2007 Shark Finning Report to Congress

Pursuant to the

Shark Finning Prohibition Act of 2000

(Public Law 106-557)

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

Prepared by the
National Marine Fisheries Service

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Abbreviations and Acronyms

ABC	Allowable Biological Catch
ADF&G	Alaska Department of Fish and Game
AKFSC	Alaska Fisheries Science Center
APEC	Asia Pacific Economic Cooperation Forum
BSAI	Bering Sea/Aleutian Islands
C	carbon
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCMs	Commission Members, Cooperating non-Members, and participating Territories of the Western Central Pacific Fisheries Commission
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COASTSPAN	Cooperative Atlantic States Shark Pupping and Nursery
COFI	Food and Agriculture Organization of the United Nations Committee on Fisheries
CPUE	catch per unit effort
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FFWC	Florida Fish and Wildlife Commission
FMP	fishery management plan
FR	Federal Register
GCEL	General Counsel for Enforcement and Litigation
GOA	Gulf of Alaska
GULFSPAN	Gulf of Mexico States Shark Pupping and Nursery
HMS	highly migratory species
Hg	methyl mercury
IATTC	Inter-American Tropical Tunas Commission
ICES	International Council for the Exploration of the Sea
ICCAT	International Commission for the Conservation of Atlantic Tunas
IPOA	International Plan of Action
ISC	North Pacific Interim Scientific Committee for Tuna and Tuna-like Species
IUCN	International Union for Conservation of Nature and Natural Resources

IUU ....Illegal, Unreported and Unregulated
kg...kilogram
LCS ....large coastal sharks
LDWF ....Louisiana Department of Wildlife and Fisheries
MAFMC..Mid-Atlantic Fishery Management Council
MHI..Main Hawaiian Islands
mt ....metric tons
N...nitrogen
n..sample size
NEFSC ....Northeast Fisheries Science Center
NEFMC...New England Fishery Management Council
NMFS..National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Administration
NAFO..Northwest Atlantic Fisheries Organization
NOVA ....Notice of Violation and Assessment
NPFMC ....North Pacific Fishery Management Council
NRIFSF ....National Research Institute for Far Seas Fisheries
NWFSC...Northwest Fishery Science Center
NWHI..Northwestern Hawaiian Islands
OFL ....overfishing levels
OLE...Office of Law Enforcement
OTC...oxytetracyline
PIFSC..Pacific Island Fishery Science Center
PSAT...pop-up satellite archival tags
PFMC..Pacific Fishery Management Council
ppm ....parts per million
SAFE...Stock Assessment and Fishery Evaluation
sd...standard deviation
SCRS...Standing Committee on Research and Statistics
SCS ....small coastal sharks
SEDAR ....Southeast Data, Assessment, and Review
SEFSC...Southeast Fisheries Science Center
SPTT ....South Pacific Tuna Treaty
SSL..sound scattering layer
STAR ....Stock Assessment and Review
SWFSC ....Southwest Fisheries Science Center
SWRO ....Southwest Regional Office
TAC...Total Allowable Catch
UNGA ....United Nations General Assembly
USVI ....United States Virgin Islands
VMS..Vessel Monitoring System

WCPFC ....Western and Central Pacific Fisheries Commission
WPacFin..Western Pacific Fishery Information Network
WPFMC ....Western Pacific Fishery Management Council
WSSD ....World Summit on Sustainable Development

Executive Summary

Because of their biological and ecological characteristics, sharks present an array of issues and challenges for fisheries management and conservation. Many shark species are characterized by relatively late maturity, slow growth, and low reproductive rates, which can make them particularly vulnerable to overexploitation. Concern has grown over the past decade about the status of shark stocks and the sustainability of their exploitation in world fisheries, as demand for some shark species and shark products (i.e., fins) has increased.

Shark finning is the practice of taking a shark, removing a fin or fins (whether or not including the tail) of a shark, and returning the remainder of the shark to the sea. The Shark Finning Prohibition Act of 2000 prohibited the practice of shark finning for any person under U.S. jurisdiction. The Act requires the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) to promulgate regulations to implement the prohibitions of the Act, initiate discussion with other nations to develop international agreements on shark finning and data collection, and establish research programs. This report describes NMFS' efforts to carry out the Shark Finning Prohibition Act.

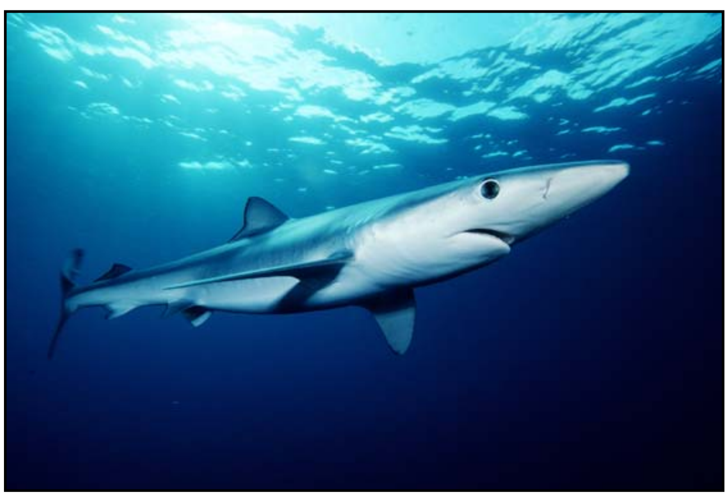
The Magnuson-Stevens Fishery Conservation and Management Act (MSA) forms the basis for fisheries management in federal waters, and requires NMFS and the eight regional fishery management councils to take specified actions. In the U.S. Atlantic Ocean, sharks and other highly migratory species are managed directly by NMFS. In the U.S. Pacific Ocean, three regional fishery management councils—Pacific, North Pacific, and Western Pacific—are responsible for developing fishery management plans. Sharks in the federal waters are currently managed under eight different fishery management plans. Additional information on shark management in the United States can be found on pages 7 to 23 of this report.

The Department of Commerce and the Department of State have been active in promoting development of international agreements consistent with the Shark Finning Prohibition Act. In 2006, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) adopted a conservation measure prohibiting directed fishing on shark species in the Convention Area, other than for scientific research purposes. The Commission agreed that the prohibition shall apply until such time as the CCAMLR Scientific Committee has investigated and reported on the potential impacts of this fishing activity and the Commission has agreed on the basis of advice from the Scientific Committee that such fishing may occur in the Convention Area. It also agreed that any bycatch of shark, especially juveniles and gravid females, taken accidentally in other fisheries, shall, as far as possible, be released alive.

Also in 2006, the Western and Central Pacific Fisheries Commission (WCPFC), adopted a resolution calling on Commission Members, Cooperating non-Members, and participating Territories (CCMs) to implement the Food and Agriculture Organization's (FAO) International Plan of Action (IPOA) for the Conservation and Management of Sharks. CCMs are to advise the WCPFC annually on their implementation of the IPOA for Sharks, including, as appropriate, results of their assessment of the need for a National Plan of Action and/or the status of their National Plans of Action for the Conservation and Management of Sharks. Each CCM must include key shark species, to be identified by the Scientific Committee, in their annual reporting to the WCPFC of annual catches, and catch and fishing effort statistics by gear type, including available historical data, in accordance with the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific and agreed reporting procedures. The resolution also calls on CCMs to take measures necessary to require that their fishers fully utilize any retained catches of sharks. Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing or transshipment. CCMs must require their vessels to have on board fins that total no more than 5 percent of the weight of sharks onboard, up to the first point of landing. Further information on international efforts to advance the goals of the shark finning prohibition can be found on pages 35 to 41 of this report.

Numerous research studies undertaken by NMFS Science Centers have produced much valuable information on shark status, mobility, migration, habitat, ecology, and age and growth characteristics—all of which will be incorporated into effective shark fishery management decisions. A detailed description of NMFS' research efforts regarding sharks can be found on pages 42 to 69 of this report.

Overall, compared with the years before enactment of the Shark Finning Prohibition Act, great strides continue to be made in shark conservation, data gathering, management, research, and education on a national and global scale that will contribute to sustainable management of sharks.



Blue shark swimming off southern California.
Source: Mark Conlin/NMFS Photo

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1. Introduction

Sharks, skates, and rays are within the class Chondrichthyes—the cartilaginous fishes—and the subclass Elasmobranchii. Sharks are an ancient and diverse group of fishes presenting an array of issues and challenges for fisheries management and conservation due to their biological and ecological characteristics. Most sharks are predators at the top of the food chain, and many shark species are characterized by relatively late maturity, slow growth, and low reproductive rates. Abundance of these top predators is often low compared to organisms at lower trophic levels. The combination of these characteristics makes sharks particularly vulnerable to overexploitation.

Concern has grown over the past few decades about the status of shark stocks and the sustainability of their exploitation in world fisheries, as demand for some shark species and shark products has increased and international fishing effort directed at sharks and evidence of overfishing have increased. This situation has resulted in several international initiatives to promote greater understanding of sharks in the ecosystem and in greater efforts to conserve the many shark species in world fisheries.

In U.S. fisheries in 2006, three out of 12 shark stocks or stock complexes with a known overfishing[1] status are listed as subject to overfishing (Table 1). Three out of ten shark stocks or stock complexes with a known overfished[2] status are listed as overfished (Table 1). Twenty two and 24 shark stocks or stock complexes have an unknown or undefined status in terms of their overfishing and overfished status, respectively (Table 1).

Shark finning is the practice of taking a shark, removing a fin or fins (whether or not including the tail) of a shark, and returning the remainder of the shark to the sea.[3] Because the meat of the shark is usually of low value, the finless sharks are thrown back into the sea and subsequently die. Shark fins are very valuable and are among the most expensive fish products in the world (FOA 2006). Shark fins are considered a delicacy in East Asia and are used to make shark fin soup. The growth in demand for some shark products, such as fins, continues to drive increased exploitation of sharks (Bonfil 1994, Rose 1996, Walker 1998).

On December 21, 2000, President Clinton signed into law the Shark Finning Prohibition Act of 2000 out of concern for the status of shark populations and the effects of fishing mortality associated with finning on shark populations. Section 3 of this Act amended the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to prohibit any person under U.S. jurisdiction from: (i) engaging in the finning of sharks; (ii) possessing shark fins aboard a fishing vessel without the corresponding carcass; and (iii) landing shark fins without the corresponding

[1] Overfishing means the harvest rate is above a prescribed fishing mortality threshold.
[2] Overfished means the stock size is below a prescribed biomass threshold.
[3] As defined in Section 9 of the Shark Finning Prohibition Act.

carcass. Section 3 of the Shark Finning Prohibition Act contains a rebuttable presumption that any shark fins landed from a fishing vessel or found on board a fishing vessel were taken, held, or landed in violation of the Act if the total weight of shark fins landed or found on board exceeds 5 percent of the total weight of shark carcasses landed or found on board. This is commonly referred to as the "5 percent rule."

The Shark Finning Prohibition Act requires NOAA's NMFS to promulgate regulations to implement its prohibitions (Section 4), initiate discussion with other nations to develop international agreements on shark finning and data collection (Section 5), provide Congress with annual reports describing efforts to carry out the Shark Finning Prohibition Act (Section 6), and establish research programs (Sections 7 and 8). Section 9 of the Act defines shark finning.

Consistent with Section 4 of the Act, NMFS published a proposed rule (66 FR 34401; June 28, 2001) and final rule (67 FR 6194; February 11, 2002) to implement the provisions of the Shark Finning Prohibition Act. The final rule prohibits: 1) any person from engaging in shark finning aboard a U.S. fishing vessel; 2) any person from possessing shark fins on board a U.S. fishing vessel without the corresponding shark carcasses; 3) any person from landing from a U.S. fishing vessel shark fins without the corresponding carcasses; 4) any person on a foreign fishing vessel from engaging in shark finning in the U.S. EEZ, from landing shark fins without the corresponding carcass into a U.S. port, and from transshipping shark fins in the U.S. EEZ; and 5) the sale or purchase of shark fins taken in violation of the above prohibitions. In addition, all shark fins and carcasses are required to be landed and weighed at the same time, once a landing of shark fins and/or shark carcasses has begun.

Section 6 of the Shark Finning Prohibition Act requires that the Secretary of Commerce, in consultation with the Secretary of State, to provide Congress with annual reports describing efforts to carry out the Act. The Act specifically states that the report:

(1) includes a list that identifies nations whose vessels conduct shark-finning and details the extent of the international trade in shark fins, including estimates of value and information on harvesting of shark fins, and landings or transshipment of shark fins through foreign ports;
(2) describes the efforts taken to carry out this Act, and evaluates the progress of those efforts;
(3) sets forth a plan of action to adopt international measures for the conservation of sharks; and
(4) includes recommendations for measures to ensure that United States actions are consistent with national, international, and regional obligations relating to shark populations, including those listed under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

These four topics are described in this *Report to Congress*. Regarding item one above, no reliable information exists to determine those nations whose vessels conduct shark finning. However, information on the international trade of shark fins is available from the Food and Agriculture Organization (FAO) of the United Nations and information on U.S. import and export of shark fins is available from the U.S. Census Bureau. This information can be found on pages 25 to 34 of this report. However, it is important to note that due to the complexity of the shark fin trade, fins are not necessarily produced in the same country as those from which they are exported.

Consistent with item two above, this *Report to Congress* summarizes all of the recent management (p. 7 to 20), enforcement (p. 21-23), international efforts (p. 35-41), and research activities (p. 42-69) related to sharks that are in support of the Shark Finning Prohibition Act. This report, prepared in consultation with the Department of State, also provides an update to last year's report, and includes complete information for 2006 activities.

Regarding item three above, the United States participated in the development of and endorsed the FAO's International Plan of Action (IPOA) for the Conservation and Management of Sharks. Consistent with the IPOA. The U.S. developed a National Plan of Action (NPOA) for the Conservation and Management of Sharks in February 2001. In addition to meeting the statutory requirement of the Shark Finning Prohibition Act, the annual *Report to Congress* serves as a periodic updating of information called for in the IPOA and NPOA.

Regarding item four above, NMFS does not have specific recommendations for shark conservation and management at this time. Consistent with the provisions of Section 5 of the Shark Finning Prohibition Act, the Department of Commerce and the Department of State have been active in promoting development of international agreements consistent with the Act. Recommendations are brought forward through bilateral, multilateral, and regional efforts. As agreements are developed, the U.S. implements those agreements and reports on them in the annual *Report to Congress*. Information on recent international efforts, including CITES, can be found on pages 35 to 41of this report.

Continuing efforts are being made nationally and internationally to increase data collection on shark stock assessments, develop gear modifications and capture/release techniques to minimize lethal shark bycatch, and increase our knowledge of shark ecology. These efforts should lead to improved shark management and are supported through agreements with international fishery management organizations including: Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), Western and Central Pacific Fisheries Commission (WCPFC), Northwest Atlantic Fisheries Organization (NAFO), International Commission for the Conservation of Atlantic Tuna (ICCAT), United Nations General Assembly (UNGA), CITES, FAO and FAO's Committee on Fisheries (COFI).

Table 1 Status of shark stocks and stock complexes in U.S. fisheries in 2006.
Source: NMFS 2007

Status of shark stocks and stock complexes in U.S. fisheries in 2006			
FMP & Jurisdiction	Stock or Stock Complex	Overfishing?	Overfished?
Spiny Dogfish FMP — NEFMC & MAFMC	Spiny dogfish	No	Undefined[1]
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Sandbar shark[2]	Yes	Yes
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Gulf of Mexico blacktip shark[3]	No	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Atlantic blacktip shark[3]	Unknown	Unknown
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Large coastal shark complex[4]	Unknown[5]	Unknown[5]
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Finetooth shark[6]	Yes	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Atlantic sharpnose shark[6]	No	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Blacknose shark[6]	No	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Bonnethead shark[6]	No	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Small coastal shark complex[7]	No	No
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Shortfin mako shark[8]	Unknown	Unknown
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Porbeagle shark[8]	No	Yes
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Blue shark[8]	Unknown	Unknown
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Dusky shark[9]	Yes	Yes
Consolidated Atlantic Highly Migratory Species FMP — NMFS Highly Migratory Species Division	Pelagic shark complex[10]	Unknown	Unknown
Pacific Coast Groundfish FMP — PFMC	Leopard shark	Unknown	Unknown
Pacific Coast Groundfish FMP — PFMC	Soupfin shark	Unknown	Unknown
Pacific Coast Groundfish FMP — PFMC	Spiny dogfish	Unknown	Unknown
West Coast Highly Migratory Species FMP & Pelagic Fisheries of the Western Pacific Region FMP — PFMC & WPFMC	Common thresher – North Pacific	Unknown	Unknown
West Coast Highly Migratory Species FMP & Pelagic Fisheries of the Western Pacific Region FMP — PFMC & WPFMC	Shortfin make shark – North Pacific	Unknown	Unknown
West Coast Highly Migratory Species FMP & Pelagic Fisheries of the Western Pacific Region FMP — PFMC & WPFMC	Blue shark – North Pacific	No	No
West Coast Highly Migratory Species FMP & Pelagic Fisheries of the Western Pacific Region FMP — PFMC & WPFMC	Bigeye thresher shark – North Pacific	Unknown	Unknown
West Coast Highly Migratory Species FMP & Pelagic Fisheries of the Western Pacific Region FMP — PFMC & WPFMC	Pelagic thresher shark – North Pacific	Unknown	Unknown

Pelagic Fisheries of the Western Pacific Region FMP — WPFMC	Longfin mako shark – North Pacific	Unknown	Unknown
	Oceanic white tip shark – Tropical Pacific	Unknown	Unknown
	Silky shark – Tropical Pacific	Unknown	Unknown
	Salmon shark – North Pacific	Unknown	Unknown
Coral Reef Ecosystems of the Western Pacific Region — WPFMC	Coral Reef Ecosystem Multi-Species Complex – Hawaiian Archipelago[11]	Unknown	Unknown
	Coral Reef Ecosystem Multi-Species Complex – American Samoa[11]	Unknown	Unknown
	Coral Reef Ecosystem Multi-Species Complex – Northern Mariana Islands[11]	Unknown	Unknown
	Coral Reef Ecosystem Multi-Species Complex – Guam[11]	Unknown	Unknown
	Coral Reef Ecosystem Multi-Species Complex – Pacific remote island areas[11]	Unknown	Unknown
Gulf of Alaska Groundfish FMP — NPFMC	Other species complex[12]	Undefined	Undefined
Bering Sea/Aleutian Island Groundfish FMP — NPFMC	Other species complex[13]	No	Undefined
Totals:		3 "yes" 9 "no" 21 unknown 1 undefined	3 "yes" 7 "no" 21 unknown 3 undefined

Notes about Table 1:

[1] There is currently no definition contained in the spiny dogfish FMP to make a determination of overfished because there is no approved miminum biomass level; however, based on current

NMFS recommended biomass threshold, the biomass estimates indicate the stock is not overfished.

[2] This stock is part of the Large Coastal Shark Complex, but is assessed separately.

[3] This stock is part of the Large Coastal Shark Complex, but is assessed separately. Blacktip shark was previously listed as a single stock, but is now assessed as two separate Atlantic and Gulf of Mexico stocks.

[4] In addition to Sandbar Shark, Gulf of Mexico Blacktip Shark, and Atlantic Blacktip Shark, the Large Coastal Shark Complex also consists of additional stocks including Spinner Shark, Silky Shark, Bull Shark, Tiger Shark, Lemon Shark, Nurse Shark, Scalloped Hammerhead Shark, Great Hammerhead Shark, and Smooth Hammerhead Shark. In addition, several LCS species cannot be retained in commercial or recreational fisheries, including Bignose Shark, Galapagos Shark, Night Shark, Caribbean Reef Shark, Narrowtooth Shark, Sand Tiger Shark, Bigeye Sand Tiger Shark, Whale Shark, Basking Shark, and White Shark.

[5] The latest stock assessment concluded that the status of the LCS complex was unknown. The current assessment indicates that the peer reviewers of 2006 Large Coastal Shark Assessment felt it was unclear what exactly the results of the assessment represented, making it impossible to support the use of the results for management of the complex. The previous stock assessment concluded that the stock was subject to overfishing and overfished.

[6] This stock is part of the Small Coastal Shark Complex, but is assessed separately.

[7] In addition to Finetooth Shark, Atlantic Sharpnose Shark, Blacknose Shark, and Bonnethead Shark, the Small Coastal Shark Complex also consists of: Atlantic Angel Shark, Caribbean Sharpnose Shark, and Smalltail Shark; these three species cannot be retained in recreational or commercial fisheries.

[8] This stock is part of the Pelagic Shark Complex, but is assessed separately.

[9] Dusky sharks are a prohibited species and are assessed separately.

[10] In addition to Shortfin Mako Shark, Blue Shark, and Porbeagle Shark, the Pelagic Shark Complex also consists of Oceanic Whitetip Shark and Thresher Shark. This complex also consists of stocks that cannot be retained in recreational or commercial fisheries, which include Bigeye Thresher Shark, Bigeye Sixgill Sharks, Longfin Mako Shark, Sevengill Shark, and Sixgill Shark.

[11] This complex contains up to 146 "currently harvested coral reef taxa" [five of which are sharks (Grey Reef Shark, Silvertip Shark, Galapagos Shark, Blacktip Reef Shark, and Whitetip Reef Shark)] and innumerable "potentially harvested coral reef taxa."

[12] The Other Species Complex consists of Pacific Sleeper Shark, Salmon Shark, Spiny Dogfish and numerous octopi, squid, and sculpins.

[13] The Other Species Complex consists of Pacific Sleeper Shark, Salmon Shark, Spiny Dogfish and numerous skates, octopi, and sculpins.

Sandbar Shark (*Carcharhinus plumbeus*)
Source: NMFS Northeast Fisheries Science Center

2. Management and Enforcement

2.1 Management Authority in the United States

Previous reports to Congress discussed the MSA and other legal authorities for management entities governing U.S. fisheries in which sharks are directed catch, incidental catch, or bycatch. The MSA forms the basis for fisheries management in federal waters, and requires NMFS and the eight regional fishery management councils to take specified actions. State agencies and interstate fishery management commissions are bound by state regulations and, in the Atlantic region, by the Atlantic Coast Fisheries Cooperative Management Act.

2.2 Current Management Authority in the Atlantic Ocean

Development of fishery management plans (FMPs) is the responsibility of one or more of the eight regional fishery management councils, except for Atlantic highly migratory species (HMS), which include tunas, swordfish, billfish, and sharks. Since 1990, shark fishery management in federal waters of the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea (excluding dogfishes, skates, and rays) has been the responsibility of the Secretary of Commerce, delegated to NMFS.

In 1993, NMFS implemented the FMP for Sharks of the Atlantic Ocean. Under the FMP, three management units were established for shark species: large coastal sharks (LCS), small coastal sharks (SCS), and pelagic sharks (Table 2.2.1). NMFS identified LCS as overfished, and therefore, among other things, implemented commercial quotas for LCS and established recreational harvest limits for all sharks. At that time, NMFS also banned finning of all sharks in the Atlantic Ocean.

In April 1999, NMFS published the FMP for Atlantic Tunas, Swordfish, and Sharks, which included numerous measures to rebuild or prevent overfishing of Atlantic sharks in commercial and recreational fisheries. The 1999 FMP replaced the 1993 FMP, and addressed numerous shark management measures, including: reducing commercial LCS and SCS quotas; establishing a commercial quota for blue sharks and a species-specific quota for porbeagle sharks; expanding the list of prohibited shark species; implementing a limited access permitting system in commercial fisheries; and establishing season-specific over- and underharvest adjustment procedures.

On December 24, 2003, the final rule implementing Amendment 1 to the FMP for Atlantic Tunas, Swordfish, and Sharks was published in the *Federal Register* (68 FR 74746). This final rule revised the shark regulations based on the results of the 2002 stock assessments for SCS and LCS. In Amendment 1 to the 1999 FMP, NMFS revised the rebuilding timeframe for LCS to 26 years from 2004, and implemented several new regulatory changes. Management measures enacted in the amendment included: using maximum sustainable yield as a basis for setting commercial quotas; eliminating the commercial minimum size restrictions; implementing trimester commercial fishing seasons effective January 1, 2005; imposing gear restrictions to reduce bycatch; implementing a time/area closure off the coast of North Carolina effective January 1, 2005; and establishing three regional commercial quotas (Gulf of Mexico, South Atlantic, and North Atlantic) for LCS and SCS management units.

Most of the regulations in Amendment 1 to the FMP for Atlantic Tunas, Swordfish, and Sharks became effective on February 1, 2004; however, the change in commercial quotas, removal of the commercial minimum size, establishment of regional quotas, and change in recreational bag limit became effective on December 30, 2003. The time/area closure off North Carolina and the trimester seasons became effective January 1, 2005. In addition, as of November 15, 2004, directed shark vessels with gillnet gear on board, regardless of location, are required to have a Vessel Monitoring System (VMS) installed and operating during right whale calving season (November 15–March 31); and, as of January 1, 2005, directed shark vessels with bottom longline fishing gear on board, located between 33° and 36° 30' N latitude, are required to have a VMS installed and operating during the mid-Atlantic shark closure period (January 1–July 31). The VMS requirement was finalized on December 24, 2003 (68 FR 74746), and was delayed pending a type-approval notice, which was published on April 15, 2004 (69 FR 19979). The final rule announcing the effective date for the VMS requirement was published on August 17, 2004 (69 FR 51010). NMFS published a proposed rule on March 26, 2006 (71 FR 15680), that would require participants in the Atlantic shark bottom longline fishery to possess, maintain, and utilize the same sea turtle dehooking and safe release equipment, and follow the same protocols as required in the pelagic longline fishery.

The latest stock assessment on LCS, which followed the Southeast Data Assessment and Review (SEDAR) process, was completed in June 2006. During the Review Workshop, an official recommendation was made to alter the current regime for conducting LCS complex-based assessments to species-specific assessments. During the 2006 LCS assessment, the Atlantic stock of sandbar sharks was individually assessed and was found to be overfished with overfishing occurring. Regulatory actions are required to be in place by 2008 to adjust the commercial quota of sandbar sharks as necessary to achieve rebuilding by the target year of 2070. Blacktip sharks were divided into two stocks, a Gulf of Mexico stock and an Atlantic stock. Due to an absence of reliable estimates of abundance, biomass, and exploitation rates, the current status of blacktips in the Atlantic is unknown. Alternatively, the Gulf of Mexico stock is not overfished and overfishing is not occurring; however, it was recommended that current catch rates of this stock be maintained. An assessment of SCS is expected to commence in 2007.

The first individual stock assessment for dusky sharks was completed in May 2006. Due to potential identification problems and catch data originating from a variety of sources, the magnitude of dusky shark catch has previously been difficult to ascertain. Three models were used to ascertain the current status of a single dusky shark stock, the most optimistic of which indicated that the dusky shark population has been depleted by 62 to 80 percent of the unfished virgin biomass. The assessment also summarized the relevant biological data, discussed the fisheries affecting dusky sharks, and detailed the data and methods used to assess shark status. Some recommendations were also made regarding future avenues of research and issues to consider in future stock assessments.

On October 2, 2006, the 1999 FMP was replaced with the final Consolidated Atlantic HMS FMP, which consolidates management of all Atlantic HMS under one plan, reviews current information on shark essential fish habitat, requires the second dorsal and anal fin to remain on shark carcasses through landing, requires shark dealers to attend shark identification workshops, and includes measures to address overfishing of finetooth sharks (71 FR 58058). This FMP manages several species of sharks (Table 2.2.1). The 2001–2005 commercial shark landings and the 2006 preliminary commercial shark landings are shown in tables 2.2.2 and 2.2.3, respectively. On November 7, 2006 (71 FR 65086), NMFS published a notice of intent to conduct an Environmental Impact Statement in conjunction with Amendment 2 to the Consolidated Atlantic HMS FMP, which will restructure the management of Atlantic shark stocks based on the results of several stock assessments including LCS, sandbar, blacktip, dusky, and porbeagle sharks. Scoping meetings for this Amendment 2 were scheduled for January 2007.

Observer coverage in the shark bottom longline fishery began in 1994 on a voluntary basis. Since 2002, observer coverage has been mandatory for selected bottom longline vessels. NMFS aims to obtain 5 percent observer coverage of the commercial effort and in doing so deploys approximately five to seven observers to monitor 300–400 commercial fishing trips per year. The data collected through the observer program are critical to the monitoring of takes and mortality estimates for protected sea turtles, sea birds, marine mammals, and smalltooth sawfish. Data obtained through the observer program are also vital for conducting stock assessments of sharks and for use in the development of fishery management measures for Atlantic sharks.

The Mid-Atlantic Fishery Management Council has the lead in consultations with the New England Fishery Management Council, for the management of spiny dogfish in federal waters of the Atlantic Coast pursuant to the Spiny Dogfish FMP, which became effective in February 2000. The FMP incorporates the MSA regulations governing the harvest, possession, landing, purchase and sale of shark fins from 50 CFR Part 600, Subpart N. The management program establishes a restrictive spiny dogfish possession limit of 600 pounds per trip and a coastwide commercial quota. Upon attainment of the coastwide quota, the fishery is closed to further landings by federally permitted vessel. The fishery is managed in state waters by the Atlantic States Marine Fisheries Commission through an Interstate FMP for Spiny Dogfish that utilizes similar management measures.

Table 2.2.1 U.S. Atlantic shark management units, shark species for which retention is prohibited, and data collection only species.

Sharks in the Consolidated Atlantic HMS FMP			
Large Coastal Sharks (LCS)		**Small Coastal Sharks (SCS)**	
Sandbar	*Carcharhinus plumbeus*	Atlantic sharpnose	*Rhizoprionodon terraenovae*
Silky	*Carcharhinus falciformis*	Finetooth	*Carcharhinus isodon*
Tiger	*Galeocerdo cuvier*	Blacknose	*Carcharhinus acronotus*
Blacktip	*Carcharhinus limbatus*	Bonnethead	*Sphyrna tiburo*
Spinner	*Carcharhinus brevipinna*		
Bull	*Carcharhinus leucas*	**Pelagic Sharks**	
Lemon	*Negaprion brevirostris*	Shortfin mako	*Isurus oxyrinchus*
Nurse	*Ginglymostoma cirratum*	Common thresher	*Alopias vulpinus*
Scalloped hammerhead	*Sphyrna lewini*	Porbeagle	*Lamna nasus*
Great hammerhead	*Sphyrna mokarran*	Oceanic whitetip	*Carcharhinus longimanus*
Smooth hammerhead	*Sphyrna zygaena*	Blue	*Prionace glauca*
Prohibited Species			
Sand tiger	*Carcharias taurus*	Caribbean reef	*Carcharhinus perezi*
Bigeye sand tiger	*Odontaspis noronhai*	Narrowtooth	*Carcharhinus brachyurus*
Whale	*Rhincodon typus*	Caribbean sharpnose	*Rhizoprionodon porosus*
Basking	*Cetorhinus maximus*	Smalltail	*Carcharhinus porosus*
White	*Carcharodon carcharias*	Atlantic angel	*Squatina dumeril*
Dusky	*Carcharhinus obscurus*	Longfin mako	*Isurus paucus*
Bignose	*Carcharhinus altimus*	Bigeye thresher	*Alopias superciliosus*
Galapagos	*Carcharhinus galapagensis*	Sevengill	*Heptranchias perlo*
Night	*Carcharhinus signatus*	Sixgill	*Hexanchus griseus*
		Bigeye sixgill	*Hexanchus vitulus*
Deepwater and Other Species (Data Collection Only)			
Iceland catshark	*Apristurus laurussoni*	Great lanternshark	*Etmopterus princeps*
Smallfin catshark	*Apristurus parvipinnis*	Smooth lanternshark	*Etmopterus pusillus*
Deepwater catshark	*Apristurus profundorum*	Fringefin Lanternshark	*Etmopterus schultzi*
Broadgill catshark	*Apristurus riveri*	Green lanternshark	*Etmopterus virens*
Marbled catshark	*Galeus arae*	Cookiecutter shark	*Isistius brasiliensis*
Blotched catshark	*Scyliorhinus meadi*	Bigtooth Cookiecutter	*Isistius plutodus*
Chain dogfish	*Scyliorhinus retifer*	Smallmouth velvet Dogfish	*Scymnodon obscurus*
Dwarf catshark	*Scyliorhinus torrei*	Pygmy shark	*Squaliolus laticaudus*
Japanese gulper shark	*Centrophorus acus*	Roughskin spiny Dogfish	*Squalus asper*
Gulper shark	*Centrophorus granulosus*	Blainville's dogfish	*Squalus blainvillei*
Little gulper shark	*Centrophorus uyato*	Cuban dogfish	*Squalus cubensis*
Kitefin shark	*Dalatias licha*	Bramble shark	*Echinorhinus brucus*
Flatnose gulper shark	*Deania profundorum*	American sawshark	*Pristiophorus schroederi*
Portuguese shark	*Centroscymnus coelolepis*	Florida smoothhound	*Mustelus norrisi*
Greenland shark	*Somniosus microcephalus*	Smooth dogfish	*Mustelus canis*
Lined lanternshark	*Etmopterus bullisi*		
Broadband dogfish	*Etmopterus gracilispinnis*		
Caribbean lanternshark	*Etmopterus hillianus*		

Table 2.2.2 Commercial landings for Atlantic large coastal, small coastal, and pelagic sharks in metric tons and dressed weight[4] (mt dw), 2001–2005.
Source: Cortés and Neer (2002); Cortés (2003); Cortés and Neer (2005); Cortés pers. comm. (2007).

2001–2005 Commercial Shark Landings					
Species Group	2001	2002	2003	2004	2005
Large coastal sharks	1,549	1,883	1,947	1,458	1,500
Small coastal sharks	329	279	242	205	295
Pelagic sharks	157	212	289	308	122
Total	2,035	2,374	2,478	1,971	1,917

[4] Dressed weight is the weight of fish after the gills, guts, head and fins have been removed and discarded (usually at sea).

Table 2.2.3 Preliminary landings estimates in metric tons and dressed weight (mt dw) for the 2006 Atlantic shark commercial fisheries. Landings are based on the quota monitoring system.

2006 Preliminary Commercial Shark Landings					
Species Group	Region	First Season	Second Season	Third Season	Group Total
Large coastal sharks (i.e., sandbar, silky, tiger, blacktip, spinner, bull, lemon, nurse, and hammerheads)	Gulf of Mexico	337	344	352	**1,808**
	South Atlantic	393	207	109	
	North Atlantic	<1	60	6	
Small coastal sharks (i.e., Atlantic sharpnose, finetooth, blacknose, bonnethead)	Gulf of Mexico	78	80	23	**341**
	South Atlantic	45	75	40	
	North Atlantic	0	0	0	
Blue sharks	No regional quotas	20	<1	0	**68**
Porbeagle sharks		0	<1	1	
Pelagic sharks (other than blue or porbeagle)		0	25	21	
Total:		873	792	552	2,217

2.3 Current Management Authority in the Pacific Ocean

Pacific Fishery Management Council (PFMC)

The PFMC's area of jurisdiction is the Exclusive Economic Zone (EEZ) off the coasts of California, Oregon, and Washington. In late October 2002, the PFMC adopted it for U.S. West Coast Highly Migratory Species (HMS) Fisheries FMP. This FMP's management area also covers adjacent high seas waters for fishing activity under the jurisdiction of the HMS FMP. The final rule implementing the HMS FMP was published in the *Federal Register* on April 7, 2004 (69 FR 18443). This FMP manages several sharks as part of the management unit (Table 2.3.1), including the common thresher (*Alopias vulpinus*) and shortfin mako (*Isurus oxyrinchus*), sharks valued but not primarily targeted in the West Coast–based fisheries, as well as blue sharks (*Prionace glauca*, a frequent bycatch species), bigeye thresher (*Alopias superciliosus*), and pelagic thresher (*Alopias pelagicus*, incidental catch) sharks. The HMS FMP also includes some shark species for monitoring purposes (Table 2.3.1). These species, which often comprise a fishery's bycatch, are monitored on a consistent and routine basis to the extent practicable. Lastly, the HMS FMP also designated some shark species as prohibited because of their special status (Table 2.3.1). If intercepted, these species—including great white, megamouth, and basking sharks—must be released immediately, unless other provisions for their disposition are established.

The FMP proposed precautionary annual harvest guidelines for common thresher and shortfin mako sharks to prevent localized depletion, which could take decades to correct given the biological characteristics of the species. The common thresher shark and the shortfin mako shark are considered vulnerable to overexploitation due to their low fecundity, long gestation periods, and relatively old age at maturation. The FMP also establishes a formal requirement for fishery monitoring and annual Stock Assessment and Fishery Evaluation (SAFE) reports as well as a full FMP effectiveness review every two years. This should ensure new information will be collected and analyzed so additional conservation action can be taken if any species is determined to need further protection.

The Pacific Coast Groundfish FMP includes three shark species (leopard, soupfin, and spiny dogfish) in the groundfish management unit (Table 2.3.2). Beginning in 2003, NMFS established a "rockfish conservation area" closing large areas to fishing for groundfish, including sharks, by most gear types that catch groundfish. In addition, the Pacific Coast Groundfish FMP manages its shark species with a combined annual optimal yield for all "other fish," which includes sharks, skates, ratfish, morids, grenadiers, kelp greenling, and some other groundfish species. This optimal yield is reduced by a precautionary adjustment of 50 percent from the acceptable biological catch. Beginning in 2006, NMFS implemented 2-month cumulative trip limits for spiny dogfish for both open access and limited entry fisheries to control the harvest of dogfish and associated overfished groundfish species. Table 2.3.3 lists landings (round weight[5] equivalent in metric tons) for various sharks from fisheries off California, Oregon, and Washington from 1995 through 2006.

[5] Round weight is the weight of the whole fish before processing or removal of any part.

Table 2.3.1 Shark Species in the West Coast Highly Migratory Species Fishery Management Plan.

West Coast Highly Migratory Species FMP	
Sharks listed as management unit species	
Common thresher	*Alopias vulpinus*
Shortfin mako	*Isurus oxyrinchus*
Blue sharks	*Prionace glauca*
Bigeye thresher	*Alopias superciliosus*
Pelagic thresher	*Alopias pelagicus*
Sharks included in the FMP for monitoring purposes	
Blue shark	*Prionace glauca*
Whale shark	*Rincodon typus*
Prickly shark	*Echinorrihinus cookie*
Salmon shark	*Lamma ditropis*
Leopard shark	*Triakis semifasciata*
Hammerhead sharks	Sphyrnidae
Soupfin shark	*Galeorhinus galeus*
Silky shark	*Carcharhinus falciformis*
Oceanic whitetip shark	*Carcharhinus longimanus*
Blacktip shark	*Carcharhinus limbatus*
Dusky shark	*Carcharhinus obscurus*
Sixgill shark	*Hexanchus griseus*
Spiny dogfish	*Squalus acanthias*
Prohibited species	
Great white	*Carcharodon carcharias*
Megamouth	*Megachasma pelagios*
Basking sharks	*Cetorhinus maximus*

Table 2.3.2 Shark species in the groundfish management unit of the Pacific Coast Groundfish Fishery Management Plan.

Pacific Coast Groundfish FMP	
Sharks listed as management unit species	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*

Table 2.3.3 Shark landings (round weight equivalent in metric tons) for California, Oregon, and Washington, 1995–2006, organized by species group.
Source: NWFSC fishticket data and the Pacific States Marine Fisheries Commission, PacFIN Database, Report # 307, July 2007, www.psmfc.org/pacfin/data

Shark Landings (mt) for California, Oregon, and Washington												
Species Name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bigeye thresher shark	31	20	32	11	6	5	2	--	5	5	10	4
Blue shark	5	1	1	3	<1	1	2	42	1	<1	1	<1
Common thresher shark	270	319	320	361	320	295	373	301	294	115	179	159
Leopard shark	10	8	11	15	14	13	12	13	10	11	13	11
Other shark	1	2	3	5	6	5	38	4	20	3	5	4
Pelagic thresher shark	5	1	35	2	10	3	2	2	4	2	<1	<1
Shortfin mako	95	96	132	100	63	80	46	82	69	54	33	46
Soupfin shark	44	65	63	54	75	48	45	32	35	27	26	30
Spiny dogfish	367	249	425	462	514	624	564	875	447	667	718	595
Unspecified shark	16	5	7	7	13	6	3	4	3	6	5	5
Pacific angel shark	18	16	31	50	48	34	28	22	17	13	12	14
Total	**862**	**782**	**1,060**	**1,070**	**1,070**	**1,114**	**1,115**	**1,377**	**905**	**904**	**1,003**	**870**

North Pacific Fishery Management Council (NPFMC)

The NPFMC manages fisheries in federal waters off Alaska. Sharks are managed under the "other species" category in the Gulf of Alaska (GOA) Groundfish FMP and the Bering Sea/Aleutian Island (BSAI) Groundfish FMP. "Other species" comprises taxonomic groups of slight economic value and are not generally targeted. The category includes sharks, skates, octopi, and sculpins in the BSAI and sharks, octopi, squid, and sculpins in the GOA. These species have limited economic potential and are important components of the ecosystem, but sufficient data are lacking to manage each separately; therefore, an aggregate annual quota limits their catch. Aggregate catch of the whole category must be recorded and reported.

In the BSAI and GOA a survey is conducted biannually for the "other species" category, most recently in 2005 in the BSAI and GOA. These survey results were incorporated into the December 2006 SAFE reports for "other species" in the BSAI and GOA (available from the NPFMC). A NMFS survey of "other species" is scheduled for 2007 and the results will be incorporated in the 2007 SAFE report. The BSAI Plan Team recommends to the NPFMC annual overfishing levels (OFL) and Allowable Biological Catch (ABC) amounts for the "other species" category based on the best available and most recent scientific information. The NPFMC recommends Total Allowable Catch (TAC) levels for "other species" in the BSAI. In recent years the NPFMC has recommended a TAC for these species estimated to be sufficient to meet incidental catch amounts in other directed groundfish fisheries but not sufficient to allow for a directed fishery targeting on these species. In the GOA, because assessments for the “other species” category have not been regularly conducted, the GOA Plan Team does not recommend OFL and ABC amounts for the “other species” category in the GOA. The Alaska Fisheries Science Center (AKFSC) prepared preliminary stock assessments for “other species” in 2006. In 2006, NMFS implemented Amendment 69 to the GOA FMP, which allows the NPFMC to recommend the annual TAC for the “other species” category in the GOA at a level less than or equal to 5 percent of the sum of all other TACs established for assessed species.

This action was intended as a short term, proactive management measure to better conserve those stocks that comprise the “other species” complex while the NPFMC develops a more comprehensive long-term approach for the management of the “other species” complex in both the GOA and BSAI. The NPFMC and NMFS are currently investigating alternative management strategies for sharks in GOA and BSAI, which could involve setting annual OFLs, ABCs, and TACs for sharks apart from other groundfish in the “other species” complex. Since 2006, the NPFMC has recommended an annual TAC of 4,500 mt for the “other species” category in the GOA. The NPFMC’s recommendation was based on the GOA Plan Team’s estimate of incidental catch needs in other directed groundfish and Pacific halibut fisheries (4,000 mt) and comments from the Scientific and Statistical Committee, Advisory Panel, and public. An annual TAC of 4,500 mt would meet incidental catch needs in the directed groundfish and halibut fisheries and allow for a modest directed fishery for the “other species” complex of approximately 500 mt each year and the development of markets for these species.

Seven shark species have been identified during fishery surveys or observed during groundfish fishing in the Alaskan waters (Table 2.3.4). The brown cat, basking, sixgill, and blue sharks are very rarely taken in any sport or commercial fishery and are not targeted for harvest. Pacific sleeper, salmon, and spiny dogfish sharks are taken incidentally in groundfish fisheries and are monitored in season by NMFS. Sharks are the only group in the complex consistently identified to species in catches by fishery observers. Most of the shark incidental catch occurs in the midwater trawl pollock fishery and in the hook and line fisheries for sablefish, Greenland turbot, and Pacific cod along the outer continental shelf and upper slope areas. The most recent estimates of the incidental catch of sharks in the GOA and BSAI are from 2006. These data are included in Chapter 18 in the 2006 BSAI SAFE report and Appendix E to the December 2006 GOA SAFE report and the NMFS catch accounting system. Estimates of the incidental catch of sharks in the GOA and BSAI groundfish fisheries from 2000 through 2006 have ranged from 418-1,256 metric tons (mt) and 234-1,362 mt, respectively (Table 2.3.5). Due to limited catch reports on individual species and larger taxonomic groups in the “other species” category estimates of the incidental catch of sharks in the BSAI and GOA are largely based on NMFS survey results, observer data, and NMFS Catch Accounting System data.

Table 2.3.4 Shark species identified during fishery surveys or observed during groundfish fishing in the Alaskan waters.

Shark Species Identified in Alaskan Waters	
Common Name	Species Name
Pacific sleeper shark	*Somniosus pacificus*
Salmon shark	*Lamna ditropis*
Spiny dogfish shark	*Squalus acanthias*
Brown cat shark	*Apristurus brunneus*
Basking shark	*Cetorhinus maximus*
Sixgill shark	*Hexanus griseus*
Blue shark	*Prionace glauca*

Table 2.3.5 Incidental catch (in metric tons) of sharks in the Gulf of Alaska and Bering Sea/Aleutian Islands commercial groundfish fisheries, 2000-2006.
Source: NMFS Survey, Observer Data, and NMFS Catch Accounting System Data

Incidental Catch of Sharks								
Fishery	Species	2000	2001	2002	2003	2004	2005	2006
Gulf of Alaska groundfish fishery	**Spiny dogfish**	397.6	494.0	117.0	368.6	175.6	415.5	904.0
	Pacific sleeper shark	608.2	249.0	225.6	292.5	232.3	454.2	240.0
	Salmon shark	37.8	32.8	58.2	35.7	21.6	52.7	29.0
	Unidentified shark	73.6	77.0	16.8	52.3	39.0	60.4	83.0
	Total	1,117.2	852.8	417.6	749.1	468.5	982.8	1,256.0
Bering Sea and Aleutian Islands groundfish fishery	**Spiny dogfish**	8.9	17.3	9.4	10.8	7.2	6.7	7.0
	Pacific sleeper shark	490.4	687.3	838.5	217.8	267.8	188.0	307.0
	Salmon shark	23.3	24.4	46.6	18.9	13.9	17.8	61.0
	Unidentified shark	67.6	35.0	467.8	32.1	57.5	21.9	305.0
	Total	590.2	764.0	1,362.3	279.6	346.4	234.4	680.0

In 2005, 36 mt of sharks were retained in the GOA (3.7 percent of the total incidental catch), and 21 mt of sharks were retained in the BSAI (5.0 percent of the total incidental catch). In 2006, 62 mt of sharks were retained in the GOA (4.9 percent of the total incidental catch), and 31 mt of sharks were retained in the BSAI (4.6 percent of the total incidental catch). In 2006, two vessels targeted sharks using hook and line gear in the GOA, one vessel using a Federal Fishing Permit and another vessel using a permit issued by the Commissioner of the Alaska Department of Fish and Game (ADF&G) for use in State waters. The catches of these vessels are confidential but catches of sharks were very low in amount, effort was very short-lived, and deemed unsuccessful by the participants.

The ADF&G manages the recreational fishery with a daily bag limit of one shark of any species per day, and a limit of two sharks of any species annually. The catch consists almost entirely of spiny dogfish and salmon shark. The vast majority of spiny dogfish are released, but there is a modest directed sport fishery for salmon sharks, especially in Prince William Sound. There were no reported incidents of sport-caught sharks being finned and discarded, and state regulations prohibit the intentional waste or destruction of any sport-caught species.

State of Alaska regulations prohibit directed commercial fishing of sharks statewide except for a spiny dogfish permit fishery (5 AAC 28.379) adopted by the Alaska Board of Fisheries for the Cook Inlet area beginning in 2005. Sharks taken incidentally to commercial groundfish and salmon fisheries may be retained and sold provided that the fish are fully utilized as described in 5 AAC 28.084. The state limits the amount of incidentally taken sharks that may be retained to 20 percent of the round weight of the directed species on board a vessel except in the Southeast District where a hook and line or troll vessels may retain up to 35 percent round weight of sharks to round weight of the target species on board (5AAC 28.174 (1) and (2)). Also in the State's East Yakutat Section and the Icy Bay Subdistrict salmon gill-netters may retain all spiny dogfish taken as bycatch during salmon gillnet operations (5AAC 28.174 (3)). All sharks landed must be recorded on an ADF&G fish ticket. In 2006, one permit was issued for the Cook Inlet spiny dogfish fishery.

Western Pacific Fishery Management Council (WPFMC)

In 2000, the WPFMC prepared an amendment to the Pelagic Fisheries of the Western Pacific Region FMP (Pelagics FMP) to conserve and manage sharks. The Shark Finning Prohibition Act of 2000 rendered the measure on shark finning in the amendment as unnecessary. To address the issue of shark feeding in EEZ waters around Hawaii, the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 made it unlawful for any person to chum for sharks (except for harvesting purpose) in the western Pacific region. As a result, the WPFMC will not be taking any further action to amend the Pelagics FMP related to sharks. There are nine species of sharks in the pelagic management unit of the Pelagics FMP (Table 2.3.6). Five species of coastal sharks are listed as currently harvested in the Coral Reef Ecosystems of the Western Pacific FMP (Table 2.3.7).

The longline fisheries in the Western Pacific, in Hawaii and American Samoa, were responsible for the vast majority of the sharks landed. Shark landings (estimated whole weight) by the Hawaii-based longline fisheries peaked at about 2,870 mt in 1999, due largely to the finning of blue sharks (Table 2.3.8). A State of Hawaii law prohibiting landing shark fins without an associated carcass passed in mid-2000 (Hawaii Revised Statues 188.40-5). This law apparently decreased shark landings by almost 50 percent in 2000. With the subsequent enactment of the federal Shark Finning Prohibition Act, shark landings from 2001 to 2006 were down by more then 93 percent from their peak. Landings in 2006 (preliminary data) were the lowest seen since 2001. Today, sharks are marketed as fresh shark fillets and steaks in Hawaii supermarkets and restaurants, as well as exported to the U.S. mainland.

The American Samoa longline fishery landed a small amount of sharks relative to Hawaii's longline fishery (Table 2.3.8). The pattern of shark landings by the American Samoa longline fishery was similar to shark landings by the Hawaii-based longline fishery. Landings increased from 1 mt in 1995 to 13 mt in 1999, followed by a decline. The decline in shark landings by the American Samoa longline fishery is also attributed to the Shark Finning Prohibition Act.

Table 2.3.6 Pacific Sharks in the pelagic management unit in the Pelagic Fisheries of the Western Pacific Region Fisheries Management Plan (as amended in March 2004).

Pelagic Fisheries of the Western Pacific Region FMP	
Shark species in the pelagic management unit	
Blue shark	*Prionace glauca*
Shortfin mako shark	*Isurus oxyrinchus*
Longfin mako shark	*Isurus paucus*
Oceanic white tip shark	*Carcharhinus longimanus*
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*Alopias pelagicus*
Bigeye thresher shark	*Alopias superciliosus*
Silky shark	*Carcharhinus falciformis*
Salmon shark	*Lamna ditropis*

Table 2.3.7 Five coastal sharks listed as management unit species in the Coral Reef Ecosystems of the Western Pacific Fishery Management Plan and designated as currently harvested coral reef taxa. Other coastal sharks in the management unit of the FMP belonging to the Families Carcharhinidae and Sphyrnidae are designated as potentially harvested coral reef taxa.

Coral Reef Ecosystems of the Western Pacific Fishery Management Plan	
Sharks listed as management unit species and designated as currently harvested coral reef taxa	
Grey reef shark	*Carcharhinus amblyrhynchos*
Silvertip shark	*Carcharhinus albimarginatus*
Galapagos shark	*Carcharhinus galapagenis*
Blacktip reef shark	*Carcharhinus melanopterus*
Whitetip reef shark	*Triaenodon obesus*

Table 2.3.8 Shark landings (mt) from the Hawaii-based longline fishery and the American Samoa longline fishery, 1995–2006.
Source: Pacific Islands Fisheries Science Center's Fisheries Monitoring and Analysis Program and Western Pacific Fisheries Information Network

Shark Landings (mt)													
Fishery	Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Hawaii-based longline fishery	**Blue shark**	1,400	1,900	2,100	2,500	2,400	1,200	30	30	20	60	30	12
	Mako shark	70	50	60	90	110	80	60	80	90	70	110	95
	Thresher shark	30	30	60	120	190	100	50	50	50	60	30	33
	Miscellaneous shark	120	30	70	110	170	70	10	20	10	10	-	11
	Total shark landings	**1,620**	**2,010**	**2,290**	**2,820**	**2,870**	**1,450**	**150**	**180**	**170**	**200**	**170**	**151**
American Samoa longline fishery	**Total shark landings**	**1**	**3**	**5**	**11**	**13**	**4**	**1**	**3**	**4**	**1**	**< 1**	**1**

2.4 NMFS Enforcement Actions Pertaining to the Shark Finning Prohibition Act

Listed below are substantive investigations, either initiated or concluded during calendar year 2006, by the NOAA National Marine Fisheries Service Office for Law Enforcement (OLE), which involved violations of the Shark Finning Prohibition Act and its underlying regulations. During this reporting period, violations were primarily detected, investigated, and prosecuted in the Southeast and Pacific Islands Enforcement Divisions. In general, violations included the illegal finning of sharks, the possession of prohibited shark species, and the unauthorized offload of shark fins into U.S. ports. Moreover, the NOAA Office of General Counsel for Enforcement and Litigation (GCEL) has instituted several enforcement actions for violations of the Shark Finning Prohibition Act.

The following cases are highlighted as significant enforcement actions by the OLE:

- In January 2006, NMFS special agents from the Southeast Division and officers from the Florida Fish and Wildlife Commission (FFWC) boarded a commercial fishing vessel after it ran aground in the Florida Keys National Marine Sanctuary. During the boarding, a NMFS special agent discovered and seized approximately 48 shark fins, 32 under-sized lobsters and three under-sized cobias. There were no corresponding shark carcasses onboard the vessel as required by law. A state citation in the amount of $1,305 was issued for the under-sized lobsters and cobia. In September 2006, the NOAA GCEL issued a Notice of Violation and Assessment (NOVA) in the penalty amount of $10,000, as well as a 30-day permit sanction for possession of 48 shark fins without corresponding carcasses.

- In April 2006, a NMFS special agent from the Southeast Division and an officer from the FFWC boarded a commercial fishing vessel while it was offloading in Florida. As the NMFS special agent and FFWC officer approached the vessel, a crew member threw three large fish overboard. During the subsequent boarding and inspection, the special agent and officer discovered nine undersized red grouper. After the captain claimed that all of the fish had been removed from the vessel, the NMFS special agent found and seized approximately 336 shark fins and 14 pieces of filleted fish hidden under a pile of ice in the vessel's hold. The NOAA GCEL issued a penalty in the amount of $106,000 for possession of 336 shark fins without corresponding carcasses; landing sharks during a commercial closure; destruction of evidence; making false statements to a federal agent; and possession of under-sized red-grouper and fillets.

- In April 2006, the NOAA GCEL issued a penalty in the amount of $98,500 to a vessel owner for violations of the Shark Fining Prohibition Act, which were committed in or about calendar year 2003. In January 2004, a NMFS special agent from the Southeast Division obtained records from a seafood company regarding its commercial landings of sharks and shark fins from 2002 through 2003. It was determined that the seafood company and associated fishing vessel owner/operator had violated the Shark Finning Prohibition Act by exceeding federal limits, among other apparent violations.

- In May 2006, NMFS special agents from the Southeast Division and officers from the FFWC boarded a commercial fishing vessel in Florida. During the boarding, the FWC officers and NMFS special agents found shark carcasses and shark fins onboard, although the large coastal shark season was closed, as well as a prohibited swordfish carcass that was under-sized. In August 2006, the NOAA GCEL issued a NOVA to the fishing vessel captain/owner in the penalty amount of $68,000 for possession of approximately 91 pounds of shark fins and shark carcasses during a closed period, and for possession of an under-sized swordfish carcass.

- In July 2006, and pursuant to a federal enforcement agreement with the OLE, officers from the Louisiana Department of Wildlife and Fisheries (LDWF) boarded a commercial shrimp vessel while it was in federal waters off the coast of Louisiana. During the boarding, the officers discovered approximately 15 shark fins without the associated shark carcasses onboard the vessel. In December 2006, the NOAA GCEL issued a NOVA penalty in the amount of $1,900 for the unlawful possession of the fins.

- In September 2006, officers from the LDWF, while acting under a federal enforcement agreement, observed the offloading of a commercial fishing vessel in Louisiana. During the offload, the officers found quantities of shark fins that were approximately five times the legal “fin-to-carcass” ratio. The shark fins were seized and their value was estimated at $10,700. The NOAA GCEL issued a NOVA to the vessel owner in the amount of $165,000 and a 170-day permit sanction.

Other pending cases of note are as follows:

- In June 2006 and pursuant to a federal enforcement agreement with the OLE, officers from the LDWF boarded a commercial shrimp vessel while it was in federal waters, approximately 40 miles off the coast of Louisiana. During the boarding, the officers found approximately 34 shark fins without the associated carcasses onboard the vessel. In addition, the LDWF officers found multiple fillets of cobia and red drum, as well as two additional small shark carcasses, which the captain did not have a federal permit to possess or retain. This case is currently under review by NOAA.

- In September 2006, a NMFS special agent from the Southeast Division forwarded a final investigative report to the Office of the United States Attorney in Louisiana, regarding an investigation concerning non-permitted sales of shark fins, which occurred in or about calendar year 2004. In January 2005, officers with the LDWF conducted an inspection of a seafood business. Subsequent investigation revealed that the company had unlawfully sold approximately 7,100 pounds of shark fins, with an estimated value of $318,000 in 2004. The owner of the company has pleaded guilty to multiple criminal violations of the Lacey Act and is awaiting federal sentencing.

- In June 2006, a Coast Guard boarding team in the Pacific Islands Division conducted an inspection of a commercial pelagic longline vessel. During the boarding and inspection, a fishing vessel crew member attempted to conceal a storage bag from the U.S. Coast Guard team. Further investigation revealed that the bag contained approximately 70 pieces of shark fins. Upon being interviewed, the vessel operator and crew members admitted to finning sharks that were recovered from their pelagic longline gear. In addition, the operator and crew indicated that the sharks were dead prior to finning, and the fins were intended for personal consumption. Only four shark carcasses were found in the vessel's fish hold. This case is currently under review by NOAA.

2.5 Education and Outreach

The U.S. National Plan of Action for the Conservation and Management of Sharks states that each U.S. management entity (i.e., NMFS, Regional Fishery Management Councils, Interstate Marine Fisheries Commissions, and states) should cooperate with regard to education and outreach activities associated with shark conservation and management. As part of the effort to implement the U.S. National Plan of Action, NMFS and other U.S. shark management bodies have:

1. Developed training tools and programs in elasmobranch identification (such as identification posters and color guidebooks).
2. Developed information and materials to raise awareness among recreational fishermen, commercial fishermen, fishing associations, and other relevant groups about the need and methods to reduce bycatch mortality and increase survival of released elasmobranchs where bycatch occurs.
3. Attempted to raise awareness among the non-fishing public about the ecological benefits from elasmobranch populations, detrimental effects of habitat destruction (e.g., coastal development and coastal pollution), and appropriate conservation measures to avoid, minimize, or mitigate adverse effects on necessary habitats.

2.6 Fishing Capacity

Numerous management tools are in use in U.S. fisheries to reduce capacity, including limited entry, vessel and permit buybacks, and exclusive quota programs (e.g., individual fishing quotas, community development quotas, and cooperatives). A limited access permit program for Atlantic sharks has been in place since 1999 that has capped the number of commercial shark permits in the fishery. This limited access permit program includes both directed and incidental commercial shark permits. The directed shark permit, which allows a vessel to target shark using any authorized gear, also has a vessel upgrading restrictions, further restricting capacity growth. A limited entry program for the U.S. West Coast Swordfish/Thresher Shark Drift Gillnet Fishery has been in place since 1980. Permits that are not renewed on an annual basis are retired with no replacements allowed into the fishery. As a result, fishing efforts and associated shark catch levels (target common threshers and non-target short-finned mako and blue sharks) have been decreasing in this fishery. Additional capacity reduction measures are still being investigated as an effective method for increasing the sustainability of elasmobranch fisheries. Pursuant to both an ongoing analytical program and to provisions in the recently reauthorized MSA, NMFS continues to assess levels of capacity in federally managed fisheries, including fisheries for sharks, skates, and rays that are managed by fishery management plans. NMFS completed a report on excess capacity in 2006 that included fisheries for sharks. The results suggest reasonably high levels of excess capacity (capacity in excess of current harvests) in federally managed fisheries for shark species.

Blue Shark (*Prionace glauca*)
Source: NMFS Northeast Fisheries Science Center

3. Imports and Exports of Shark Fins

The summaries of annual U.S. imports and exports of shark fins in Tables 3.1.1 and 3.2.1 are based on information submitted by importers and exporters to the U.S. Customs and Border Protection and U.S. Census Bureau as reported in the NMFS Trade database. Exports of shark fins far exceed imports in both weight and value. The total weight and value of imports has increased every year since 2003. In 2006, the total weight of shark fin exports declined however the value increased compared to 2005.

3.1 U.S. Imports of Shark Fins

During 2006, imports of shark fins were entered through the following U.S. Customs and Border Protection districts: Los Angeles, New York City, San Francisco, Cleveland, Seattle, and San Juan, Puerto Rico. In 2006, countries of origin in order of importance based on quantity were Hong Kong, Panama, China, New Zealand, Nicaragua, Mexico, and Canada (Table 3.1.1). It should be noted that, due to the complexity of the shark fin trade, fins are not necessarily produced in the same country as those from which they are exported. In the United States, factors such as availability of labor, overseas contacts, and astute trading can all play a role in determining the locale from which exports are sent.

3.2 U.S. Exports of Shark Fins

The vast majority of shark fins exported in 2006 were sent from the United States to Hong Kong, Germany, Canada, and Japan, and small amounts were sent to Mexico and Netherlands (Table 3.2.1). The mean value per metric ton (mt) has been increasing since 2002, most notably in the Hong Kong market. Using data from Table 3.2.1, mean values of dried shark fins for all countries combined has fluctuated between $9,445/mt and $84,211/mt from 2001 to 2006. Hong Kong's significantly higher dollar value to quantity, as compared to shark fin trade with other countries, is associated with the higher quality demanded in Hong Kong's inelastic market, and historically high consumption patterns.

3.3 International Trade of Shark Fins

The Food and Agriculture Organization of the United Nations compiles data on the international trade of fish. The summaries of imports, exports, and production shark fins in tables 3.3.1, 3.3.2, & 3.3.3 are based on information provided in FAO's FishStat database. The quantities and values in those tables are totals for all dried, dried and salted, fresh, or frozen shark fins. Total global imports of shark fins has fluctuated between 13,995 mt and 16,781 mt from 2001-2005, while the total global exports of shark fins has fluctuated between 10,726 mt and 14,735 mt from 2001-2005. Hong Kong is the largest importer and exporter of shark fins.

Table 3.1.1 Weight and value of dried shark fins imported into the United States, by country of origin.
Source: U.S. Census Bureau

Country	2001 (mt)	2001 Value	2002 (mt)	2002 Value	2003 (mt)	2003 Value	2004 (mt)	2004 Value	2005 (mt)	2005 Value	2006 (mt)	2006 Value
Argentina	7.658	$97,495	0	$0	0.450	$7,425	0	$0	0	$0	0	$0
Australia	0	$0	1.018	$12,232	0.475	$9,675	0.028	$2,592	0.192	$11,286	0	$0
Bangladesh	0	$0	0.052	$5,303	0	$0	0	$0	0	$0	0	$0
Brazil	2.2	$49,740	0	$0	0.353	$2,001	0	$0	2.269	$30,867	0	$0
Canada	6.811	$53,848	0.697	$39,879	0	$0	0	$0	0	$0	0.088	$4,719
China	1.204	$32,210	20.756	$578,052	0	$0	1.565	$19,211	0.150	$8,004	3.567	$132,312
Costa Rica	0.756	$22,857	0.110	$2,700	0	$0	0	$0	0	$0	0	$0
Ecuador	2.634	$8,147	0	$0	0	$0	0	$0	0	$0	0	$0
Guatemala	0	0	0	$0	0	$0	0	$0	0.102	$2,120	0	$0
Hong Kong	2.300	$403,742	2.637	$144,746	1.157	$41,017	4.893	$106,573	7.124	$524,463	16.240	$1,053,272
India	7.488	$35,601	4.212	$22,292	5.686	$30,000	2.808	$16,500	0	$0	0	$0
Indonesia	0	$0	0	$0	0	$0	0	$0	0.524	$12,135	0	$0
Japan	5.728	$221,387	1.498	$108,104	0	$0	0.489	$28,013	0	$0	0	$0
Madagascar	0	$0	0.190	$7,441	0	$0	0	$0	0	$0	0	$0
Mexico	7.306	$109,620	2.760	$34,370	0	$0	0	$0	0	$0	0.406	$4,054
Namibia	0	$0	0.130	$7,450	0	$0	0	$0	0	$0	0	$0
New Zealand	0	$0	0	$0	0	$0	0	$0	0	$0	1.003	$26,400
Nicaragua	0	$0	0	$0	0	$0	0	$0	0.506	$23,130	0.456	$22,158
Panama	4.218	$27,600	0	$0	0	$0	4.119	$160,034	0.585	$72,975	6.964	$138,875
Peru	0.038	$2,674	0	$0	0	$0	0	$0	0	$0	0	$0
Philippines	0	$0	0	$0	0.998	$3,383	0	$0	15.866	$67,101	0	$0
Singapore	2.200	$13,220	5.081	$61,345	0	$0	0	$0	0	$0	0	$0
South Africa	0.125	$8,575	0	$0	0	$0	0	$0	0	$0	0	$0
Taiwan	0	$0	0	$0	0.200	$4,796	0	$0	0	$0	0	$0
Vietnam	0	$0	0	$0	1.918	$11,849	0.551	$10,767	0	$0	0	$0
Total	**50.664**	**$1,086,716**	**39.141**	**$1,023,914**	**11.237**	**$110,146**	**14.453**	**$343,690**	**27.318**	**$752,081**	**28.724**	**$1,381,790**
Mean value	**$21,449/mt**		**$26,160/mt**		**$9,802/mt**		**$23,780/mt**		**$27,531/mt**		**$48,106/mt**	

Table 3.2.1 Weight and value of dried shark fins exported from the United States, by country of destination.

Note: Data in table are "total exports" which is a combination of domestic exports (this may include products of both domestic and foreign origin) and re-exports. Re-exports of "foreign" products are commodities that have entered the United States as imports and not sold, which, at the time of re-export, are in substantially the same condition as when imported.

Source: U.S. Census Bureau

Country	2001 (mt)	2001 Value	2002 (mt)	2002 Value	2003 (mt)	2003 Value	2004 (mt)	2004 Value	2005 (mt)	2005 Value	2006 (mt)	2006 Value
Aruba	0	$0	0.352	$4,156	0	$0	0	$0	0	$0	0	$0
Canada	0	$0	51.809	$395,252	4.723	$524,687	2.354	$270,387	1.687	$216,729	1.822	$245,950
China	0	$0	0	$0	0	$0	15.876	$150,000	2.350	$117,500	0	$0
Colombia	0	$0	0	$0	0	$0	0.377	$2,752	0	$0	0	$0
Denmark	0	$0	0	$0	0	$0	0	$0	2.804	$133,180	0	$0
France	13.344	$133,170	0	$0	0	$0	0	$0	0	$0	0	$0
Germany	0	$0	0	$0	0	$0	0	$0	0	$0	2.632	$90,625
Hong Kong	307.064	$2,863,157	45.173	$2,932,284	38.193	$3,441,436	61.242	$4,179,392	57.358	$3,390,495	41.763	$3,536,087
Japan	0.500	$8,500	2.400	$44,625	2.447	$42,150	0	$0	0	$0	1.600	$34,500
Malaysia	2.245	$82,584	0	$0	0	$0	0	$0	0	$0	0	$0
Mexico	2.756	$16,250	7.889	$55,120	1.334	$9,702	2.153	$86,049	0.937	$37,486	0.418	$16,700
Netherlands	0	$0	0	$0	0	$0	0	$0	0	$0	0.600	$21,550
Portugal	0	$0	0	$0	0.097	$3,029	0.100	$2,717	0.110	$2,988	0	$0
South Africa	0.132	$8,575	0	$0	0	$0	0	$0	0	$0	0	$0
South Korea	0	$0	12.939	$28,525	0.809	$22,400	0	$0	0	$0	0	$0
Taiwan	9.224	$54,392	3.823	$25,513	1.041	$52,947	1.359	$69,292	0	$0	0	$0
Thailand	0	$0	0	$0	0	$0	9.381	$106,925	0	$0	0	$0
Total	**335.265**	**$3,166,628**	**124.385**	**$3,485,475**	**48.644**	**$4,096,351**	**92.842**	**$4,867,514**	**65.246**	**$3,898,378**	**48.835**	**$3,945,412**
Mean value	**$9445/mt**		**$28,022/mt**		**$84,211/mt**		**$52,428/mt**		**$59,749/mt**		**$80,791/mt**	

Table 3.3.1: Weight and value of shark fins imported by countries other than the United States.
Source: Food and Agriculture Organization of the United Nations, FishStat database, http://www.fao.org/

Country	2001 Import (mt)	2001 Import Value ($US)	2002 Import (mt)	2002 Import Value ($US)	2003 Import (mt)	2003 Import Value ($US)	2004 Import (mt)	2004 Import Value ($US)	2005 Import (mt)	2005 Import Value ($US)
Angola	0	3,000	0	4,000	0	0	0	0	0	0
Antigua and Barbuda	0	0	0	1,000	0	0	0	0	0	0
Australia	0	0	0	0	0	0	0	0	9	1,056,000
Brazil	0	0	0	0	0	0	4	20,000	2	8,000
Brunei Darussalam	0	0	15	35,000	3	18,000	2	3,000	0	0
Viet Nam	4	122,000	0	0	0	0	0	0	3	10,000
Cambodia	0	0	0	0	0	0	0	0	1	12,000
Canada	0	0	70	4,255,000	58	5,286,000	38	4,989,000	27	4,833,000
South Africa	2	11,000	15	95,000	12	151,000	0	0	0	0
China	3,129	18,784,000	3,555	21,951,000	3,818	22,307,000	4,776	27,523,000	3,338	17,758,000
Taiwan Province of China	85	1,501,000	89	1,565,000	135	3,025,000	140	3,467,000	124	3,877,000
Djibouti	0	0	0	0	0	0	0	0	0	15,000
China, Hong Kong SAR	10,462	292,588,000	10,938	282,571,000	12,352	308,245,000	11,040	329,778,000	10,348	306,968,000
Congo, Republic of	0	2,000	0	0	0	0	0	0	0	0
Indonesia	41	910,000	46	643,000	144	1,540,000	193	2,407,000	332	2,486,000
Korea, Dem. People's Rep	1	491,000	1	296,000	0	175,000	1	268,000	1	331,000
Korea, Republic of	6	191,000	18	263,000	4	168,000	5	268,000	2	109,000
Lao People's Dem. Rep.	0	4,000	0	0	0	0	0	0	0	5,000
Chile	0	0	0	0	0	0	0	11,000	0	0
China, Macao SAR	111	1,771,000	116	2,325,000	108	2,471,000	96	2,831,000	59	3,368,000
Maldives	0	2,000	0	0	0	0	0	0	0	0
Nepal	0	6,000	0	10,000	0	0	0	0	0	0
Malaysia	72	250,000	66	533,000	44	229,000	293	480,000	93	311,000
Senegal	1	1,000	0	0	0	0	0	0	0	0

Thailand	81	856,000	60	568,000	103	1,045,000	121	1,256,000	113	1,317,000
Turkmenistan	0	0	0	0	0	2,000	0	0	0	0
Suriname	0	0	0	0	0	0	13	9,000	0	0
Venezuela, Boliv Rep of	0	0	0	0	0	12,000	0	0	0	0
TOTAL	**13,995**	**317,493,000**	**14,989**	**315,115,000**	**16,781**	**344,674,000**	**16,722**	**373,310,000**	**14,452**	**342,464,000**
MEAN VALUE	**$22,686/mt**		**$21,023/mt**		**$20,540/mt**		**$22,324/mt**		**$23,697/mt**	

Table 3.3.2: Weight and value of shark fins exported by countries other than the United States.

Note: Data in table are "total exports," which is a combination of domestic exports (this may include products of both domestic and foreign origin) and re-exports. Re-exports of "foreign" products are commodities that have entered into a country as imports and not sold, which, at the time of re-export, are in substantially the same condition as when imported.

Source: Food and Agriculture Organization of the United Nations, FishStat database, http://www.fao.org/

Country	2001 Total Export (mt)	2001 Total Export Value ($US)	2002 Total Export (mt)	2002 Total Export Value ($US)	2003 Total Export (mt)	2003 Total Export Value ($US)	2004 Total Export (mt)	2004 Total Export Value ($US)	2005 Total Export (mt)	2005 Total Export Value ($US)
Angola	8	300,000	2	113,000	4	224,000	5	249,000	4	265,000
Argentina	0	0	4	74,000	4	145,000	4	133,000	9	504,000
Bangladesh	0	0	0	0	0	0	0	0	7	552,000
Brazil	0	0	4	60,000	82	1,065,000	179	2,405,000	157	2,292,000
Seychelles	12	230,000	1	19,000	7	126,000	5	33,000	7	56,000
Solomon Islands	2	111,000	1	19,000	2	45,000	2	51,000	3	70,000
Brunei Darussalam	0	0	0	0	0	0	0	0	12	82,000
Myanmar	0	0	0	0	0	0	0	0	2	23,000
Cambodia	0	0	0	0	0	0	0	0	0	5,000
South Africa	75	834,000	49	1,029,000	14	158,000	0	0	0	0
China	1,693	39,529,000	1,814	34,434,000	2,199	38,123,000	2,476	40,966,000	1,349	20,753,000
Taiwan Province of China	653	2,420,000	622	2,443,000	554	2,022,000	710	3,270,000	756	7,441,000
Colombia	18	1,217,000	19	1,157,000	15	987,000	17	1,130,000	14	1,034,000
El Salvador	0	0	0	0	0	0	0	0	57	1,673,000
Costa Rica	124	7,057,000	41	1,807,000	43	1,464,000	6	123,000	0	0
Djibouti	0	0	10	34,000	0	0	0	0	0	0
Gabon	0	0	0	0	0	0	0	0	6	528,000
Côte d'Ivoire	0	0	0	0	0	0	0	1,000	0	0
Guinea	0	0	0	0	0	0	0	4,000	47	2,163,000
China, Hong Kong SAR	6,531	104,953,000	8,927	118,747,000	9,113	128,646,000	8,560	138,005,000	7,134	127,102,000
Congo, Republic of	16	744,000	8	378,000	12	601,000	14	430,000	18	848,000

Indonesia	479	8,220,000	771	8,414,000	1,288	10,204,000	943	10,936,000	1,554	8,065,000
Japan	230	9,864,000	208	7,781,000	220	8,492,000	205	10,262,000	168	8,140,000
Kenya	0	0	0	0	0	0	0	0	15	824,000
Korea, Republic of	13	502,000	25	864,000	25	696,000	5	293,000	7	357,000
Kuwait	0	0	1	14,000	0	7,000	0	0	0	0
Chile	0	0	33	1,433,000	40	1,499,000	54	2,474,000	39	1,639,000
Liberia	0	0	0	0	0	1,000	0	0	3	296,000
Libyan Arab Jamahiriya	0	0	0	0	0	27,000	1	27,000	1	59,000
China, Macao SAR	0	0	0	0	0	0	0	0	24	674,000
Madagascar	0	0	0	0	0	0	0	0	33	1,044,000
Maldives	19	1,010,000	14	692,000	21	889,000	20	551,000	13	542,000
Mauritania	0	0	38	431,000	47	685,000	82	1,222,000	74	1,233,000
Mozambique	4	163,000	6	240,000	8	212,000	1	62,000	2	123,000
Uruguay	20	384,000	28	597,000	33	526,000	38	977,000	39	570,000
Netherlands Antilles	2	50,000	0	0	0	0	0	0	0	0
Malaysia	10	30,000	16	148,000	6	27,000	463	565,000	37	196,000
Nigeria	0	12,000	0	0	0	0	0	0	1	25,000
Vanuatu	0	0	0	0	0	13,000	0	0	0	0
Marshall Islands	0	0	21	594,000	21	242,000	1	52,000	0	0
Pakistan	88	1,633,000	89	1,704,000	0	0	0	0	0	0
Panama	108	2,764,000	125	3,015,000	90	3,270,000	103	3,860,000	97	3,544,000
Kiribati	1	49,000	0	14,000	1	77,000	0	25,000	1	70,000
Philippines	0	0	80	259,000	78	257,000	54	411,000	0	0
Guinea-Bissau	0	0	0	0	1	92,000	0	0	3	110,000
Senegal	139	5,170,000	137	3,922,000	88	2,915,000	72	2,537,000	2	8,000
Sierra Leone	0	10,000	0	0	0	0	0	0	0	0
Somalia	4	290,000	0	39,000	0	0	0	0	0	0
Thailand	61	1,405,000	34	970,000	29	905,000	29	1,036,000	44	1,916,000
Tonga	8	147,000	5	53,000	5	59,000	4	212,000	3	83,000
Turks and Caicos Is.	0	0	0	0	0	0	0	2,000	0	0
United Arab Emirates	378	11,060,000	507	14,534,000	474	12,425,000	468	10,149,000	555	14,626,000
Suriname	0	0	9	227,000	6	231,000	6	218,000	7	312,000
Venezuela, Boliv Rep of	19	1,146,000	13	735,000	18	469,000	40	874,000	20	351,000

Papua New Guinea	2	114,000	1	104,000	3	342,000	12	271,000	9	652,000
Yemen	9	200,000	183	4,040,000	141	3,530,000	156	5,434,000	179	5,846,000
TOTAL	**10,726**	**201,618,000**	**13,846**	**211,138,000**	**14,692**	**221,698,000**	**14,735**	**239,250,000**	**12,512**	**216,696,000**
MEAN VALUE	**$18,797/mt**		**$15,249/mt**		**$15,090/mt**		**$16,237/mt**		**$17,319/mt**	

Table 3.3.3: Production of shark fins in metric tons by country.
Source: Food and Agriculture Organization of the United Nations, FishStat database, http://www.fao.org/

Country	2001	2002	2003	2004	2005
Bangladesh	181	263	172	4	1
South Africa	75	49	14	0	0
Taiwan Province of China	320	159	137	134	137
El Salvador	0	0	0	136	149
Fiji Islands	187	160	180	175	160
Côte d'Ivoire	0	32	0	0	0
Sri Lanka	85	83	83	110	80
Guyana	69	68	45	82	151
India	130	408	455	827	744
Indonesia	479	771	1,288	943	1,554
Korea, Republic of	13	25	25	5	7
Maldives	19	12	19	20	13
Uruguay	20	0	39	35	43
Pakistan	88	55	52	68	81
Philippines	88	80	78	54	84
Senegal	70	140	109	33	34
Singapore	387	435	1,021	246	320
Yemen	267	236	142	156	179
TOTAL	2,478	2,976	3,859	3,028	3,737

4. International Efforts to Advance the Goals of the Shark Finning Prohibition Act

Consistent with the provisions of Section 5 of the Shark Finning Prohibition Act, the Department of Commerce and the Department of State have initiated ongoing consultation regarding the development of international agreements consistent with the Act. Discussions have focused on possible bilateral, multilateral, and regional agreements with other nations. The law calls for the United States to pursue an international ban on shark finning and to advocate improved data collection (including biological data, stock abundance, bycatch levels, and information on the nature and extent of shark finning and trade). Determining the nature and extent of shark finning is the first step toward reaching agreements to decrease the incidence of finning worldwide.

4.1 Bilateral Efforts

In 2006, NMFS participated in bilateral discussions with a number of countries (including Canada, Chile, Taiwan and the European Union), which included issues relating to international shark conservation and management. Recent emphasis in these bilateral contacts has been on the collection and exchange of information, including requests for data such as shark and shark fin landings, transshipping activities, and the value of trade. In addition, the United States continues to encourage other countries to implement the FAO's IPOA for the Conservation and Management of Sharks, by finalizing their own national plans of action.

4.2 Regional Efforts

The U.S. Government continues to work within regional fishery management bodies to facilitate shark research, monitoring, and management initiatives, as appropriate. The United States has successfully led efforts to ban shark finning and implement shark conservation and management measures within a number of such organizations in recent years. Table 4.2.1 lists regional fishery management organizations and regional/multilateral programs in which the United States has worked to address shark conservation and management. Of the list in Table 4.2.1, ICCAT, NAFO, WCPFC, and the Inter-American Tropical Tuna Commission (IATTC) have adopted finning prohibitions. Further activities or planning of four organizations are discussed below as a supplement to last year's report to Congress.

Table 4.2.1 Regional Fishery Management Organizations and Programs.

Regional Fishery Management Organizations and Programs
• Northwest Atlantic Fisheries Organization (NAFO)
• Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)
• Inter-American Tropical Tunas Commission (IATTC)
• International Commission for the Conservation of Atlantic Tunas (ICCAT)
• Western and Central Pacific Fisheries Commission (WCPFC)
• Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the United States of America (South Pacific Tuna Treaty [SPTT])
• International Council for the Exploration of the Sea (ICES)
• Asia Pacific Economic Cooperation Forum (APEC) and the Convention on Migratory Species
• North Pacific Interim Scientific Committee for Tuna and Tuna-like Species (ISC)
• South East Atlantic Fisheries Organization
• Department of State Regional Environmental Hub Program

North Atlantic Fisheries Organization (NAFO)

At its 26th Annual Meeting in September 2004, the NAFO Fisheries Commission became the first regional fisheries management organization in the world to establish a catch limit for a directed elasmobranch fishery. The total allowable catch for skates in Division 3LNO (the "nose" and "tail" of the Grand Bank) was set at 13,500 metric tons, for each of the years 2005–2007. This total allowable catch was higher than the United States had initially sought, but the U.S. delegation ultimately joined the consensus of which this measure was a part. In addition to this catch limit, NAFO adopted a U.S.-proposed resolution regarding data collection and reporting relative to elasmobranchs in the NAFO Regulatory Area. At its 27th Annual Meeting in September 2005, the NAFO Fisheries Commission adopted a ban on shark finning in all NAFO-managed fisheries and mandated the collection of information on shark catches. At the 2006 NAFO Annual Meeting, a U.S. proposal for improving elasmobranch data collection was also adopted.

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)
Five shark species (*Lamna nasus*, *Somniosus antarcticus*, *Etmopterus cf. granulosus*, *Centroscymnus coelolpis* and *Squalus acanthias*) are known to occur in the northern part of the area addressed by CCAMLR. Only the first three species appear to be abundant enough to have the potential to attract commercial interest. The identification of a sixth species, *Halaelurus canescens,* from observer reports at South Georgia has yet to be confirmed.

CCAMLR adopted a conservation measure in 2006 prohibiting directed fishing on shark species in the Convention Area, other than for scientific research purposes. The Commission agreed that the prohibition shall apply until such time as the CCAMLR Scientific Committee has investigated and reported on the potential impacts of this fishing activity and the Commission has agreed on the basis of advice from the Scientific Committee that such fishing may occur in the Convention Area. It also agreed that any bycatch of shark, especially juveniles and gravid females, taken accidentally in other fisheries, shall, as far as possible, be released alive.

During the discussion of the conservation measure at CCAMLR, the United States stated that the issue of management of shark-related fisheries, with a particular focus on the practice of shark finning, is an important one for CCAMLR to consider. The United States noted that it has enacted legislation and regulations banning the practice of shark finning, and has been using educational efforts and enforcement actions to ensure that U.S. flagged vessels and foreign vessels making U.S. port calls comply with the statutory ban on retaining shark fins without retention of the shark carcasses to the first point of landing.

The United States expressed hope that the investigations of the Scientific Committee would yield analysis of the stock abundance, shark bycatch levels and other important biological data of the shark species of the Southern Ocean. It is believed that this conservation measure is an important first step to an eventual ban on the practice of shark finning without utilization of the shark carcasses. The United States also mentioned that there is a need for future efforts to collect information on the extent of shark finning in the Convention Area and the amount of trade/transshipment through ports of Contracting and non-Contracting parties. The United States urged all Contracting Parties to prepare and submit their respective National Plans of Action for the Conservation and Management of Sharks to the FAO Committee on Fisheries, as set forth in the IPOA for the Conservation and Management of Sharks, if they have not already done so.

International Commission for the Conservation of Atlantic Tunas (ICCAT)
In 2004, ICCAT adopted a significant agreement on sharks. This measure marked the first time ICCAT has exerted management authority over sharks. The approved measure, requiring full utilization of shark catches, mandates fishermen to retain all parts of the shark except the head, guts, and skin to the point of first landing. Countries are required to ensure their vessels retain onboard fins totaling no more than 5 percent of the weight of sharks on board up to the first point of landing. Parties not requiring fins and carcasses to be offloaded together at the point of first landing must ensure compliance with the ratio through certification, monitoring, or other means. These requirements, which parallel current U.S. law, are significant because they provide the means to enforce the prohibition on finning even when no fishery observers are aboard the vessel. The 2004 agreement also: 1) establishes requirements for data collection on catches of

sharks; 2) calls for research on shark nursery areas; and 3) encourages the release of live sharks, especially juvenile sharks.

In 2005, the Standing Committee on Research and Statistics (SCRS) reviewed the stock assessment of shortfin mako sharks, as well as the appropriateness of the 5 percent fin-to-carcass ratio. SCRS concluded the shortfin mako biomass in the North Atlantic may be below the biomass that can support maximum sustainable yield, as trends in catch per unit effort suggest depletions of 50 percent or more. The SCRS, therefore, recommended the Commission take actions to reduce fishing mortality if ICCAT wants to improve the status of the stock. SCRS noted reductions in fleet capacity and effective effort could provide the most direct benefit to the stock. At the 2005 ICCAT annual meeting, the Commission adopted a recommendation regarding shortfin mako sharks; but the recommendation does nothing more than press parties that have not yet implemented the 2004 ICCAT shark measure with respect to shortfin mako sharks to implement the measure and submit a report to the Commission. With regard to the 5 percent fin-to-carcass ratio, the SCRS concluded this ratio is not inappropriate with respect to mixed species shark fisheries that keep the primary fin set (first dorsal, two pectoral, and lower lobe of the caudal fin). The fin-to-carcass ratios are, however, highly variable depending on the species, fin set used, and fin cutting techniques. Other variables relate to how sharks are dressed and whether fins are dried on board. SCRS recommended that conversion factors between fins and body weights be developed and implemented on a species-specific and/or fleet-specific basis. The Commission did not consider alterations to the 5 percent fin-to-carcass ratio at its 2005 meeting.

In 2006, ICCAT adopted an edited version of its 2005 measure that strengthened the wording on data requirements. It was also agreed that there should be an SCRS data preparation workshop for sharks in 2007, since ICCAT will assess shortfin mako and blue sharks in 2008. The United States is hopeful that new tagging data that will be available for the 2008 assessment will improve accuracy and data confidence.

Western and Central Pacific Fisheries Commission (WCPFC)

At its third regular session in Apia, Samoa (December 11–15, 2006), the WCPFC adopted Conservation and Management Measure 2006-05 calling on Commission Members, Cooperating non-Members, and participating Territories (CCMs) to implement the FAO IPOA for the Conservation and Management of Sharks.

CCMs are to advise the WCPFC annually on their implementation of the IPOA for Sharks, including, as appropriate, results of their assessment of the need for a National Plan of Action and/or the status of their National Plans of Action for the Conservation and Management of Sharks. Each CCM must include key shark species, to be identified by the Scientific Committee, in their annual reporting to the WCPFC of annual catches and catch and fishing effort statistics by gear type, including available historical data, in accordance with the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (Convention) and agreed reporting procedures. WCPFC shall consider appropriate assistance to developing CCMs for the implementation of the IPOA and collection of data on shark catches.

The resolution also calls on CCMs to take measures necessary to require that their fishers fully utilize any retained catches of sharks. Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing or transshipment. CCMs must require their vessels to have on board fins that total no more than 5 percent of the weight of sharks onboard, up to the first point of landing. CCMs that currently do not require fins and carcasses to be offloaded together at the point of first landing must take the necessary measures to ensure compliance with the 5 percent ratio through certification, monitoring by an observer, or other appropriate measures. CCMs may alternatively require that their vessels land sharks with fins attached to the carcass or that fins not be landed without the corresponding carcass. The specification of the 5 percent ratio of fin weight to shark weight shall be reviewed by the Scientific Committee in 2007 (and occasionally thereafter) and the Scientific Committee will recommend any appropriate revisions to the WCPFC for its consideration. CCMs shall take measures necessary to prohibit fishing vessels from retaining on board, transshiping, landing, or trading any fins harvested in contravention of this conservation and management measure. In fisheries for tunas and tuna-like species that are not directed at sharks, CCMs shall take measures to encourage the release of live sharks that are caught incidentally and are not used for food or other purpose. CCMs shall advise the WCPFC annually on the implementation of this conservation measure and any alternative measures.

On the basis of advice from the Scientific Committee, the Technical and Compliance Committee and the WCPFC, CCMs shall review the implementation and effectiveness of this measure, and any alternative measures applied and shall consider the application of additional measures for the management of shark stocks in the Convention Area, as appropriate. CCMs are encouraged to cooperate in the development of stock assessments for key shark species within the Convention Area. This decision applies to sharks caught in association with fisheries managed under the Convention, and to sharks listed in Annex 1 of the 1982 Convention occurring in the Convention Area. At the initial stage, the measures described above apply to vessels greater than 24m overall length. The measures enter into force on January 1, 2008, and in the interim shall be applied as a resolution.

4.3 Multilateral Efforts

The U.S. Government continued work within other multilateral fora to facilitate shark research, monitoring, and management initiatives, as appropriate. Table 4.3.1 lists these multilateral fora. Of the list in Table 4.3.1, the activities or planning of three organizations are discussed below as a supplement to last year's report to Congress.

Table 4.3.1 Other Multilateral Fora.

Other Multilateral Fora
• Food and Agriculture Organization of the United Nations (FAO) Committee on Fisheries (COFI)
• International Union for Conservation of Nature and Natural Resources (IUCN)
• Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
• World Summit on Sustainable Development (WSSD)
• United Nations General Assembly (UNGA)

Food and Agriculture Organization of the United Nations (FAO) Committee on Fisheries (COFI)

In December 2005, a representative from NMFS attended the FAO Expert Consultation to Review Implementation of the IPOA for Sharks at National Levels. The major conclusions/recommendations from this meeting were that the IPOA should continue. Recommendations of the Consultation include the following: countries with expertise in the management of elasmobranch fisheries may take the initiative by offering assistance to countries that lack this expertise; appropriate international funding organizations (e.g., The Global Environmental Facility) could be formally approached by FAO to help developing countries get funding to aid in implementation; more coordination and involvement should be undertaken by Regional Fishery Management Organizations; and FAO should hire a person specifically to assist countries in implementation. A report on the proceedings from this meeting was produced in early 2006. It is now available on the FAO website at: ftp://ftp.fao.org/docrep/fao/009/a0523e/a0523e00.pdf. The recommendations of this expert consultation will be considered at the 2008 COFI Meeting.

At the time of the writing of this report, the following countries have developed National Plans of Action for the Conservation and Management of Sharks: Australia, Canada, Ecuador, Japan, Malaysia, Mexico, Taiwan, United Kingdom, and the United States.

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)

Although CITES did not meet during 2006, the CITES Animals Committee continued to work on sharks to identify key shark species threatened by international trade and examined those sharks for consideration and possible listing under CITES. The Animals Committee also continued work to: 1) review the use of commodity codes used for international trade in sharks;

2) examine and report on linkages between the trade in shark fins and meat and Illegal, Unreported and Unregulated (IUU) shark fishing activities, including the main species of shark taken by IUU fishing and the relative importance of fins compared to meat in trade arising from IUU fishing; and 3) make species-specific recommendations at meetings of the Conferences of the Parties aimed at improving the conservation status of sharks and the regulation of international trade in these species. The Conservation of Parties will meet again in 2008.

United Nations General Assembly (UNGA)

In December 2005, the UNGA adopted by consensus a resolution on Oceans and the Law of the Sea: "Sustainable Fisheries, including through the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments." The resolution, strongly supported by the United States, recognizes the importance and vulnerability of sharks and the need for measures to promote long-term sustainability of shark populations and fisheries. It confirms the role of relevant regional and subregional fisheries management organizations and arrangements in the conservation and management of sharks and encourages the implementation of the FAO IPOA for Sharks. It further encourages the international community to increase the capacity of developing states to implement the FAO IPOA for Sharks.

Although the UNGA did not adopt any new measures relating to conservation and management of sharks in its 2006 fisheries resolution, the United States has engaged in an internal process to consider the development of language on shark conservation and management for proposal during negotiations of 2007 UNGA Fisheries Resolution text. This language will likely call for increased attention to shark conservation and management (including issues relating to finning, data collection, assessment, and trade in shark products) at the national level, within regional fishery management organizations, and in other appropriate multilateral fora. The goal of this language will be to support and enhance the work envisioned by the FAO IPOA for Sharks and to chart an integrated approach to shark conservation and management. Ultimately, prohibiting shark finning is just one component of a broad suite of measures that will be necessary to achieve the long-term sustainability of shark populations.

A shortfin mako shark being leadered into the tagging cradle during the SWFSC juvenile shark abundance survey.
Source: Rachel Graham/NMFS Photo

5. NMFS Research on Sharks

5.1 Data Collection and Quality Control, Biological Research, and Stock Assessments

Pacific Islands Fisheries Science Center (PIFSC)

Fishery Data Collection

Market data from the PIFSC shoreside sampling program contains detailed biological and economic information on sharks in the Hawaii-based longline fishery dating from 1987. These data are primarily collected from fish dealers who are required to submit sales/transaction data to the State of Hawaii. The Western Pacific Fishery Information Network (WPacFIN) is a federal–state partnership collecting, processing, analyzing, sharing, and managing fisheries data on sharks and other species from American island territories and states in the Western Pacific. The WPacFIN program has also assisted other U.S. islands' fisheries agencies in American Samoa, Guam, and the Northern Mariana Islands to modify their data collecting procedures to collect bycatch information. These modifications have improved the documentation of shark interactions with fishing gear. Shark catches in the Hawaii-based longline fishery have been monitored by a logbook program since 1990, and by an observer program since 1994.

Biometrical Research on Catch Statistics

Funding for further biometrical research on shark bycatch issues has been received through the Pelagic Fisheries Research Program (University of Hawaii). This work will use information from all three fishery data collection programs (market, logbook, and observer) to improve our understanding of shark catches in the Hawaii-based longline fishery. New analyses of shark catches will draw upon earlier published studies regarding blue shark and blue marlin (Walsh and Kleiber 2001; Walsh et al. 2002; Walsh et al. 2005) for methodology. These analyses will assess both true bycatch (i.e., discarded and without economic value) and incidental catch (i.e., retained, non-target species with economic value) of sharks in this fishery. One concern in this study is several regulatory changes have been instituted in this fishery in recent years. Because shark catches include both true bycatch and incidentally caught species, changes in the logbook reporting behavior of fishermen may have stemmed from the regulatory changes and can be identified and described. The expectation is bycatch reporting could become less accurate after regulatory changes, whereas reporting of incidentally caught species can be checked against market sales records and would remain largely unaffected. Another objective of the project is to use the fishery observer catch data to investigate the condition and fate of the catch. Observers record the number of retained catch and discards that come up dead during longline haulback. Preliminary results indicate that all of the species taken in substantial numbers by this fishery, especially blue shark (*Prionace glauca*), exhibit a high rate of survival (about 90 percent) up to the time of retrieval of the fishing gear at the boat. Although this obviously does not reveal any subsequent effects, it suggests that this fishery may cause relatively low rates of shark mortality.

Insular Shark Surveys

Densities of insular sharks (Table 5.1.1) have been estimated at most of the U.S. island possessions within the Tropical Central, Northern, and Equatorial Pacific on annual or biennial surveys conducted by the Coral Reef Ecosystem Division since 2000.

These estimates include surveys of:

- 10 major shallow reefs in the Northwestern Hawaiian Islands (2000, 2001, 2002, 2003, 2004, 2006).
- The Main Hawaiian Islands (2005, 2006).
- The Pacific Remote Island Areas of Howland and Baker in the U.S. Phoenix Islands and Jarvis Island, and Palmyra and Kingman Atolls in the U.S. Line Islands (2000, 2001, 2002, 2004, 2006).
- American Samoa including Rose Atoll and Swains Island (2002, 2004, 2006).
- Similar surveys at Guam, and the Commonwealth of the Northern Marianas Islands (2003, 2005, 2007), Johnston Atoll (2004, 2006), and at Wake Atoll (2005, 2007).

To date, these surveys suggest sharks appear to be relatively abundant at most reefs in the Northwestern Hawaiian Islands (NWHI) and Pacific Remote Island Areas, but are noticeably sparse and/or small-bodied at most reefs in the Main Hawaiian Islands (MHI), American Samoa, and Marianas Archipelago, especially in the southern islands.

One significant result to date has been the contrast in densities of sharks and other large-bodied apex predator fishes between the largely unfished NWHI and the heavily fished MHI. Surveys conducted in the NWHI and MHI during 2000 encountered apex predator stocks averaging 100-fold less dense in the MHI than in the NWHI (Friedlander and DeMartini 2002). Observations made from 2001 to 2006 have generally affirmed the greater abundances of sharks and other apex predators in the NWHI relative to the MHI (Holzwarth et al. 2006; Coral Reef Ecosystem Division unpublished data). Similarly, in surveys around 20 islands/shoals of the Marianas Archipelago, sharks were found to be at least an order of magnitude less dense around the southern inhabited islands (e.g., Guam and Saipan), compared to the remote northernmost islands (Schroeder et al. 2006).

Table 5.1.1 Shark species observed in PIFSC Resource Assessment and Monitoring Program surveys around U.S. Pacific Islands.

Shark species observed		
Common Name	Species	Family
Gray reef shark	*Carcharhinus amblyrhynchos*	Carcharhinidae
Silvertip shark	*Carcharhinus albimarginatus*	Carcharhinidae
Galapagos shark	*Carcharhinus galapagensis*	Carcharhinidae
Blacktip reef shark	*Carcharhinus melanopterus*	Carcharhinidae
Tiger shark	*Galeocerdo cuvier*	Carcharhinidae
Whitetip reef shark	*Triaenodon obesus*	Carcharhinidae
Tawny nurse shark	*Nebrius ferrugineus*	Ginglymostomatidae
Whale shark	*Rhincodon typus*	Rhincodontidae
Scalloped hammerhead shark	*Sphyrna lewini*	Sphyrnidae
Great hammerhead shark	*Sphyrna mokarran*	Sphyrnidae
Zebra shark	*Stegostoma varium*	Stegostomatidae

Selective Removal of Large Sharks to Reduce Monk Seal Mortality

Galapagos shark predation has become the dominant mortality source for nursing and recently weaned endangered Hawaiian monk seal pups at French Frigate Shoals, the most important breeding site in the NWHI. Intense predation by a relatively small number of sharks (~ 20) on preweaned pups was first detected in the late 1990s, when 18-28 mortalities were documented each year from 1997 to 1999. This equated to 38 to 69 percent of the annual cohort. Subsequent mitigation efforts resulted in the removal of 12 sharks known to be preying on monk seal pups and the ensuing predation losses dropped to 8 to 12 pups from 2000 to 2006. Sharks were removed using a combination of shore-based handline fishing, boat fishing, and hand-held harpoon. In addition to the shark removal work, there have been parallel research efforts to learn more about shark behavior and abundance (sonic tag tracking), and explore possible ways of deterring sharks from pups (e.g., chemical deterrents or physical barriers). Recently, sharks have become progressively more wary and are now conducting their predation at times when they are least likely to encounter humans. Most predation occurred at Trig Island, but it increased at other sites over time and we attribute these results in part to shark displacement away from Trig Island due to 7 years of intense fishing effort during the monk seal pupping season in late spring and summer. The decision framework for implementing the shark removal experiment was evaluated in terms of expected costs and benefits (to both monk seals and sharks), uncertainties in the predation data, and concerns about the acceptability of a removal project within a refuge. Given the declining status of endangered monk seals and the probable minimal effect of the shark removals, we concluded available data were sufficient to support the removal experiment.

Stock Assessment of Pelagic Sharks

Work was initiated in 2000 as a collaborative effort with scientists at the National Research Institute for Far Seas Fisheries (NRIFSF). A report was produced (Kleiber et al. 2001) but was not published in the peer-reviewed literature. The 2001 report indicated the blue shark stock was not being overfished. PIFSC and NRIFSF scientists have renewed this collaboration, along with scientists from the Joint Institute of Marine and Atmospheric Research at the University of Hawaii, the Imperial College of London, and the Fisheries Research Agency (Japan) to update the blue shark assessment with the latest Japanese and Hawaiian longline fishery data, as well as with better estimates of Taiwanese and Korean catch and effort data.

Blue sharks in the North Pacific were selected as the study population because of the relatively wide availability of data, the purported separation of northern and southern hemisphere stocks, and the documented high catch and finning rates. Before 1993, sharks were not recorded by species in the Japan logbook data. Since blue sharks make up the vast majority of the shark catch, earlier data were assumed to pertain to blue sharks. Because this assumption is not applicable to other shark species, no useful time series of data exists for those species. Investigation of the status of other shark species may require creative modeling approaches and the use of such models to design tagging programs and other research to test model assumptions and predictions.

Objectives were to determine the degree to which the blue shark population has been affected by fishing activity and whether current fishing practices need to be managed to ensure continued viability and utilization of the resource. In addition to re-estimating catch and effort data based on a longer time series of data, this study incorporates several new features: 1) effort data has been obtained from the Fisheries Administration of Taiwan; 2) catches for the Japanese inshore longline fleet have been included; 3) catch estimates have been contrasted with estimates from the shark fin trade; 4) catch per unit effort has been standardized using both a generalized linear model and a statistical habitat model; and 5) two different stock assessment models have been applied. The two models, a surplus production model and an integrated age and spatially structured model, represent opposite ends of the spectrum in terms of data needs and the results show the production model to be in general agreement with the bulk of evidence from the integrated model. However, it must be acknowledged that one of the several alternate analyses indicates that the population is overfished and another indicates that overfishing is occurring as well. Furthermore, the end of the time series available is several years previous to current time, and in that interval the effort expended by longline and other fishing vessels has continued to rise. It would be prudent to assume that the population is at least close to being overfished and fishing mortality is at least close to the overfishing level. The uncertainty could well be reduced by a vigorous campaign of tagging and by continuous, faithful reporting of catches and details of fishing gear.

Southwest Fisheries Science Center (SWFSC)

Juvenile Shark Survey

The Southern California Bight is home to a number of pelagic shark species and a known nursery area for shortfin mako (*Isurus oxyrinchus*) and blue (*Prionace glauca*) sharks. The SWFSC has been monitoring the relative abundance of juvenile mako and blue sharks since 1994 using a fishery independent longline survey. The annual survey was conducted during June and July, 2006. One to three fishing sets were completed daily. A total of 5,733 hooks were fished at 28 sampling stations. Catch included 90 shortfin mako, 272 blue, and two common thresher sharks (*Alopias vulpinus*), 23 pelagic rays (*Pteroplatytrygon violacea)*, 3 ocean sunfish (*Mola mola)* and one lancet fish (*Alepisaurus brevirostris)*. The preliminary data indicate the overall catch rate was 0.445 per 100 hook-hours for makos and 1.35 per 100 hook-hours for blue sharks. The catch per-unit effort (CPUE) for both blue and mako sharks was higher in 2006 than in the previous two years (Table 5.1.2), however there has been a small but significant decrease for both species over the 13 year history of the survey.

Table 5.1.2 Catch per unit effort of sharks caught on the juvenile shark survey.

Catch per unit effort of sharks caught on the juvenile shark survey (units are per 100 hook-hours)			
Species	2004	2005	2006
Shortfin mko *Isurus oxyrinchus*	0.399 per 100 hook-hours	0.369 per 100 hook-hours	0.445 per 100 hook-hours
Blue shark *Prionace glauca*	0.499 per 100 hook-hours	0.443 per 100 hook-hours	1.350 per 100 hook-hours

In conjunction with the fisheries independent survey, additional studies were also conducted during the 2006 cruise. To obtain more detailed information on movements and define the habitat of Pacific sharks, satellite tags were deployed on the three shark species in collaboration with the Tagging of Pacific Pelagics project. Satellite pop-up tags and satellite-linked radio transmitter tags were deployed on 12 mako sharks, two blue sharks, and one thresher shark. Of the 12 tags deployed on mako sharks, four were still transmitting in May 2007 after 10 months. The data collected from the mako sharks reveal that they tend to remain near the coast off California and Baja California Mexico (www.toppcensus.org). Additional studies with mako sharks focused on stock structure, movements and age and growth. Most mako sharks caught were tagged with conventional tags, marked with oxytetracyline (OTC) for age validation and growth studies, and DNA samples were taken.

Essential Fish Habitat (EFH) and Pup Abundance Survey of Common Thresher Sharks

Like many other sharks, the pups of the common thresher are found in near-shore waters of the Southern California Bight. Such waters are Essential Fish Habitat (EFH) for this shark species, but the extent of this habitat is poorly defined. In 2003, the SWFSC began a survey to: 1) determine the continuity of thresher pup distribution along the coast of the Southern California Bight; and 2) develop a pup abundance index. In September 2006, the fourth year of sampling took place in inshore waters out to 25 fathoms from Point Conception south to San Diego, California. Fifty nearshore longline sets were conducted with a total of 4,950 hooks fished. Overall, 266 common threshers and 2 shortfin mako sharks were caught. The catch also included 19 soupfin sharks and small numbers of other nearshore teleosts[6] and elasmobranchs. Roughly 60 percent of the thresher sharks caught were young-of-the-year. The majority of sharks were tagged with conventional tags and OTC for age validation studies, DNA sampled, and then released. Seven of the larger thresher sharks were tagged with satellite tags. Six of seven tags deployed in September 2006 popped up in the southern California Bight after 8 months

[6] Teleosts are a division of the class Actinopterygii. Teleosts account for 95 percent of all living fishes and are the most advanced of the bony fishes.

Movements of the common thresher shark obtained from satellite tags were described in a University of San Diego Master's thesis (Baquero Gallegos 2006). Compared to the mako and blue sharks, the threshers spent most of their time in near-shore waters. An analysis of diving behavior indicates a diurnal pattern of diving during the day and staying closer to the surface at night. These were the first detailed movement data from common thresher sharks in this area and, along with the survey data, will help define the common thresher shark's EFH. Currently the SWFSC Fisheries Resources Division is collaborating with Drs. Jeffrey Graham of Scripps Institution of Oceanography and Oscar Sosa-Nishizaki of Centro de Investigación Científica y de Educación Superior de Ensenada to examine the movements, essential habitat and fisheries for thresher sharks off Baja California, Mexico.

Shark Feeding Habits

Recent studies into shark feeding habits have focused on a comparison of blue, shortfin mako, common thresher and bigeye thresher (*Alopias superciliosus*) shark diets. These species co-occur in California Current waters off California, Oregon, and Washington although the bigeye thresher has been found only as far north as Cape Blanco, Oregon. By the end of 2006, 333 stomachs had been examined and distinct differences among the four shark species are apparent. For mako sharks, jumbo squid (*Dosidicus gigas*) and Pacific saury (*Cololabis saira*) were the two most important prey items. For blue shark, cephalopods of the *Argonauta* spp. and *Gonatus* spp. were the most important prey items. For thresher sharks, Pacific sardine (*Sardinops sagax*) and northern anchovy (*Engraulis mordax*) were the two most important prey items. For bigeye thresher, Barracudinas (family Paralepididae) and Pacific hake (*Merluccius productus*) were the most important prey items. Comparing the first 12 prey items ranked by Geometric Index of Importance demonstrates that mako sharks fed on a combination of different teleosts and cephalopods, blue sharks fed primarily on squid, common threshers consumed mostly coastal pelagic teleosts and bigeye threshers fed on deep scattering layer, demersal and also pelagic species. Analyses are ongoing of interannual differences and the influence of both prey availability and prevailing oceanographic conditions.

Trophic Status of the Common Thresher and Shortfin Mako Shark Inferred from Stable Isotope Analysis

While the common thresher and shortfin mako shark are suspected of undergoing shifts in diet during development, there is little quantitative evidence to support this. Stomach content analyses of these two shark species are ongoing; however that type of analysis provides only a snapshot of foraging unless sampling is exhaustive in time and space and sample sizes are large. In contrast, stable isotope[7] analysis gives an integrated view of foraging over time and provides an important complement to stomach content analysis. In brief, the nitrogen (N) isotope ratio ($^{15}N/^{14}N$) changes by a predictable amount at each increase in trophic level as a result of metabolic processes. Thus, if you can measure the difference in $^{15}N/^{14}N$ between the base of the food web and the predator being studied, you can estimate the trophic[8] level of the predator. In contrast, the carbon (C) isotope ratio ($^{13}C/^{12}C$) changes very little as trophic level increases and

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[7] Isotopes are any of the several different forms of an element each having different atomic mass. For example, most carbon in nature is present as ^{12}C, with approximately 1 percent being ^{13}C. Stable isotopes are isotopes that do not degrade measurably over the lifetime of an animal.

[8] The higher the trophic level, the higher the organism is on the food chain. Trophic levels typically range from 1 to 5.

maintains a ratio similar to the original carbon source. Thus C isotope ratios provide insight into the carbon source at the base of the food web.

To date, the isotope ratios in muscle and liver of over 30 animals of each species have been characterized over a broad size range. The common thresher soft tissues showed a linear increase in $\delta^{15}N$ ($^{15}N/^{14}N$) with increasing size (from 65 to 201 cm fork length[9]) suggesting a gradual trophic increase from 3.0 to 4.3 with ontogeny[10]. (Note that the symbol "δ" refers to the difference between the isotope value in a measured sample and that in a standard sample, as a percent.) An observed enrichment of muscle $\delta^{15}N$ in comparison to liver suggests that there may be a seasonal shift in diet. The low variability in the common thresher $\delta^{13}C$ ($^{13}C/^{12}C$) indicates limited individual variability in their diet. $\delta^{13}C$ gives some insight into the source of carbon (energy flow) or food web dynamics but can be confounded by lipids and other unknown biotic factors.

The results for the shortfin mako, in contrast, did not show a clear increase in $\delta^{15}N$ with increasing size. This suggests that there is not an ontogenetic shift in trophic level over a size range from 77 to 317 cm fork length. Trophic levels for the mako sharks ranged from 3.4 to 4.8. Similar to the thresher sharks, the muscle tissue $\delta^{15}N$ was enriched relative to the liver in smaller sharks although the reverse was true for all females greater than 250 cm fork length, the approximate size at sexual maturity. This could be due to seasonal shifts in diet or changes in the physiology as females mature. The high variability in the shortfin mako $\delta^{13}C$ suggests a more opportunistic diet with more individual variability.

Population Structure of the Shortfin Mako

The shortfin mako is a wide-ranging pelagic shark caught globally in temperate and tropical waters. The stock structure within their broad range is poorly understood, especially in the Pacific. In the North Atlantic, thousands of conventional tags have been deployed, and although 608 have been returned, not a single shark was recaptured south of 10°N. This suggests at a minimum, a northern and southern stock. Although the more limited conventional tag returns in the Pacific reveal movement across the North Pacific from California to as far as Japan, the potential for separation between the North and South Pacific is not known. A study is being conducted using mitochondrial DNA analyses from samples gathered around the Pacific to test the hypothesis that shortfin makos from the North and South Pacific are genetically distinct. In addition, this study will examine whether female makos are philopatric[11] as seen in some other shark species.

To date, 153 samples from four sites in the Pacific (southern California, Hawaii, New Zealand, and Australia) have been analyzed. Preliminary analysis reveals that genetic divergence increases with geographic distance. Sharks in locations in closest proximity, California/Hawaii and Australia/New Zealand, show no population subdivision. This is in contrast to the locations at the greatest distance where divergence is apparent. Sharks in Australia and New Zealand are both genetically distinct from California and Hawaii. As shark populations continue to decline, a

[9] Fork length is a measurement used frequently for fish length when the tail has a fork shape. It is the projected straight distance between the tip of the snout and the fork of the tail.
[10] Ontogeny refers to the development of an organism.
[11] A migratory animal that returns to a specific location in order to breed or feed.

better understanding of stock structure is critical to developing accurate stock assessments and ensuring effective management of this species.

Blue Shark Dynamics in the U.S. Pacific Coast EEZ

Blue shark CPUE in the California and Oregon drift gillnet fishery for swordfish is being examined to develop a model of preferred habitat based on catch statistics and environmental data. The capture rate of blue sharks in the fishery is typically second highest after the ocean sunfish (*Mola mola*), yet their meat is not marketable in the U.S. Historically, one targeted swordfish was caught for every 1.1 blue sharks, although blue sharks have been caught in lower numbers in recent years. Determining the spatial and temporal distribution of these sharks with respect to remotely measured environmental variables such as sea surface temperature may enable fisheries managers to apply appropriate measures to limit their bycatch. To standardize blue shark CPUE and examine how CPUE varies spatially and temporally, a generalized additive model is being developed. Preliminary results suggest that the CPUE has remained steady for the study period (1990-2005). In addition, it looks like the blue sharks in the eastern Pacific U.S. EEZ follow a proposed latitudinal migration pattern with individuals segregating by sex and age class; smaller individuals are caught in greater numbers in the northern areas of the fishery, and males appear to have a more southern distribution than females.

Mako and Thresher Ageing

Age and growth of mako and thresher sharks are being analyzed by ring formation in recaptured animals with OTC-marked vertebrae. Since the beginning of the program in 1997, a total of 948 sharks have been marked with OTC and released during the juvenile shark surveys for both species. Of these, 50 mako and 12 common threshers have been recaptured. Recaptures are critical to the validation of the age-length relationship determined using ring formation in vertebrae. Accurate ageing is essential for understanding a shark’s productivity and resilience to exploitation as well as to stock assessments.

Preliminary results from shortfin mako vertebrae indicate juvenile and sub-adults lay down two bands of unequal size each year; however, as they mature and move offshore, the calcification pattern in the vertebrae appears to change with hyaline and calcified zones becoming narrower and more equal in relative size. This is an extremely important finding, because the examination of whether the shortfin mako lays down one band or two bands per year has been ongoing for several years, with independent labs reporting conflicting results.

Thresher shark vertebrae are also being aged at the SWFSC using both OTC validation and X-radiography techniques. The purpose is to expand and refine previous thresher shark ageing studies using a larger sample size from the driftnet fishery with accompanying information on sex and maturity stage. Preliminary results from common thresher sharks indicate that they lay down one band per year.

Bioaccumulation of Mercury in the Common Thresher and Shortfin Mako Shark

As apex predators, the common thresher and shortfin mako sharks have the potential to bioaccumulate high concentrations of methyl mercury in their tissues. Despite the potential human health risk, there are no comprehensive published studies of the mercury levels in these fish. A 1991 preliminary study in Hawaii found mean mercury levels in both shortfin mako

(1.32 parts per million (ppm)) and pelagic (*Alopias pelagicus*) and bigeye thresher sharks (mean = 1.02 ppm) to be higher than the 1.0 ppm recommended by the U.S. Food and Drug Administration (FDA) and Environmental Protection Agency (EPA). The SWFSC has been conducting a study on bioaccumulation of mercury with size and sex for the shortfin mako and common thresher shark in the eastern North Pacific as well.

The muscle tissue from 38 common thresher and 33 mako sharks were analyzed for methyl mercury (Hg) concentrations. For both species a relatively large size range was sampled allowing for examination of ontogenetic effects [Thresher 63-241 cm fork length; shortfin mako 75-330 cm fork length]. All of the common thresher muscle sampled in this study, regardless of size, had total Hg levels below the US FDA/EPA recommended limit of 1.00 ppm for human consumption (average = 0.13 ppm). A similar result was found for shortfin mako sharks of 160 cm fork length or less, with the exception of one (mean = 0.47 ppm, standard deviation (sd) = 0.24 ppm, sample size (n) = 21). In contrast, all shortfin makos greater than 160 cm fork length had muscle Hg levels exceeding this 1.00 ppm threshold (mean = 2.14 ppm, sd = 0.46 ppm, n = 13).

This study is the first to establish the ontogenetic relationship between Hg and size for both of these apex predators and the difference likely reflects differences in ecology and physiology. We conclude that there is little cause for concern of the human consumption of common threshers and juvenile shortfin makos of sizes predominantly taken in the U.S. west coast drift gillnet fishery.

Harvest Guidelines for West Coast Common Thresher and Shortfin Mako Sharks
The PFMC, based on analyses conducted by SWFSC scientists, has imposed precautionary harvest guidelines of 340 and 150 metric tons (round weight) for common thresher and shortfin mako, respectively. The Council's HMS advisory bodies, SWFSC scientists and Southwest Regional Office (SWRO) staff are trying to get a better handle on the thresher and mako shark recreational catch, which has been increasing in recent years, to determine whether a change in the harvest guidelines is necessary. Recreational catch of sharks is not well monitored under the current recreational fishing surveys. Regulations in place limit recreational anglers to two thresher and two mako sharks per day. Working with scientists of the Pfleger Institute of Environmental Research, SWFSC and SWRO staff are developing guidelines for responsible catch and release of recreationally caught sharks and a plan to survey fishing clubs and monitor tournament catch of pelagic sharks.

<u>Northwest Fisheries Science Center (NWFSC)</u>

Monitoring and assessment activities
The NWFSC conducts and supports several activities addressing the monitoring and assessment of sharks along the West Coast of the United States and in Puget Sound. The Pacific Fishery Information Network serves as a clearinghouse for commercial landings data, including sharks. In addition, the At-Sea Hake and West Coast Groundfish Observer Programs collect data on shark species caught on vessels selected for observer coverage.

The NWFSC conducts annual trawl surveys of the West Coast, designed primarily to acquire abundance data for West Coast groundfish stocks. The tonnages of all shark species collected during these surveys are documented. In addition, the survey program has conducted numerous special projects in recent years to help researchers acquire data and samples necessary for research on various shark species. Since 2002, the survey has collected biological data and tissue samples from spiny dogfish, including dorsal spines, which can be used to age the fish. Biological data and tissue samples were also collected from leopard sharks and cat sharks during the bottom trawl surveys.

In addition to these monitoring activities, the NWFSC is assessing for the first time the population status of longnose skate. This assessment is under way and will be presented and reviewed during the 2007 stock assessment review (STAR) process. The NWFSC coordinates the STAR panel review process for all such groundfish stock assessments provided as scientific advice to the PFMC.

Movement studies

The NWFSC, in collaboration with Washington Department of Fish and Wildlife and the Seattle Aquarium, has been estimating movement parameters of sixgill and sevengill sharks in Puget Sound and Willipa Bay. Vemco ultrasonic tags were surgically implanted into the body cavity of each shark and released fish at their capture site. Automated listening stations were used to detect fish tagged with ultrasonic transmitters, thus allowing shark movement to be monitored. In addition, movement was monitored with active, boat-based tracking. These data have allowed estimation of movement parameters (e.g., move length and turning angles) that allow home ranges to be estimated; daily, seasonal, and interannual movements to be described; and important habitats to be quantified. Also, models based on habitat-specific movement parameters allow for inference of relative abundance in different habitats. In addition, upon capture, biological data (e.g., genetic samples, blood samples, gut contents, and length/weight) are collected and used by Washington Department of Fish and Wildlife to support management of these species.

Alaska Fishery Science Center (AKFSC)

Shark Research and Assessments

Research efforts at the Alaska Fishery Science Center's Auke Bay Laboratory are focused on:

1. Collection of data to support stock assessments of shark species subject to incidental harvest in Alaskan waters.
2. Pacific sleeper shark predation of Steller sea lions.
3. Movement and diet of salmon sharks.
4. Tagging of Pacific sleeper sharks in Southeast Alaska.
5. Collaborative research with the University of Alaska and the University of Washington to investigate the population dynamics, life history, and ecological role of spiny dogfish in the Gulf of Alaska.

Stock Assessments of Shark Species Subject to Incidental Harvest in Alaskan Waters

Species currently assessed include Pacific sleeper sharks (*Somniosus pacificus*), spiny dogfish (*Squalus acanthias*), and salmon sharks (*Lamna ditropis*), which are the shark species most commonly encountered as bycatch in Alaskan waters. Stock assessment is currently limited to analysis of commercial bycatch relative to biomass estimated from NMFS fishery-independent bottom trawl surveys in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands. Stock assessments are summarized annually in an appendix to the NPFMC Stock Assessment and Fishery Evaluation Report available online (for example, see Courtney et al. 2006a and 2006b).

Pacific Sleeper Shark Predation of Steller Sea Lions

In August 2001 and May 2002, Auke Bay Laboratory scientists investigated the diet of Pacific sleeper sharks to test the hypothesis that sleeper sharks prey on Steller sea lions (*Eumetopia jubatus*). Scientists collected 198 stomach samples and found predominant prey items to be walleye pollock, octopus, unidentified teleost fish, Pacific salmon, and marine mammal tissue appearing to be from cetaceans. Stomach content analysis found no direct evidence of sea lion predation. In addition to the diet study, data on the vertical and geographic movement of sleeper sharks were collected by tagging for comparison with the vertical distribution of Steller sea lions. Thirty-three sleeper sharks were tagged with archival satellite tags designed to transmit depth data and location to polar orbiting Argos satellites. Data from 25 satellite tags have been recovered. Based on tag endpoint locations, the sharks typically moved less than 100 kilometers from the release locations. Archived depth data showed some sleeper sharks regularly traversed depths at rates of over 200 meters per hour and sometimes came to the surface at night. Two manuscripts have resulted from this study: Hulbert et al. (2006) and Sigler et al. (2006).

Tagging of Pacific Sleeper Sharks in Southeast Alaska

During the summers of 2003–2006, scientists from the Auke Bay Laboratory deployed 91 electronic archival tags, 24 acoustic tags, and 10 satellite popup tags on Pacific sleeper sharks in the upper Chatham Strait region of Southeast Alaska. Eight satellite tags have been recovered. The recovery of temperature, depth, and movement data from the electronic archival and acoustic tags will aid in the identification of Pacific sleeper shark habitat utilization and distribution in Southeast Alaska, and identify the potential for interactions between Pacific sleeper sharks and other species in this region.

Collaborative Research of Spiny Dogfish in the Gulf of Alaska

The Auke Bay Laboratory has collaborated with the Juneau Center of the University of Alaska Fairbanks School of Fisheries and Ocean Sciences and with the University of Washington during 2004–2007 to investigate the population dynamics, life history, and ecological role of spiny dogfish in the Gulf of Alaska. As part of this study, Auke Bay Laboratory scientists deployed 100 electronic archival tags, 617 numerical tags, and one satellite popup tag on spiny dogfish in Yakutat Bay, Alaska. One satellite tag and one archival tag have been recovered. Data from tag recoveries will provide insights into the seasonal residency and movement patterns of spiny dogfish in Yakutat Bay and the northeast Pacific Ocean. The Auke Bay Laboratory has also provided shark bycatch data, biomass estimates, field and technical support, and a graduate student committee member in support of graduate student research. Results from graduate student research will be incorporated into annual stock assessments.

Northeast Fisheries Science Center (NEFSC)

Fishery Independent Surveys for Coastal and Pelagic Sharks

NMFS and its predecessor agencies, the Bureau of Commercial Fisheries and the Bureau of Sport Fish and Wildlife, had conducted periodic longline surveys for swordfish, tunas, and sharks off the east coast of the United States since the early 1950's. Surveys first targeted tunas and swordfish along the edge of the continental shelf, and subsequently focused on pelagic and coastal sharks over a variety of depths, including inshore bays and estuaries. The last large-scale pelagic fishing trip was conducted in 1985; however, the NEFSC Narragansett Laboratory completed a pilot survey in the spring of 2006 and conducted pelagic sets subsequent to a 2007 fishery independent coastal shark survey. Goals of this research are to initiate a standardized fishery independent pelagic shark survey for research collections and to monitor their abundance and distribution for management and stock assessment.

Age and Growth of Coastal and Pelagic Sharks

Validation of ageing techniques for the tiger shark (*Galeocerdo cuvier*), along with age estimates, was submitted for publication in Marine Biology. Bomb carbon results validated that one band pair was deposited annually for this species and updated growth curves were provided. Results of an ageing study on the thresher shark (*Alopias vulpinus*) have been formatted for publication providing unvalidated growth curves for this species. Ageing studies of the night shark (*Carcharhinus signatus*, with NMFS scientists at the SEFSC Panama City Laboratory) have been put on hold until more samples are collected. An age and growth study of the bull shark (*Carcharhinus leucas*, with scientists at the Florida Division of Natural Resources) is under way with samples being photographed in preparation of ageing. Results of an age and growth study on the smooth skate (in conjunction with the University of New Hampshire) will be published in Environmental Biology of Fishes in 2007. Work on ageing scalloped hammerhead (*Sphyrna lewini*) progressed with the preliminary reading of vertebrae by one reader. A manuscript on the ontogenetic changes in the vertebrae of the basking shark (*Cetorhinus maximus*) was prepared for publication. In addition, collections of vertebrae took place at tournaments and fish were OTC-injected during fishing operations on-board sport and commercial and research vessels.

Biology of the Thresher Shark

Life history studies of the thresher shark (*Alopias vulpinus*) continued with the completion of a manuscript regarding age and further collection of food habits and reproductive samples. Reproductive tissues were processed and are currently being sectioned using histological techniques[12]. Once completed, the histological results will be combined with the morphological reproductive data to determine sexual sizes at maturity for this species.

Biology of the Torpedo Ray

A life history study of the torpedo ray (*Torpedo nobiliana*) continued with data collection and sampling for age and growth, reproduction, and food habits. Reproductive tissues were processed and sectioned using histological techniques. Vertebrae were also processed using histology and are currently being sectioned. This research is part of a University of Rhode Island graduate student's master's thesis.

[12] Histology is the study of tissue that has been sectioned as a thin slice. Thin slices of tissue are applied to a microscopic slide and viewed under a microscope.

Collection of Recreational Shark Fishing Data and Samples
Biological samples for age and growth, feeding ecology, and reproductive studies and catch data for pelagic sharks were collected at eight recreational fishing tournaments in the Northeast. This information will enhance ongoing biological studies and will be added to a long-term database of historic landings information for the period 1961–2006.

Pelagic and Coastal Shark Diet and Feeding Ecology Studies
Construction of an electronic database of diet information for pelagic and coastal shark species continued. When completed, the database will contain over 5,000 samples from 29 species of shark and 11 species of teleost fishes. The goals of this effort are to: 1) characterize the diet; 2) analyze the diet relative to biotic and abiotic factors; 3) compare diet overlap between species; 4) examine the diet for temporal changes over decades; and 4) determine gastric evacuation rates and daily rations.

NEFSC researchers in conjunction with the University of New England and Massachusetts Division of Marine Fisheries used stable isotopes to determine the trophic position of the white shark (*Carcharodon carcharias*) in marine food webs (Estrada et al. 2006). Stable ^{15}N and ^{13}C analysis demonstrated that incremental analysis of isotopes along the radius of a vertebral centrum produces a chronological record of dietary information allowing for reconstruction of an individual's trophic history. Isotopic values verified two distinct ontogenetic trophic shifts in the white shark: one following parturition (birth), and one at a total length of greater than 341 cm (when diet shifts from fish to marine mammals). This type of retrospective trophic-level reconstruction has broad applications in future studies on the ecology of shark species to determine life-long feeding patterns, which would be impossible through other methods.

Reproductive Studies
Reproductive studies on thresher sharks and torpedo rays are ongoing. In addition, an update of a reproductive study on blue sharks is ongoing to determine if there have been changes since the original 1979 study. The NEFSC is also cooperating with researchers at the University of New England on applying non-invasive techniques to determine maturity. By ground-truthing blood hormone chemistry to histological sections, organ condition and morphology data, hormone levels can be determined at the different stages of maturity. In the future, only a blood sample from each specimen may be needed to determine maturity status.

Morphometric Database
Analysis of a relational database (including nine length and multiple weight measurements) for 20 species of pelagic and coastal sharks continued. Additional data were measured for missing species and sizes.

Cooperative Shark Tagging Program
The Cooperative Shark Tagging Program provides information on distribution, movements, and EFH for shark species in U.S. Atlantic and Gulf of Mexico waters. This program involves more than 7,000 volunteer recreational and commercial fishermen, scientists, and fisheries observers since 1962. Through 2006, over 200,000 sharks of more than 50 species were tagged and 12,000 sharks of 33 species were recaptured. The review and redesign of the shark mark/recapture

database continued, including all input and auditing programs, forms, and outreach activities. Substantial progress was made on the integration of other NEFSC Cooperative Tagging Programs (black sea bass, yellowtail flounder) with the goal of a centralized tagging infrastructure for the Northeast. Online reporting of recaptures for all species was initiated. Work continued on tagging database designs to look at future system development and refinements in an attempt to support all groups and coordinate future activities.

Tiger shark (*Galeocerdo cuvier*) with a NMFS Cooperative Shark Tagging Program tag.
Source: NMFS Northeast Fisheries Science Center

Atlantic Blue Shark Life History and Assessment Studies

A collaborative program to examine the biology and population dynamics of the blue shark (*Prionace glauca)* in the North Atlantic is ongoing. A detailed reexamination of the reproductive parameters and feeding ecology of the blue shark continued with collection of additional biological samples to determine if any changes have occurred since the 1970's. Progress continued on the population dynamics study in the North Atlantic with the objectives of constructing a time series of blue shark catch rates from research surveys, estimation of blue shark migration and survival rates, and development of an integrated tagging and population dynamics model for the North Atlantic. This study—critical for use in stock assessment—is being conducted in collaboration with scientists at the School of Aquatic and Fishery Sciences, University of Washington, and has resulted in survival rate estimates for blue sharks based on tag and release data from the NMFS Cooperative Shark Tagging Program.

Atlantic Shortfin Mako Life History and Assessment Studies

Estimates of shortfin mako (*Isurus oxyrinchus*) survival rates using Cooperative Shark Tagging Program mark-recapture data were completed as part of a University of Rhode Island graduate student's Ph.D. dissertation. The overall goals of this study are to examine the biology and population dynamics of the shortfin mako in the North Atlantic.

Coastal Shark Longline Studies

Work continued on the recovery of data applicable to coastal shark analyses from research cruises occurring since the early 1960's, which could provide valuable historical perspective for evaluating the stock status of Atlantic sharks. This data recovery process is part of a larger, systematic effort to electronically recover and archive historical longline surveys and biological observations of large marine predators (swordfish, sharks, tuna, and billfish) in the North Atlantic (Hoey et al. 2005). These efforts include reconstructing the historic catch, size composition, and biological sampling data into a standardized format for time series analysis of catch rates and size to be used in future stock assessments for both species-specific and shark species complexes. In a cooperative effort with the SEFSC, standardized indices of abundance from this time series were also created for the night shark for use in a report detailing the status of the U.S. night shark population.

Cooperative efforts were directed at electronically recovering the catch rate and size frequency data from the University of North Carolina shark longline survey to be used in stock assessments for both species-specific and shark species complexes. This work was done in cooperation with University of North Carolina Professor, Dr. Frank Schwartz, who has conducted this standardized survey since 1972.

Essential Fish Habitat for NMFS HMS

NEFSC staff participated in a working group with other staff from the NMFS HMS Division and SEFSC to update and refine the EFH designations for managed shark species. This process is ongoing in 2006.

Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) Survey

Apex Predators Program staff of the NEFSC manage and coordinate this project using researchers in major coastal Atlantic states from Florida to Delaware to conduct a cooperative, comprehensive, and standardized investigation of valuable shark nursery areas. This research identifies which shark species use coastal zones as pupping and nursery grounds, gauges the relative importance of these areas, and determines migration and distribution patterns of neonate and juvenile sharks. Participants in the 2006 COASTSPAN survey included the North Carolina Division of Marine Fisheries, South Carolina Department of Natural Resources, Coastal Carolina University, University of Georgia’s Marine Extension Service with cooperation from the Georgia Department of Natural Resources, and the Florida Fish and Wildlife Conservation Commission. Researchers from the Apex Predators Program and the University of Rhode Island conducted the survey in Delaware Bay and the U.S. Virgin Islands (USVI). This latter study is the first comprehensive survey of elasmobranchs in the USVI and has resulted in the identification of critical shark nursery habitat for blacktip and lemon sharks in Fish Bay, USVI (DeAngelis 2006). In addition, the NEFSC has also recently begun conducting active and passive acoustic telemetry studies on juvenile blacktip and lemon sharks in Fish Bay, USVI based on the results of the COASTSPAN survey in that area. This work is being done in cooperation with the Massachusetts Division of Marine Fisheries and in conjunction with studies on other species by NMFS Galveston Lab and NMFS Headquarters in Silver Spring, Maryland.

In 2006, the NEFSC initiated a pilot study in Delaware Bay using a larger version of the COASTSPAN longline gear to target sand tigers (*Carcharias taurus*) and larger sandbar sharks for identifying EFH and for future stock assessment purposes. This study incorporates historical NEFSC sampling stations for comparison to pre-management abundance. Preliminary results indicate that this survey will be a successful monitoring tool for the Delaware Bay sand tiger shark population and for evaluating long-term changes in abundance and size composition.

Juvenile Shark Survey for Monitoring and Assessing Delaware Bay Sandbar Sharks
In July and August, NEFSC staff conducted this part of the COASTSPAN project for the juvenile sandbar shark population in Delaware Bay nursery grounds using longline surveys. A random stratified sampling plan, based on depth and geographic location, is ongoing to assess and monitor the juvenile sandbar shark population during the nursery season. In addition, the mark-recapture data from this project are being used to examine the temporal and spatial relative abundance and distribution of sandbar sharks in the Bay. In 2006, a total of 362 sharks were caught, (143 sandbar sharks and 219 smooth dogfish) with 192 (53 percent) of the sharks released with tags.

Diet, Feeding Ecology, and Gastric Evacuation Studies of Delaware Bay Sandbar and Smooth Dogfish Sharks
The diet and feeding ecology of sandbar sharks (*Carcharhinus plumbeus*) and smooth dogfish (*Mustelus canis*) were investigated within Delaware Bay. These species are the two most abundant shark species in the Bay ecosystem, so their role as top predators within the Bay could be substantial. Sharks were captured using longline and gillnet gears in conjunction with sampling for migration, population, and other habitat studies. The diet was characterized by collection of food habits samples using a non-lethal stomach eversion technique. This enabled the sharks to be tagged and released, contributing to migration studies as well as remaining within the population. Most previous studies have employed lethal sampling techniques. Several multivariate statistical methods as well as standard dietary analyses were applied to the data. These techniques, along with the large sample size and high dietary resolution, enabled detailed feeding patterns to be examined. Samples from 1,173 sandbar sharks and 364 smooth dogfish were obtained during the summer months from 2003 to 2006. Nearly all smooth dogfish (98 percent) contained at least one food item, whereas only 56 percent of sandbar sharks did. In general, the diet of the smooth dogfish was dominated by crustaceans whereas the sandbar diet was dominated by teleost fish prey. The dietary results for these species are for the most part consistent with earlier studies in other locales, although this study provides a greater level of detail and comparisons not previously performed. Further analysis of ecological patterns as well as potential competition between the species is being examined. Gastric evacuation experiments have been concluded for the sandbar sharks and early results indicate a faster digestion rate then formerly thought.

Habitat Utilization and Essential Fish Habitat of Delaware Bay Sandbar Sharks and Sand Tigers
A study was initiated in 2005 with staff of Delaware State University and the University of Rhode Island to use automated acoustic telemetry to quantify residence time and fine-scale habitat use of juvenile sandbar sharks and to identify their most critical nursery habitats in Delaware Bay. Bottom monitors were deployed in known nursery areas and at opportunistic points throughout the bay, and neonate and juvenile sandbar sharks were implanted with transmitters. This study continued in 2006 as well as a pilot study to define sand tiger shark EFH using the same acoustic array. Funding was received through the NOAA Living Marine Resources Cooperative Science Center.

Electronic Tagging Studies and Movement Patterns
The primary objectives of the new technology tag studies are to examine shark migratory routes, potential nursery areas, swimming behavior, and environmental associations. Secondarily, these

studies can assess the physiological effects of capture stress and post-release recovery in commercially and recreationally captured sharks. In addition to the acoustic tagging and bottom monitor studies in Delaware Bay and the USVI as part of COASTSPAN, recent NEFSC new technology studies include tracking of porbeagle sharks with acoustic and pop-up satellite archival tags (PSAT) in conjunction with the Massachusetts Division of Marine Fisheries, and placing PSAT tags on tiger, bigeye thresher, and blue sharks in conjunction with the University of New Hampshire. Integration of data from conventional (Cooperative Shark Tagging Program) and new-technology tags is particularly important to provide a comprehensive picture of the movements and migrations of sharks along with possible reasons for the use of particular migratory routes, swimming behavior, and environmental associations.

Southeast Fisheries Science Center (SEFSC)

Stock Assessments of Large Coastal and Prohibited Sharks

A stock assessment of the LCS complex, sandbar, and blacktip sharks was initiated in 2005 and completed in 2006 (SEDAR 11 2006). The assessment process now follows closely the SEDAR format implemented by some of the Councils, which consists of three workshops: data, assessment, and review. The Data Workshop took place in October 2005; the Assessment Workshop, in February 2006; and the Review Workshop, in June 2006. In addition to organizing the workshops and conducting the assessments, SEFSC scientists prepared a total of 21 documents for the data workshop and four documents for the assessment workshop. The Review Panel concluded that continued assessment of LCS as a complex was not recommendable because it was unlikely to produce effective management advice. The Panel accepted the results for sandbar sharks (overfished status and overfishing occurring) and blacktip sharks in the Gulf of Mexico (not overfished and no overfishing occurring), but concluded that stock status for blacktip sharks in the Atlantic was uncertain given the absence of reliable estimates of abundance, biomass or exploitation rates.

An assessment of the dusky shark (*Carcharhinus obscurus*), a prohibited species in U.S. waters and candidate for listing under the Endangered Species Act, was also completed by SEFSC analysts in 2006 (Cortés et al. 2006) and peer-reviewed by NEFSC scientists. Application of multiple stock assessment methodologies in concert indicated that the Atlantic stock of dusky sharks has been very heavily exploited, thus implying an overfished status and that overfishing is occurring. Because of the very low productivity of this species, rebuilding times are expected to be very long.

Funds from the NMFS Protected Resources Species of Concern Program were provided in 2006 to provide an assessment of the night shark as it pertains to the species of concern criterion. Productivity, abundance trends, and endemism were assessed and based on the analysis of all current available information, night shark should be removed from the NMFS species of concern list but retained on the prohibited species list as a precautionary approach to management until a more comprehensive assessment of the status of the stock can be conducted (i.e., stock assessment).

Observer Programs

Shark Longline Program

From 1994 to 2004, the southeastern United States commercial shark bottom longline fishery was monitored by the University of Florida Commercial Shark Fishery Observer Program. In 2005, the responsibilities of the program were moved to NMFS' Panama City Laboratory Shark Population Assessment Group in Panama City, Florida. This program is designed to meet the intent of the Endangered Species Act and the Consolidated Atlantic HMS FMP. It was created to obtain better data on catch, bycatch, and discards in the shark bottom longline fishery. All observers are required to attend a 1-week safety training and species identification course before being dispatched to the fishery. While on board the vessel, the observer records information on gear characteristics and all species caught, condition of the catch (e.g., alive, dead, damaged, or unknown), and the final disposition of the catch (e.g., kept, released, finned, etc.). The target coverage level is 3.9 percent of the total fishing effort. This level is estimated to attain a sample size needed to provide estimates of protected resource interaction with an expected coefficient of variation of 0.3. Observers spent 148 days at sea on 49 trips in 2006. Observers monitored 26 vessels and recorded information for 117 sets. Observer coverage occurred in the South Atlantic and Gulf of Mexico fishing regions (there were no trips made in the North Atlantic region).

Shark Gillnet Program

Since 1993, an observer program has been underway to estimate catch and bycatch in the directed shark gillnet fisheries along the southeastern U.S. Atlantic coast. This program was designed to meet the intent of the Marine Mammal Protection Act, the Endangered Species Act, and the 1999 revised FMP for HMS. It was also created to obtain better data on catch, bycatch, and discards in the shark fishery. The Atlantic Large Whale Take Reduction Plan and the Biological Opinion issued under Section 7 of the Endangered Species Act mandate 100 percent observer coverage during the right whale calving season (November 15 to April 1). Outside the right whale calving season (April 1 to November 14), observer coverage equivalent to 38 percent of all trips is maintained. In 2005, a program was started to include all vessels that have an active directed shark permit and fish with sink gillnet gear. These vessels were not previously subject to observer coverage because they either were targeting non-HMS or were not fishing gillnets in a drift or strike fashion. These vessels were selected for observer coverage in an effort to determine their impact on finetooth shark landings and their overall fishing impact on shark resources when the gear is not targeting sharks. Similar to the shark longline observer program, all observers are required to attend a 1-week safety training and species identification course and while on board the vessel must record information on gear characteristics and all species caught, condition of the catch, and the final disposition of the catch. A total of 75 trips on 21 gillnet vessels were observed in 2006.

Ecosystem Modeling–Reconstructing Ecosystem Dynamics in the Gulf of Mexico. An Assessment of the Trophic Impacts of Fishing and Its Effects on Keystone Predator Dynamics

Keystone species, such as sharks, can play a central role in the structure and function of marine communities. Conflicting views surround the ecological interactions between sharks and fisheries. One view suggests removals of keystone species cause a cascading trophic effect within the remaining community, which may involve changes in species composition among the prey or changes in the preferred prey of the predator. An alternate view suggests the high diversity of oceanic systems may oppose strong "top-down" effects. In light of the recent revelations on the reductions of higher trophic level species and fishing down food webs, an improved understanding of the role of keystone predators in the Gulf of Mexico would be useful in evaluating the impacts of fishing on the marine ecosystem. An Ecopath with Ecosim model is being developed to model Gulf of Mexico ecosystem dynamics. Hypotheses regarding the depletion of apex predators and their impact on predation mortality of major prey groups will be examined. Further, hypotheses regarding the role of complementary niches among sharks will be explored.

Elasmobranch Feeding Ecology and Shark Diet Database

The current Consolidated Atlantic HMS FMP gives little consideration to ecosystem function because there is little quantitative species-specific data on diet, competition, predator-prey interactions, and habitat requirements of sharks. Therefore, several studies are currently under way describing the diet and foraging ecology, habitat use, and predator–prey interactions of elasmobranchs in various communities. Atlantic angel sharks (*Squatina dumerili*) have been collected for stomach content analysis from a trawl fishery in northeastern Florida since 2004. Evidence suggests angel sharks consumed mostly teleost fishes, with Atlantic croaker (*Micropogonias undulates*) being the most common fish species (Baremore et al. 2006). The diet of the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*) was described by life-stage from Crooked Island Sound, an embayment of the northeast Gulf of Mexico. Young-of-the-year sharks feed on a mix of teleosts and invertebrates, juvenile sharks feed on sciaenids and clupeids, and mature sharks feed almost entirely on sciaenids. Examination of a variation in diet and daily ration of bonnethead sharks (*Sphyrna tiburo*) from three areas in the eastern Gulf of Mexico was completed in 2006 and a publication is scheduled for 2007 (Bethea et al. in press). The diet of the roundel skate (*Raja texana*) from the northern Gulf of Mexico is also being examined (Bethea and Hale in prep.). A database containing information on quantitative food and feeding studies of sharks conducted around the world has been in development for several years and presently includes over 400 studies. This fully searchable database will continue to be updated and fine-tuned in 2007 and will be used as part of a collaborative study on ecosystem effects of fishing large pelagic predatory fish with researchers from the University of Washington, University of Wisconsin, and the Inter-American Tropical Tuna Commission. It is also expected that this shark trophic database will be very useful for other ecosystem-level studies using Ecopath/Ecosim or similar approaches and ultimately for population assessments.

Cooperative Gulf of Mexico States Shark Pupping and Nursery Survey (GULFSPAN) and Tagging Database

The SEFSC Panama City Shark Population Assessment Group manages and coordinates a survey of coastal bays and estuaries from Cedar Key, Florida, to Louisiana. Surveys identify the presence or absence of neonate (baby) and juvenile sharks and attempt to quantify the relative importance of each area as it pertains to EFH requirements for sharks. The Group also initiated a juvenile shark abundance index survey in 1996. The index is based on random, depth-stratified gillnet sets conducted throughout coastal bays and estuaries in northwest Florida monthly from April to October. The species targeted in the index of abundance survey are juvenile sharks in the large and small coastal management groups. This index has been used as an input to various stock assessment models. A database containing tag and recapture information on elasmobranchs tagged by GULFSPAN participants and NMFS Mississippi Labs is in development and presently includes over 11,000 tagged animals and 134 recaptured animals from 1993 to present for both the Gulf of Mexico and U.S. southeast Atlantic Ocean. This fully searchable database will continue to be updated and fine-tuned in fiscal year 2007.

Essential Fish Habitat

Conventional theory assumes shark nursery areas are habitats where female sharks give birth to young or lay eggs, or where juvenile sharks spend their first weeks, months, or years of life. The SEFSC Panama City Shark Population Assessment Group is currently testing a number of hypotheses regarding juvenile sharks and EFH that challenge this assumption. There are many bays and inlets along the Gulf of Mexico coastline that may serve as EFH for sharks. These habitats vary from near-oceanic conditions to shallow, enclosed estuarine areas. Following the research recommendations in Beck et al. (2001), the Group is determining which habitats provide a greater "nursery value" for a given species. A review article evaluating the assumptions of the current shark nursery paradigm in light of available data is being prepared. Based on examination of these assumptions and available methods of quantifying and accurately describing shark nursery areas, a new more quantitative definition of shark nursery areas is proposed. This definition requires three criteria to be met for an area to be identified as a nursery: 1) sharks are more commonly encountered in the area than other areas; 2) sharks have a tendency to remain or return for extended periods; and 3) the area or habitat is repeatedly used across years. These criteria make the definition of shark nursery areas more compatible with those for other aquatic species. The improved definition of this concept will provide more valuable information for fisheries managers and shark biologists.

Determining Differences in the Ratios of Wet Fin to Dressed Carcass Weight among Sharks

The Shark Finning Prohibition Act contains a rebuttable presumption that any shark fins landed from a fishing vessel or found on board a fishing vessel were taken, held, or landed in violation of the Act if the total weight of shark fins landed or found on board exceeds 5 percent of the total weight of shark carcasses landed or found on board. This is commonly referred to as the "5 percent rule." Although many different species are harvested for their fins, the "5 percent rule" was established using data from only sandbar sharks due to a lack of data for other shark species. Using standardized data collated from state and federal databases, additional fin weight to body weight ratios were calculated for several commercially valuable shark species from coastal waters of the U.S. Atlantic Ocean and Gulf of Mexico. The wet fin to dressed carcass weight ratio of the sandbar shark (5.3 percent) was the largest of the 14 species examined, whereas the silky shark exhibited the lowest ratio at 2.5 percent. The wet fin to dressed carcass weight ratio of the sandbar shark was significantly higher than most of the other large coastal species examined, and the bonnethead shark had a wet fin to dressed carcass weight ratio (4.9 percent) significantly higher than other small coastal species examined. These preliminary results were presented at a workshop held as part of a project to compare available data about shark fin and carcass landings and shark fin products. This project produced science-based recommendations regarding a precautionary and science-based wet fin to dressed carcass weight ratio for the European Union Finning Regulation with the overall recommendation that sharks be landed with their fins still attached.

Life History Studies of Elasmobranchs

Biological samples are obtained through research surveys and cruises, recreational and commercial fishermen, and collection by onboard observers on commercial fishing vessels. Age and growth rates and other life history aspects of selected species are processed and the data analyzed following standard methodology. This information is vital as input to population models used to predict the productivity of the stocks and to ensure they are harvested at sustainable levels. Samples and preliminary analysis continued on determining life history parameters for skates in the Gulf of Mexico, a group of elasmobranchs often ignored despite being harvested as catch and bycatch in commercial fisheries. Staff from the SEFSC served as a co-editor for a volume entitled "Age and Growth of Chondrichthyan Fishes: New Methods, Techniques, and Analysis" that was published in the journal Environmental Biology of Fishes. Manuscripts published in that volume from the SEFSC included studies on differences in life history for blacktip sharks (Carlson et al. 2006) and on two Bayesian methods for estimating parameters of the von Bertalanffy growth equation (Siegfried & Sanso 2006). Following recommendations of the 2006 Large Coastal Shark SEDAR (SEDAR 11), research began to reevaluate the life history of sandbar shark and blacktip sharks, especially age at maturity.

Elemental Chemistry of Elasmobranch Vertebrae

Although numerous studies have used elemental analysis techniques for age determination in bony fishes, these procedures are rarely used to verify age assessments or temporal periodicity of growth band formation in elasmobranchs. A study was completed on the potential of using laser ablation inductively coupled plasma-mass spectrometry to provide information on the seasonal deposition of elements in the vertebrae of the round stingray. Results from this study were published in a symposium on new methods for determining the age and growth of chondrichthyan fishes (Hale et al. 2006).

Cooperative Research—Habitat Utilization among Coastal Sharks

From 2004 to 2006, through a collaborative effort between the SEFSC Panama City Shark Population Assessment Group and Mote Marine Laboratory, the use of coastal habitats by neonate and young-of-the-year blacktip and Atlantic sharpnose sharks has been monitored through an array of underwater acoustic receivers (VR2, Vemco Ltd.) placed throughout each study site. Movement patterns, home ranges, activity space, survival, and length of residence of individuals will be compared by species and area to provide information for better management of critical species and essential fish habitats. The project on Atlantic sharpnose shark was completed in 2006 and a manuscript is currently being prepared for publication.

Cooperative Research—Definition of Habitat and Migration Patterns for Bull Sharks in the Eastern Gulf of Mexico

A three year collaborative effort between the SEFSC Panama City Shark Population Assessment Group, University of Florida, and Mote Marine Laboratory began in 2005 to determine habitat use and short-term migration patterns of bull sharks (*Carcharhinus leucas*). Sharks are being outfitted with PSATs during various times of the year. Preliminary results indicate sharks do not travel extensive distances while occupying summer habitats. This project is driven by the lack of data for this species and its current prominence within the Florida coastal community. A better understanding of this species is required to effectively manage this species for both commercial and recreational fishermen, as well as the general public. Concerns regarding this species will continue to be an issue, as fishermen and the public demand that state and federal governments provide better information concerning the presence and movements of these sharks.

Cooperative Research—Brazil-U.S. pelagic shark research project

The main goal of this proposed cooperative project between Brazil (Universidade Federal Rural de Pernambuco) and the United States (SEFSC and the University of Florida's Museum of Natural History) is to conduct simultaneous research on pelagic sharks in the North and South Atlantic Ocean. Central to this project is also the development of fisheries research capacity in Brazil through graduate student training and stronger scientific cooperation between Brazil and the United States. The main research objectives include: 1) development of bycatch reduction and habitat models; 2) investigation of movement and migratory patterns; and 3) ancillary life history studies. Bycatch reduction will be investigated with the placement of hook timers and temperature-depth recorders on fishing gear to gain information on preferential feeding times, fishing depths, and temperatures of pelagic sharks and associated fauna. This information can be used in the future for development of habitat-based models. Movement and migratory patterns will be investigated through the deployment of pop-up satellite tags on pelagic species that are frequently caught in fishing operations or are of special importance to conservation interests in both countries. Information gathered will provide insight into geographical and vertical distribution patterns, which in turn will provide data on catchability that can be used if bycatch reduction measures are implemented in the future. To date, an oceanic whitetip and a longfin mako shark have been tagged with satellite tags off U.S. waters as part of this project. The ancillary studies include: genetic, age and growth, reproduction and trophic ecology analysis.

Shark Assessment Research Surveys

The SEFSC Mississippi Laboratories have conducted bottom longline surveys in the Gulf of Mexico, Caribbean, and Southern North Atlantic since 1995 (23 surveys have been completed through 2006). The primary objective was assessment of the distribution and abundance of large and small coastal sharks across their known ranges in order to develop a time series for trend analysis. The surveys, which are conducted at depths between 5 and 200 fathoms, were designed to satisfy five important assessment principles: stockwide survey, synopticity, well-defined sampling universe, controlled biases, and useful precision. The bottom longline surveys are the only long-term, nearly stock-wide, fishery-independent surveys of Western North Atlantic Ocean sharks conducted in U.S. and neighboring waters. Recently, survey effort has been extended into depths shallower than five fathoms to examine seasonality and abundance of sharks in inshore waters of the northern Gulf of Mexico and to determine what species and size classes are outside of the range of the sampling regime of the long-term survey. This work is being done in cooperation with the Dauphin Island Sea Lab and Gulf Coast Research Laboratory. For all surveys, ancillary objectives are to collect biological and environmental data, and to tag-and-release sharks. The surveys continue to address expanding fisheries management requirements for both elasmobranchs and teleosts.

5.2 Incidental Catch Reduction

Pacific Islands Fisheries Science Center (PIFSC)

Reducing Longline Shark Bycatch

The resumption of the previously closed Hawaii shallow-set longline fishery for swordfish in late 2004 and continuing through 2007 was anticipated to increase blue shark catches, as in the past blue sharks made up about 50 percent of the total catch in this fishery. With the ban on shark finning, these sharks are not retained and are categorized as regulatory bycatch. Although the anticipated increase in shark bycatch has been less than expected, perhaps due to the requirement to use fish bait instead of squid, or because of a shift towards an earlier fishing season in the reopened swordfish fishery, researchers at PIFSC have undertaken several projects to address shark bycatch on longlines.

Chemical and Electromagnetic Deterrents to Bycatch

One study under way since 2005 with funding from the National Bycatch Program seeks to test the use of chemical and electromagnetic deterrents to reduce shark bycatch. Previous research by Eric Stroud at the SharkDefense LLC, Oak Ridge, New Jersey, laboratory was conducted to identify and isolate possible semiochemical compounds from decayed shark carcasses. Semiochemicals are chemical messengers or "clues" sharks may use to orient, survive, and reproduce in their specific environments. Certain semiochemicals have the ability to trigger a flight reaction in sharks. Initial tests showed chemical repellents administered by dosing a “cloud” of the repellent into a feeding school of sharks caused favorable behavioral shifts, and teleost fishes such as pilot fish and remora accompanying the sharks were not repelled and continued to feed. This suggested other teleosts, such as longline target species (tunas or billfish), would not be repelled. Longline field testing of these chemicals was conducted in early 2006 with demersal longline sets in South Bimini using the chemicals, and similar testing of magnets, and were quite successful. In late 2006, the PIFSC began testing the ability of electropositive metals (lanthanide series) in an effort to repel sharks from longline hooks. Trials are being conducted to see if sharks can be deterred from biting freshly caught baits, observing the sharks at sea off the North Shore of Oahu. Studies on captive sandbar sharks, *Carcharinus plubeus,* in tanks indicated sharks would not get any closer than 40 cm to baits in the presence of the metal (metal approximately the same size as a 60g lead fishing weight). Researchers believe the electromagnetic force created by the metal either disrupts, irritates and/or confuses the shark’s electrosensory system causing sharks to avoid these areas.

Longline Gear Effects on Shark Bycatch

To explore operational differences in the longline fishery that might reduce shark bycatch, the observer database is being used to compare bycatch rates under different operational factors (e.g., hook type, branch line material, bait type, the presence of light sticks, soak time, etc.). A preliminary analysis was completed that compared the catches of vessels using traditional tuna hooks to vessels voluntarily using size 14/0 to 16/0 circle hooks in the Hawaii-based tuna fleet. The study was inconclusive due to the small number of vessels using the circle hooks. Subsequently 19 contracted vessels were used to test large (size 18/0) circle hooks versus tuna hooks in controlled comparisons. Preliminary analysis does not indicate these large circle hooks increase the catch rate of sharks, in contrast to findings of increased shark catch on circle hooks in studies comparing smaller circle hooks with J hooks in other fisheries.

Testing Deeper Sets

Evaluation of data on vertical depth distributions of 15 species of pelagic fish, sharks and turtles suggested that deep-set tuna-targetting longline gear could be configured (set deeper) to reduce bycatch of epipelagic animals.[13] An experiment with deeper-set longline gear was conducted in

[13] Epipelagic animals are associated with the surface layer of the ocean.

2006 by PIFSC in coordination with the Secretariat of the Pacific Community and the Joint Institute for Marine and Atmospheric Research. The experiment altered current commercial tuna longline setting techniques by eliminating all shallow set hooks (less than 100 m depth) from tuna longline sets. The objective of eliminating all shallow set hooks, a method developed by the Secretariat of the Pacific Community, was to maximize target catch of deeper dwelling species such as bigeye tuna, reduce bycatch of turtles and other protected species, and reduce incidental catch of many marketable but less desired species (e.g., billfish and sharks). A single vessel was contracted to perform 90 longline sets – 45 sets using the deep setting technique and 45 control sets using standard methods. A deep set was achieved by attaching paired 3 kilogram (kg) lead weights directly below paired floats on long portions of the mainline, thereby sinking the entire fishing portion of the line below the target depth of the shallowest hook (100 m). The deep setting technique was easily integrated into daily fishing activities with only minor adjustments in methodology. The main drawback for the crew was increased time to deploy and retrieve the gear. Catch totals of both bigeye tuna and moonfish where greater on the deep set gear than the controlled sets; whereas catch of less valuable incidental fish (e.g., striped marlin and wahoo) was lower on the deep set gear than the controlled sets. Temperature-depth recorders placed on the gear verified that the deep set method achieved the goal of ensuring that all hooks sink below 100 m. Results have shown that the deep set technique works and would be practical to incorporate into existing fishing practices in Hawaii's tuna longline fleet.

Results from several of the bycatch studies suggest combining methods to avoid bycatch. Perhaps a combination of electropositive metals fashioned into weights attached to longline gear and setting the gear deeper might avoid bycatch of sharks and marlins. Research is also being initiated to develop safer weights such as weights that do not spring back towards fishermen when branch lines holding large fish break during retrieval.

Southeast Fisheries Science Center (SEFSC)

Cooperative Research—The Capture Depth, Time, and Hooked Survival Rate for Bottom Longline–Caught Large Coastal Sharks

A project funded through the NMFS Cooperative Research Program to examine alternative measures (such as reduced soak time, restrictions on gear length, and fishing depth restrictions) in the shark bottom longline fishery to reduce mortality on prohibited sharks continued in 2006. The project will be completed in 2007.

5.3 Post-Release Survival

Pacific Islands Fisheries Science Center (PIFSC)

Improved Release Technology

The recently resumed Hawaii-based swordfish longline fishery, as well as the tuna longline fishery, is required to carry and use dehookers for removing hooks from sea turtles. These dehookers can also be used to remove external hooks and ingested hooks from the mouth and upper digestive tract of fish, and could improve post-release survival and condition of released sharks. Sharks are generally released from the gear by one of the following methods: 1) severing the branchline; 2) hauling the shark to the vessel to slice the hook free; or 3) dragging the shark from the stern until the hook pulls free. Fishermen are encouraged to use dehooking devices to minimize trauma and stress of bycatch by reducing handling time and to mitigate post-hooking mortality.

Testing of the dehookers on sharks on research cruises has indicated removal of circle hooks from shark jaws with the dehookers can be quite difficult. PIFSC is looking into the feasibility of barbless circle hooks for use on longlines, which would make it easier to dehook unwanted catch with less harm. Preliminary research in the Hawaii shore fishery has indicated that barbless circle hooks catch as much as barbed hooks, but the situation could be different with more passive gear like longlines, where bait must soak unattended for much of the day and fish have an extended period in which to try to throw the hook. Initial results from very limited longline testing of barbless hooks on research cruises in American Samoa, and in collaboration with the Narragansett Laboratory, indicated a substantial increase in bait loss using barbless hooks. Subsequent testing used rubber retainers to prevent bait loss. Summary information from before and after the use of bait retainers showed no difference between barbed and barbless hooks in the catch and catch rates of targeted species and sharks, although catches have so far been too few to provide much statistical power. Also in this study, the efficacy of the pigtail dehooker, the device required by U.S. regulations for releasing sea turtles, showed a 67 percent success rate in dehooking and releasing live sharks on barbless hooks, compared to a zero percent success rate when used with sharks caught on barbed hooks.

Post-Release Survival

Many large marine animals (sharks, turtles, and marine mammals) are accidentally caught in commercial fisheries. While conservationists and fisheries managers encourage release of these non-target species, the long-term fate of released animals is uncertain. Successful management strategies in both sport and commercial fisheries require information about long-term survival of released fish. Catch-and-release sport fishing and non-retention of commercially caught fish are justifiable management options only if there is a reasonable likelihood that released fish will survive for long periods. All recreational anglers and commercial fisherman who practice catch-and-release fishing hope the released fish will survive. Although it is safe to say that 100 percent of retained fish will die, it is not known what proportion of released fish will survive. Many factors—such as fish size, water temperature, fight time, and fishing gear—could influence survival.

Post-release survival, which is not well established for any marine species, is typically estimated using tagging programs. Historically, large-scale conventional tagging programs were used. These programs yielded low return rates, consistent with a high post-release mortality. For example, in a 30-year study of Atlantic blue sharks, only 5 percent of tags were recovered. Short-duration studies using ultrasonic telemetry have shown that large pelagic fish usually survive for at least 24 to 48 hours following release from sport fishing or longline gear. PIFSC researchers and collaborators from other agencies, academia, and the industry have been developing alternative tools to study longer-term post-release mortality. Whereas tagging studies assess how many fish survive, new approaches are being used to understand why fish die. A set of diagnostic tools is being developed to assess the biochemical and physiological status of fish captured on various gear. These diagnostics are being examined in relation to survival data obtained from a comprehensive PSAT program. Once established as an indicator of survival probability, such biochemical and physiological profiling could provide an alternative means of assessing consequences of fishery release practices.

PIFSC scientists have been developing biochemical and physiological profiling techniques for use in estimating post-release survival of blue sharks, which are frequently caught as bycatch of Pacific longliners. Using NOAA research vessels, they captured 211 sharks, of which 172 were blue sharks. Using blue sharks, PIFSC scientists and collaborators developed a model to predict long-term survival of released animals (verified by PSAT data) based on analysis of small blood samples. Five parameters distinguished survivors from moribund sharks: plasma Mg^{2+}, plasma lactate, erythrocyte Hsp70 mRNA, plasma Ca^{2+}, and plasma K^+. A logistic regression model incorporating a combination of Mg^{2+} and lactate successfully categorized 19 of 20 (95 percent) fish of known fate and predicted that 21 of 22 (96 percent) sharks of unknown fate would have survived upon release. These data suggest that a shark captured without obvious physical damage or physiological stress (the condition of 95 percent of the sharks they captured) would have a high probability of surviving upon release. The program has PSAT-tagged 32 blue sharks, eight bigeye thresher sharks, 16 oceanic white-tip sharks, one shortfin mako, and 10 silky sharks. Of the 67 PSATs reporting from released sharks, in only one case was there an indication of mortality after release. These PSAT data complement the biochemical data indicating long-term survival after release from longline gear (Moyes et al. 2006). Currently similar research and results are being written up on oceanic white-tip, *Carcharinus longimanus*, and silky shark, *Carcharinus falciformis.*

Electronic Tagging Studies and Movement Patterns

PIFSC scientists are using acoustic, archival, and PSATs to study vertical and horizontal movement patterns in commercially and ecologically important tuna, billfish, and shark species, as well as sea turtles. The work is part of a larger effort to determine the relationship of oceanographic conditions to fish and sea turtle behavior patterns. This information is intended for incorporation into population assessments, addressing fisheries interactions and allocation issues, as well as improving the overall management and conservation of commercially and recreationally important tuna and billfish species, sharks, and sea turtles. The research, sponsored by the Pelagic Fisheries Research Program and PIFSC, has shown some large pelagic fishes have much greater vertical mobility than others. More specifically, we have found swordfish, bigeye tuna, and bigeye thresher sharks remain in the vicinity of prey organisms comprising the deep Sound Scattering Layer (SSL) during their extensive diel vertical migrations. In contrast, other billfish, tuna, and shark species stay in the upper 200 m of the water column both night and day. The SSL comprises various species of squids, mesopelagic fish, and euphausiids that undertake extensive diurnal vertical migrations. This composition of organisms is referred to as the SSL because the migration of these organisms was first discovered by the sound waves that reflect off gas-filled swim bladders or fat droplets within the migrating organisms. Organisms in the SSL feed in surface waters at night to avoid being seen and eaten by their predators and then return during the day to depths of 500 m or deeper. Pelagic fishes able to mirror movements of the SSL can better exploit these organisms as prey. Also, the ability of swordfish, bigeye tuna, and bigeye thresher sharks to access great depths permits them to effectively exploit the SSL for prey even after they descend to deeper water at dawn.

Certainly, the ability to mirror the movements of vertically migrating prey confers selective advantages. However, other pelagic species—such as yellowfin tuna, silky sharks, oceanic white tip sharks, blue marlin, and striped marlin—do not make extensive regular vertical excursions. PIFSC scientists have also found one of the most ubiquitous large-vertebrate species in the pelagic environment—the blue shark—occasionally displays vertical movement behaviors similar to those of swordfish, bigeye tuna, and bigeye thresher sharks.

The PIFSC, in collaboration with Australian Institute for Marine Science and the Commonwealth Scientific and Industrial Research Organization have for the past several years been deploying electronic tags on whale sharks at Ningaloo Reef, Western Australia, to describe their vertical and horizontal movements. The work has documented that whale sharks dive deeper, below 1000 m, than previously thought. After the whale sharks leave Ningaloo Reef, some travel to Indonesia while others head across the Indian Ocean (Wilson et al. 2006).

Pop-up Satellite Archival Tags (PSAT) Performance and Meta Data Analysis Project

The purpose of this study is to explore failure (or success) scenarios in PSATs attached to pelagic fish, sharks, and turtles. Shark species in the database include bigeye thresher, blue, shortfin mako, silky, oceanic white-tip, great white, and basking sharks. Other species include black, blue, and striped marlins; broadbill swordfish; bigeye, yellowfin, and bluefin tunas; tarpon; and green, loggerhead, and olive ridley turtles. To date, of 662 PSATs attached to sharks, billfish, tunas, and turtles, 520 (79 percent) reported data. Of the tags that recorded data, 87 (17 percent) hit their programmed pop-off date and 433 tags popped-off earlier than their program date. The 142 (21 percent) non-reporting tags are not assumed to reflect fish mortality. The meta data study is designed to look for explanatory variables related to tag performance by analyzing PSAT retention rates, percentage of satellite data (i.e., depth, temperature, geolocations) retrieved, and tag failure. By examining these factors and other information about PSATs attached to vastly different pelagic species, it is anticipated certain patterns/commonalties may emerge to help improve attachment methodologies, selection of target species, and experimental design. It is anticipated this study will examine information from more than 1,000 PSATs. Information derived from this study should allow an unprecedented and critical appraisal of the overall efficacy of the technology.

Southwest Fisheries Science Center

SWFSC/SWRO Post-release mortality of blue sharks

One important question regarding bycatch interactions with fishing gear is the survivorship of animals released from the gear. To assess the survival of blue sharks we are using PSATs that will release after a short period of time and reveal the fate of the tagged animal.

In the drift gillnet fishery operating in the southern California Bight, a large number of blue sharks are caught and discarded due to the lack of market value. The percentage of animals surviving after being discarded is critical to determining the impact of this fishery on blue shark populations. To assess survivorship, blue sharks will be tagged as they are released from the drift gillnets in collaboration with the NOAA observer program. The program was scheduled to begin during the 2006-2007 drift gillnet season, however, in contrast to high numbers of blue sharks caught in this fishery historically, the catch rate of blue sharks during the 2006 season was low and no suitable sharks were tagged. During the 2007 season, deployments of 12 satellite tags are planned.

Northeast Fisheries Science Center

Post-Release Recovery and Survivorship Studies in Sharks—Physiological Effects of Capture Stress

This ongoing cooperative research with the Massachusetts Division of Marine Fisheries and the University of Massachusetts, Dartmouth is directed toward coastal and pelagic shark species caught on recreational and commercial fishing gear. This study uses blood and muscle sampling methods and acoustic tracking to obtain physiological profiles of individual sharks to characterize stamina and to determine ultimate post-release survival. Blood samples were taken from 62 specimens of eight shark species on the NEFSC coastal and pelagic shark surveys to study the physiological stress response to longline gear. The results of this research will be critical to evaluate the extensive current catch-and-release management strategies for sharks.

Removing the ventilator hose from a shortfin mako tagged during the SWFSC juvenile shark abundance survey.
Source: Mark Conlin/NMFS photo

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Shortfin mako being measured
Source: NMFS Mississippi Laboratories, Shark Team

Appendix 1: Internet Information Sources

Atlantic Ocean Shark Management

The 2006 Final Consolidated Atlantic HMS FMP; copies of Amendment 1 to the FMP for Atlantic Tunas, Swordfish and Sharks; and Atlantic commercial and recreational shark fishing regulations and brochures can be found on the Highly Migratory Species (HMS) Management Division website at http://www.nmfs.noaa.gov/sfa/hms/. Information on Atlantic shark fisheries is updated annually in the Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic HMS, which are also available on the website. The website includes links to current fishery regulations (50 CFR 635), shark landings updates, the U.S. National Plan of Action for Sharks, and the Atlantic HMS SAFE Reports.

Pacific Ocean Shark Management

The U.S. West Coast Highly Migratory Species FMP is currently available on the Pacific Fishery Management Council website: http://www.pcouncil.org/hms/hmsfmp.html.

Data reported in Table 2.3.3 (Shark landings (mt) for California, Oregon, and Washington, 1995–2006) was obtained from the Pacific States Marine Fisheries Commission's PacFIN Database, which may be found on their website at: www.psmfc.org/pacfin/data.html.

Western Pacific Shark Management

The Pelagic Fisheries of the Western Pacific Region FMP (Pelagics FMP) and amendments to the plan are available on the Western Pacific Fishery Management Council's website: http://www.wpcouncil.org/pelagic.htm.

Data reported in Table 2.3.8 (Shark landings (mt) from the Hawaii-based longline fishery and the American Samoa longline fishery, 1995–2006.) was partially obtained from the Western Pacific Fisheries Information Network (WPacFIN). WPacFIN is a federal–state partnership collecting, processing, analyzing, sharing, and managing fisheries data from American island territories and states in the Western Pacific. More information is available on their website at: http://www.pifsc.noaa.gov/wpacfin/.

North Pacific Shark Management

The Bering Sea/Aleutian Islands Groundfish FMP and the Groundfish of the Gulf of Alaska FMP are available on the North Pacific Fishery Management Council's (NPFMC) website: http://www.fakr.noaa.gov/npfmc/fmp/fmp.htm.

Stock assessments and other scientific information for sharks are summarized annually in an appendix to the NPFMC SAFE Reports that are available online: http://www.fakr.noaa.gov/npfmc/SAFE/SAFE.htm.

International Efforts to Advance the Goals of the Shark Finning Prohibition Act

NOAA Fisheries Office of International Affairs
http://www.nmfs.noaa.gov/ia/

FAO International Plan of Action for the Conservation and Management of Sharks
http://www.fao.org/figis/servlet/static?dom=org&xml=ipoa_sharks.xml

U.S. NPOA for the Conservation and Management of Sharks
http://www.nmfs.noaa.gov/sfa/hms/Final%20NPOA.February.2001.htm

NAFO Article 13: Conservation and Management of Sharks
http://www.nafo.int/fisheries/frames/regulations.html

IATTC RESOLUTION C-05-03: Resolution on the Conservation of Sharks Caught in Association with Fisheries in the Eastern Pacific Ocean
http://iattc.org/PDFFiles2/C-05-03-Sharks.pdf

ICCAT Recommendation 01-10: Recommendation Concerning the Conservation of Sharks Caught in Association with Fisheries Managed by ICCAT
http://www.iccat.int/Documents%5CRecs%5Ccompendiopdf-e%5C2004-10-e.pdf

ICCAT Recommendation 05-05: Recommendation by ICCAT to Amend Recommendation [Rec. 04-10] Concerning the Conservation of Sharks Caught in Association with Fisheries Managed by ICCAT
http://www.iccat.int/Documents%5CRecs%5Ccompendiopdf-e%5C2005-05-e.pdf

WCPFC Resolution-2005-03: Resolution on Non-Target Fish Species
http://www.wcpfc.int/

WCPFC Conservation and Management Measure 2006-05: Conservation and Management Measure for Sharks in the Western and Central Pacific Ocean
http://www.wcpfc.int/

U.S. Imports and Exports of Shark Fins

Summaries of U.S. imports and exports of shark fins based on information submitted by importers and exporters to the U.S. Customs and Border Protection Data, and U.S. Census Bureau are reported in the NMFS Trade database:
http://www.st.nmfs.gov/st1/trade/index.html.

A large shortfin mako shark being released after capture and tagging during the SWFSC juvenile shark abundance survey.
Source: NMFS photo