranging marine fish: the barndoor skate (*Raja laevis*). Masters thesis, 11 p.

Chen, G.C.T., Liu, K.-M., Joung, S.-J., and Phipps, M.J. 1996. *Shark Fisheries and Trade in Taiwan*. Taipei, Taiwan: TRAFFIC East Asia-Taipei, Project Report, 48 p.

Chen, G.C.T., Liu, K.-M., Joung, S.-J., and Phipps, M.J. 1996. TRAFFIC Report on Shark Fisheries and Trade in Taiwan, pp. 269-322. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Chivers, C.J. 1999. Stop the butchery: Sharks suffer from poor casting, human predators. *USA Today* March 19.

Church, V. 1992. Danger: No sharks! *Newsweek*, Dec 14: 64-65.

Compagno, L. 1998. Red List species assessments, pp. 72-73. In: Gribble, N.A., McPherson, G. and Lane, B., (eds). *Shark Management and Conservation*. Brisbane, Australia: Queensland Dept. of Primary Industries, pp.72-73.

Compagno, L. 1998. Status of freshwater elasmobranchs, pp. 76-77. In: Gribble, N.A., McPherson, G. and Lane, B., (eds). *Shark Management and Conservation*. Brisbane, Australia: Queensland Dept. of Primary Industries.

Compagno, L.J.V. 1990. Shark exploitation and conservation. U.S. Natl. Mar. Fish. Serv. NOAA Tech Rep. NMFS 90, 391-414.

Compagno, L.J.V. and Cook, S.F. 1995. Status of the giant freshwater stingray (whipray) *Himantura chaophraya* (Monkolprasit and Roberts 1990). *Shark News* 5: 5.

Daves, N.K. and Nammack, M.F. 1998. U.S. and international mechanisms for protecting and managing shark resources. *Fish. Res.* 39(2): 223-228.

Dayton, L. 1991. Save the sharks. *New Scientist*, June 15, 34-38.

Dorfman, A. 1991. Are sharks becoming extinct? *Time*, March 4: 67.

- Fleming, E.H. and Papageorgiou, P.A.** 1996. Shark Fisheries and Trade in Europe, pp. 457-604. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.
- Fordham, S.V.** 1996. New England groundfish: from glory to grief, a portrait of America's most devastated fishery. Washington, DC: Center for Marine Conservation, 169 p.
- Fowler, S.** 1996. Elasmobranch biodiversity and conservation in Sabah. *Shark News* 7, 12-13.
- Fowler, S. and Camhi, M.** 1998. Shark Specialist Group update - Action plan and report to CITES, pp. 58-60. In: Gribble, N.A., McPherson, G. and Lane, B., (eds.). *Shark Management and Conservation*. Brisbane, Australia: Queensland Dept. of Primary Industries;
- Fussman, C.** 1991. *Hunting the Hunter*. *Time Magazine* 14 (10): 22-28, 30.
- Gribble, N.A., McPherson, G. and Lane, B., (eds.)** 1998. *Shark Management and Conservation*. Brisbane, Australia: Queensland Dept. of Primary Industries, 143 p.
- Gruber, S.H. and Manire, C.A.** 1989. Challenge of the chondrichthyans. *Chondros* 1(1): 1,3.
- Gruber, S.H. (ed.)**. 1991. *Discovering Sharks*. American Littoral Society, Highlands, New Jersey, 122 p. [Twenty review chapters on shark biology and conservation].
- Gruber, S.H. and Manire, C.A.** 1991. The only good shark is a dead shark?, pp. 115-121. In: Gruber, S.H., (ed.). *Discovering Sharks: Amer. Littoral Soc.*
- Hanfee, F.** 1996. The Trade in Sharks and Shark Products in India, pp. 605-637. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.
- Hayes, E.** 1996. New Zealand Overview, pp. 751-790. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.
- Hayes, E.** 1996. Oceania Overview, pp. 643-659. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.
- Heneman, B. and Glazer, M.** 1996. More rare than dangerous: a case study of white shark conservation in California, pp. 481-491. In: Klimley, A.P. and Ainley, D.G., (eds.). *Great White Sharks: The Biology of Carcharodon carcharias*. San Diego: Academic Press.
- Hinman, K.** 1997. Sharks: More protection needed. *Salt Water Sportsman*. Sept. 3, 42-43.
- Hoff, T.B.** 1990. Conservation and management of the western north Atlantic shark resource based on the life history strategy limitations of sandbar sharks [Ph.D. Dissertation]: University of Delaware, 282

Hoff, T.B. and Castro, J.I. 1991. U.S. shark fishery management for the Atlantic Ocean, pp. 112-114. In: Gruber, S.H., (ed.). *Discovering Sharks: Amer. Littoral Soc.*

Hudson, E. 1998. Assessing threats to marine fishes using the IUCN Red List Categories and Criteria pp. 63-70. In: Gribble, N.A., McPherson, G. and Lane, B. (eds.). *Shark Management and Conservation*. Brisbane, Australia: Queensland Dept. of Primary Industries.

Hudson, E. and Mace, G. (eds.). 1996. *Marine Fish and the IUCN Red List of Threatened Animals*. Report of the workshop held in collaboration with WWF and IUCN at the Zoological Society of London from April 29th-May 1st, Gland, Switzerland: International Union for the Conservation of Nature (IUCN) 199626 p.

Hueter, R.E. 1996. Catch/tag-and-release: the conservation option for recreational shark fishermen. *Shark News*, 77.

Ishihara, H. and Homma, K. 1995. Shark conservation up to date and in future. Rep. Japan. Soc. Elasmobranch Stud. 32 ed., Japanese Soc. for Elasmobranch Studies, 41 pp.

Kelso, B.J. 1998. North American countries still lack effective protection for sharks. *Species*, 14-15.

Keong, C.H., (ed.). 1996. Shark Fisheries and Trade in Sharks and Shark Products in Southeast Asia pp. 807-945. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Kiyono, H. 1996. TRAFFIC Report on Shark Fisheries and Trade in Japan, pp. 145-197. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Marshall, N.T. 1996. The Seychelles Shark Fishery, pp. 341-348. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Marshall, N.T. 1996. The Somali Shark Fishery in the Gulf of Aden and the Western Indian Ocean, pp. 355-363. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Marshall, N.T. 1996. Trade in Sharks and Shark Products in Eritrea, pp. 349-354. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Marshall, N.T. 1996. Trade in Sharks and Shark Products in Kenyan Waters, pp. 365-374. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I*. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Matthew, P. 1996. Solomon Islands, Western Province Overview, pp. 791-805. In: *The World Trade in*

Sharks: A Compendium of TRAFFIC's Regional Studies, Volume II. TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Oliver, A. 1996. *Draft Discussion Paper Pursuant to CITIS Resolution Conf. 9.17: An Overview of the Biological Status of Shark Species.* 15 July 1996. National Marine Fisheries Service, Silver Spring, Maryland. 53 p. plus appendices.

Parry-Jones, R. 1996. TRAFFIC Report on Shark Fisheries and Trade in Hong Kong, pp. 83-143. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Parry-Jones, R. 1996. TRAFFIC Report on Shark Fisheries and Trade in the People's Republic of China, pp. 19-81. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Parry-Jones, R. 1996. TRAFFIC Report on Shark Fisheries and Trade in the Republic of Korea, pp. 199-268. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Pepperell, J.G. (ed). 1992. *Sharks: Biology and Fisheries.* CSIRO, Australia, 349 p. (Also issued as: Australian Journal of Marine and Freshwater Research 43(1):1-343.) [Proceedings of an international conference on shark biology and conservation held at the Taronga Zoo in Sydney, Australia].

Phipps, M.J. 1996. TRAFFIC Report on Shark Fisheries and Trade in the East Asian region, pp. 7-17. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Pratt, H.L., Gruber, S.H., and Taniuchi, T. 1990. *Elasmobranchs as Living Resources: Advances in the Biology, Ecology, Systematics and the Status of the Fisheries.* U.S. National Marine Fisheries Service, NOAA Technical Report NMFS 90, 518 p. [A compendium of thirty-nine technical articles].

Rose, D.A. 1996. *An Overview of World Trade in Sharks and Other Cartilaginous Fishes.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom, 106 p.

Smale, M.J. 1996. Trade in Sharks and Shark Products in South Africa, pp. 431-455. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Sousa, M.I., Marshall, N.T. and Smale, M.J. 1996. The Shark Trade in Mozambique, pp. 413-429. In: *The World Trade in Sharks: A Compendium of TRAFFIC's Regional Studies, Volume I.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom.

Various Authors. 1977. *Sharks.* Oceans. 10 (6): 8-47.

Weber, M.L. and Fordham, S.V. 1997. *Managing Shark Fisheries: Opportunities for International Conservation.* TRAFFIC International, Species in Danger Series, Cambridge, United Kingdom, 61 p.

Youth, H.M. 1992. *Shark-Eating Man*. *World Watch* 5 (2): 7-9.