

## Science and Management Overview: Swordfish Stocks and the West Coast Swordfish Fishery

The workshop started with an overview of Pacific swordfish fisheries, touching on swordfish life history and abundance, descriptions of domestic and international fleets, and management history. Session presenters included government and non-government fisheries scientists, as well as California and federal fisheries managers. A short film produced by John Dutton Media described the collaborative efforts among west coast scientists, fisheries managers, and DGN fishermen over the last 13 years to incorporate gear and operational changes to minimize marine mammal interactions. The film also introduced some unique approaches fishermen are taking to address market demand for sustainable and locally produced seafood. Lastly, a stakeholder panel discussed current issues in the fishery, desired scenarios, and challenges to achieving those scenarios.

## Session Speakers



**David Itano** is currently a research associate with the Pelagic Fisheries Research Program of the University of Hawaii and also represents Hawaii as vice-chair to the Western Pacific Regional Fishery Management Council. Previously, he was employed as a fishery scientist and biologist for the Secretariat of the Pacific Community Tuna Programme (Noumea) and with the government of American Samoa since 1984. Earlier in his career, he engaged in full-time and part-time commercial fisheries from Alaska to New Zealand that included troll salmon, albacore troll, shrimp trawl, dungeness crab and the western Pacific tropical tuna purse seine fishery.



**Dr. Jon Brodziak** is the senior assessment scientist working for the NMFS Pacific Islands Fisheries Science Center doing fishery resource assessments. An itinerant scientist, his published research includes contributions to applied statistics, mathematical modeling, and population ecology of squids, gadids, billfishes, flounders, salmonids, tunas, and rockfishes. His current research interests include ecosystem-based fishery management, stock assessment methods and software, and evaluating impacts of human activities and environmental variation on fish communities, including swordfish.



**Marija Vojkovich** has been with the Marine Region of the California Department of Fish and Game for over 35 years. Her experience has been almost exclusively with management issues and she spent several years monitoring highly migratory species. On a personal level, Marija has first-hand knowledge of swordfish harpoon fishing.



**Rod McInnis** serves as regional administrator for the National Marine Fisheries Service, Southwest Region. In this role, he directs approximately 150 employees to manage offshore commercial and recreational fisheries, marine resource protection, and oversees the conservation of marine and estuarine habitat. Rod has over 30 years of experience in conservation and management of living marine resources in the Pacific. He has broad experience as an administrator and regulator in implementing the major federal statutes and policies related to the conservation of living marine resources, including the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, and the Endangered Species Act. Mr. McInnis holds a Master of Arts in Marine Biology from San Francisco State University earned through graduate studies at the Moss Landing Marine Laboratories.

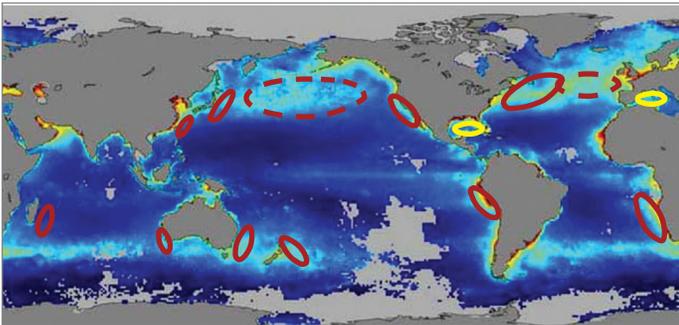


# Swordfish Life History, Habitat, and Fisheries Overview

David Itano, University of Hawaii

**Life History & Habitat:** Swordfish are considered a worldwide species comprised of many independent or semi-independent stocks. The species is fast-growing and productive. Length and age at which 50 percent of the population is estimated to reach maturity is 144 cm fork length and about four years. Swordfish have high fecundity and broadcast spawn throughout the year in the tropics and during summer and fall in temperate regions. Swordfish are highly evolved to feed at depth possessing specialized eye and brain heater organs that promote efficient hunting at depths below 2000 ft and temperatures as low as 41°F. The maximum recorded age and size is over 15 years old and approximately 1400 pounds.

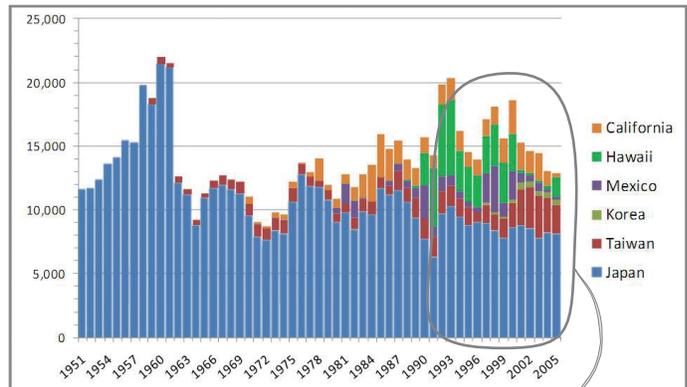
Swordfish distribution correlates with ocean productivity. Therefore, they are often found in oceanic frontal zones as well as coastal areas with relief that promote nutrient rich upwelling. They are opportunistic feeders that track the deep scattering layer. Thus, their location and daytime depth can be predicted based on local productivity, temperature, oxygen concentrations at depth, and water clarity.



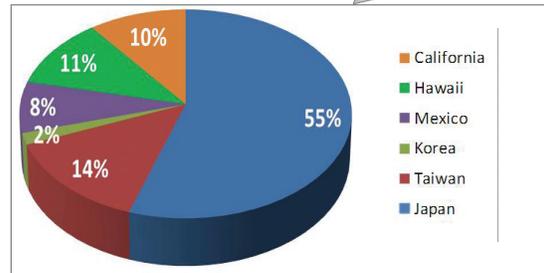
Oceanic frontal zones (dashed red ovals), enriched seas (yellow ovals) and coastal upwelling areas (red ovals) high in net primary productivity define optimal swordfish habitat and the major commercial fisheries.

**International Fisheries:** Several countries harvest North Pacific swordfish. Primary gear types in order of importance are longline, DGN, and harpoon. The U.S. catch makes up a small portion of the total Pacific-wide catch. Japan is the largest harvester, accounting for 55 percent of the mean catch from 1996 to 2005. The United States accounted for approximately 21 percent of mean catch during that time (all gear types). Of the U.S. portion, the catch was nearly split even (10 and 11 percent

respectively) between the west coast and Hawaii fleets. Over time, however, catch by the west coast fleet has declined.



North Pacific catch by flag 1951-2005.



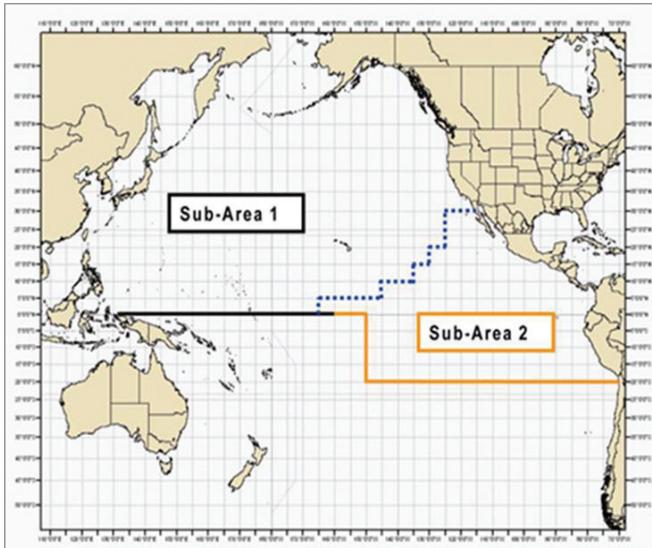
North Pacific catch by flag 1991-2005.

The U.S. swordfish fishery is managed to avoid and minimize interactions with sea turtles, especially loggerhead and leatherback sea turtles. Swordfish frequent high productivity areas that are also used by sea turtles, seabirds, and squid. The North Pacific Transition Zone is one such area. Scientists have long been studying the habitats and behaviors of sea turtles and swordfish and are incorporating their findings into recommendations for improved fishing practices. The use of habitat modeling and prediction and other gear and operational changes in U.S. fisheries have resulted in a significant decline in degree of sea turtles reported as incidental bycatch.

# North Pacific Swordfish: Stock Status and Trends

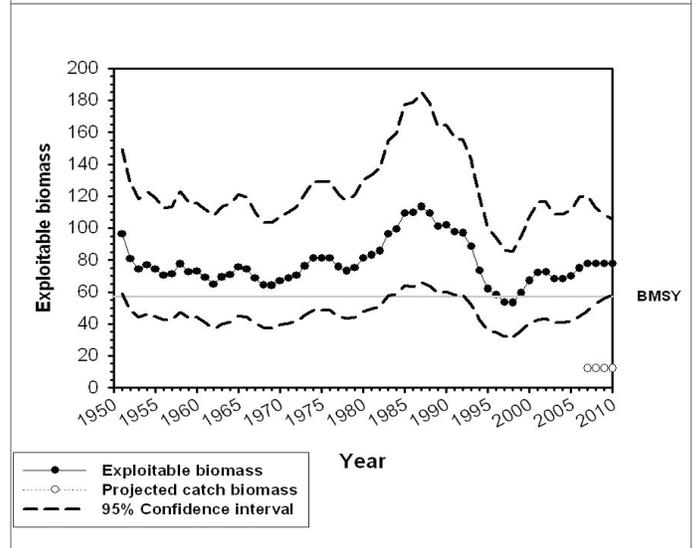
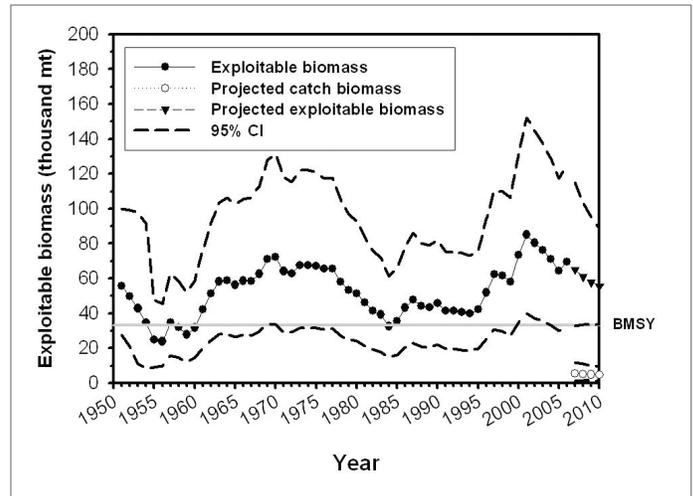
Jon Brodziak, NMFS, Pacific Islands Fisheries Science Center

North Pacific swordfish are comprised of two stocks. The western central stock primarily occurs in sub-area 1, an area stretching diagonally southwest from northern Baja to the equator and across the Pacific Ocean. The eastern stock primarily occurs south of the boundary at northern Baja to the eastern side of the Pacific off Peru. The boundary between the two stocks is not fixed, but loosely defined to exist within a 100 kilometer range. Tagging studies indicate that stock mixing occurs in the California Current off Baja California. Scientists think the boundary may be defined by a dissolved oxygen differential associated with the Intertropical Convergence Zone.



Sub Area 1 and Sub Area 2 reflect the western central and southeast stock structure of North Pacific swordfish.

Recent stock assessments indicate that both North Pacific swordfish stocks are healthy. Biomass is well above levels necessary to produce maximum sustainable yield ( $B_{MSY}$ ). This has been the case for most years since the 1950s, with the exception of a brief period in the 1990s. Currently, harvest rates in both the western and eastern North Pacific are below the harvest rate to produce maximum sustainable yield and neither stock is experiencing overfishing.



Projected swordfish biomass and catch in the eastern Pacific Sub Area 2 (top) and western central Sub Area 1 (bottom).

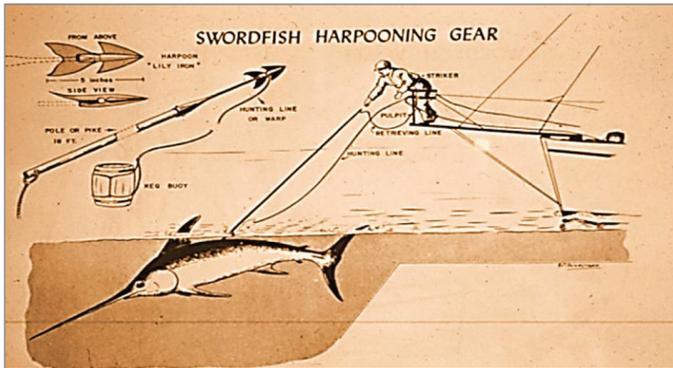
Continued management and monitoring are important to maintain the sustainability of North Pacific swordfish fisheries. Fishermen, consumers, fish stocks, the ecosystem, and management are dynamically linked subsystems of the swordfish fishery system and its assessment. Changes in one subsystem will cause changes in the others. Stock assessment and management measures will likely need to adapt through time to respond to changes in the system.



# Swordfish in California: A Brief History of the Fishery

Marija Vojkovich, California Department of Fish and Game

For over 100 years there has been commercial fishing for swordfish off of California. Fishermen first used harpoons to catch swordfish. In the late 1970s, fishermen using DGN gear to catch thresher and mako sharks discovered that they incidentally catch swordfish. Because it was profitable, they pushed to develop a DGN fishery for swordfish. Longline gear has also been used to target swordfish on the high seas beyond the west coast exclusive economic zone (EEZ). Along California, landings peaked in the 1970s for the harpoon fishery, in the late 80s for the DGN fishery, and in the late 90s and early 2000s for longline caught swordfish.

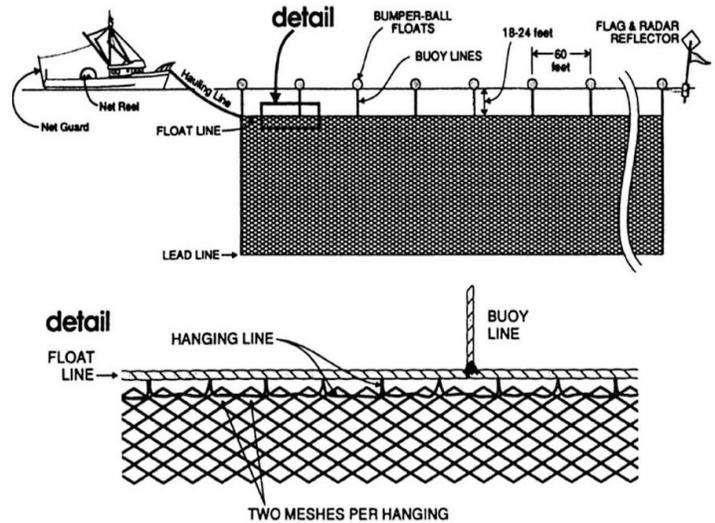


The typical gear used in the swordfish harpoon fishery.

The harpoon fishery is highly selective. While swordfish are basking at the ocean surface, fishermen harpoon an individual fish from a plank on the bow of their boat. Since 1984, spotter planes have been used to locate swordfish for fishermen. Harpoon permits, first required in 1931, were at an all-time high of 310 in 1979 and fell to a low of 25 in 2001.

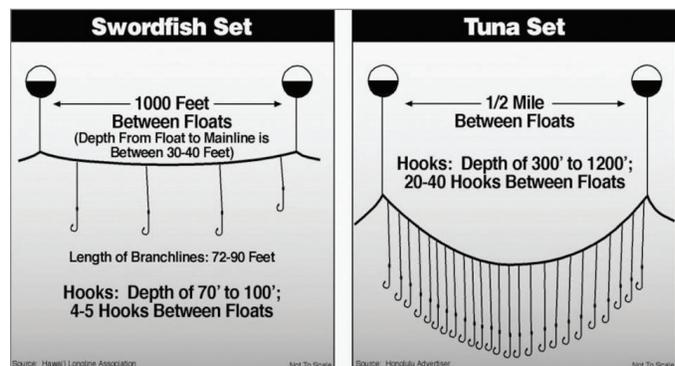
In 1980, the DGN fishery was managed by California Department of Fish and Game with swordfish and marlin quotas, observer coverage, and data collection requirements. In 1982, the quotas were repealed and spatial-temporal management was implemented to avoid gear conflicts and to protect pinnipeds. Between 1985 and 1992, additional time and area closures were implemented to manage thresher sharks and protect gray whales. In the late 1990s, additional gear modifications were required to reduce interactions with marine mammals, including the requirement to use

pingers and extend the buoy lines to deepen the net. In 2001, a large sea turtle conservation area established by NMFS closed a significant portion of coastal California to DGN fishing for three months each year.



The design of a typical net used in the California drift gillnet fishery.

Longline gear has also been used to catch swordfish on the high seas beyond the west coast EEZ, initially spurred by an influx of fishermen to California from the Gulf states in the early 1990s. Due to a court-ordered closure of the Hawaii-based swordfish longline fishery in 2001, a second wave of longline fishermen came over to the west coast and fished the high seas zone.

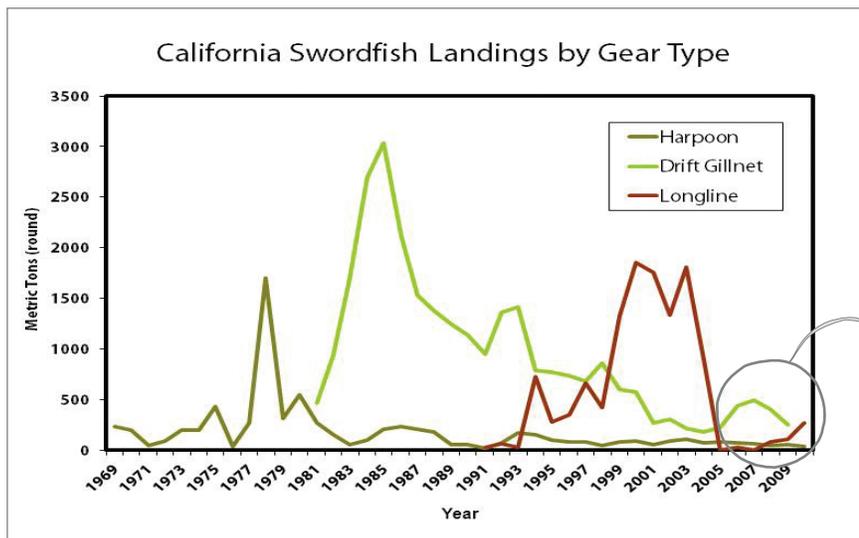


Shallow-set longline gear (left) and deep-set longline gear (right). Source: Hawaii Longline Association.

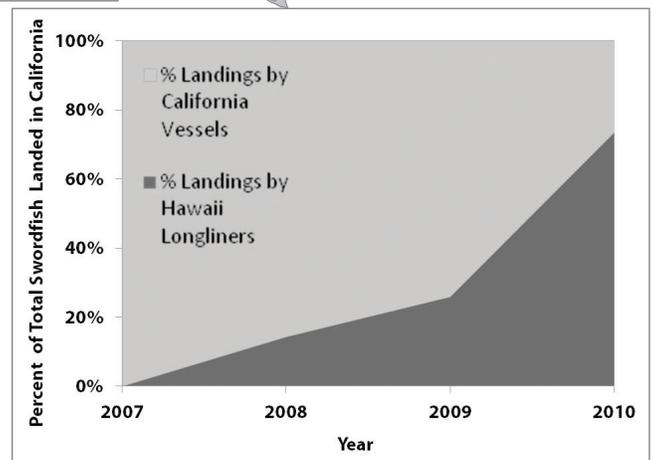
In 2004, to create a more holistic approach to managing transboundary west coast fish species and protected species, the responsibility for the management of swordfish, among other species, was transferred from the state to federal government. Through the Pacific Fishery Management Council (PFMC), the swordfish fishery has since been managed by NMFS together with the States of California, Washington, Oregon, and Idaho; commercial and recreational fishing representatives; and other fishery stakeholders.

Currently, overall west coast effort and landings have significantly declined. Today, there are approximately 30 active DGN vessels, down from nearly 300 in the mid 1980s. West coast swordfish landings have gone from a

peak of approximately 3,400 metric tons, round weight (i.e., total weight including bill, head, and all entrails) in 1985, to roughly under 400 metric tons, round weight (round mt) today. This is a small fraction of what they were in the late 1970s to early 2000s, and most is not landed by west coast fishermen. Approximately 70 percent of swordfish landed in California ports in 2010 were delivered by the Hawaii longline fleet. In 2009, Hawaii deliveries approached 35 percent of California swordfish landings. Some west coast fishermen suggested that this trend is a result of restrictive west coast regulations and a loss of access to productive fishing areas off of California.



California swordfish landings by gear type 1969-2009.



California swordfish landings by vessel origin 2007-2010.



# Federal Management of the U.S. West Coast Swordfish Fishery

Rod McInnis, NMFS, Southwest Regional Office

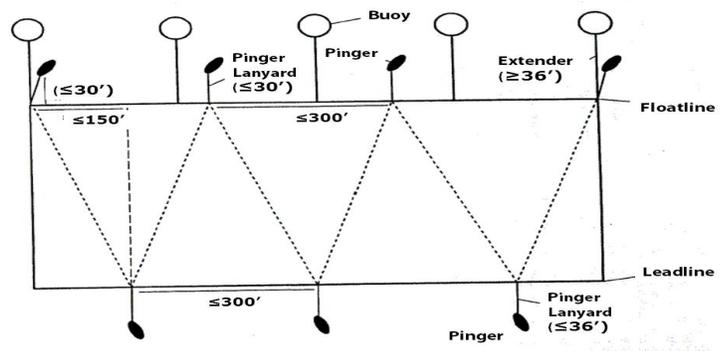
The U.S. swordfish fishery is managed to comply with numerous federal statutes. The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA) is the primary authority for managing federal fisheries. The *Fishery Management Plan (FMP) for the U.S. West Coast Fisheries for Highly Migratory Species (HMS)* was developed in accordance with extensive requirements of the MSA to ensure the sustainability of the fishery. For example, management measures must prevent overfishing, protect essential fish habitat, minimize bycatch, be based on the best scientific information available, and account for the importance of the fisheries to fishing communities. Federal fisheries must also comply with other federal laws, such as the ESA, the Marine Mammal Protection Act (MMPA), and the National Environmental Policy Act (NEPA).

The MSA established a public and highly participatory fisheries management council process that includes federal and state fisheries managers, commercial and recreational fishermen, and other stakeholders in the management of federal fisheries. Through the PFMC, NMFS manages the west coast swordfish fishery in collaboration with the States of California, Oregon, Washington, and Idaho; west coast fishermen; and other stakeholders, such as conservation organizations. NMFS and the U.S. State Department represent west coast interests in international negotiations as party to international fishery conventions. The PFMC's HMS Management Team consists of state and federal managers and scientists. The HMS Management Team works closely with the PFMC's HMS Advisory Subpanel, whose members represent HMS fishermen, seafood processors and buyers, and the conservation community. These advisory bodies identify issues and help to analyze and recommend management measures to the PFMC.

The MSA and NEPA, among other laws, have requirements for analyzing management options under consideration, standards for the information used in analyses, and processes for public comments. PFMC's Scientific and Statistical Committee (SSC) includes state and federal scientists, academics, and independent experts, who review the scientific information used for management decisions to ensure it represents the best

available science. NEPA requires that all federal actions consider and analyze a suite of alternatives. Impacts to both the human and environmental dimensions must be analyzed, including the cumulative impacts.

To protect marine mammals, many changes have been made in the operations of the west coast swordfish fishery. The MMPA provides authority to NMFS for managing marine mammals and their take. "Take", as defined under the MMPA, means to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." NMFS manages take in fisheries through fishery categorization, reporting programs, and take reduction plans. As a result of the work of the U.S. Pacific Offshore Cetacean Take Reduction Team, the DGN fleet now uses acoustic pingers and net extenders to reduce interactions with marine mammals. The Team consists of fishermen, and fishery scientists and managers who collaborate to design and implement these innovative methods. U.S. fishermen are also required to participate in skipper workshops to learn safe handling and release practices for marine mammals and sea turtles.



Drift gillnet with pinger devices to deter marine mammals.

Under the ESA, NMFS is required to minimize the impacts of federal actions, such as swordfish fishing, on threatened and endangered species to ensure the actions do not jeopardize their continued existence. Due to the history of interactions between drift gillnets and ESA-listed sea turtles, NMFS has implemented measures and conducted extensive research to reduce the fishery interactions and recover these populations. The fishery has undergone an ESA Section 7 consultation.

In the biological opinion, NMFS analyzed the impacts of the fishery as it currently operates and found that with required mitigation measures, the fishery does not jeopardize these sea turtles.

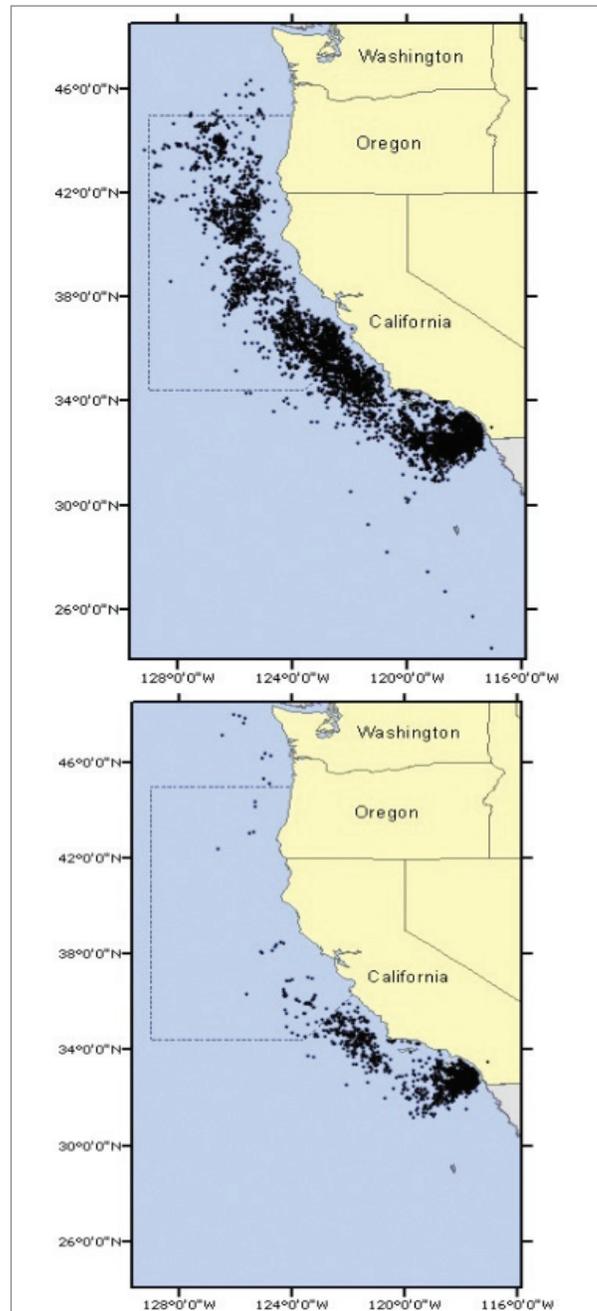
The mitigation measures included two time-area closures to protect the sea turtles. In 2001, the Pacific Leatherback Conservation Area (PLCA) was implemented to minimize interactions between leatherback sea turtles and the DGN fishery. The area extends from the coast of central California over 213,000 square miles of ocean and is annually closed from August 15 to November 15 (henceforth PLCA or leatherback closure). A separate closure may be implemented in the Southern California Bight to minimize interactions between loggerhead sea turtles and the DGN fishery. This closure could take place during the months of June, July, and/or August, depending on the oceanographic conditions. Because the peak season for swordfish fishing off of California generally occurs in October, the PLCA has greatly restricted swordfish fishing opportunity off the central California coast.



*PLCA closed to the drift gillnet fishing with mesh sizes greater than or equal to 14 inches.*

NMFS continually works to improve the science and methodology used to make fishery management

decisions. Since 2001 when the fishery was constrained to the Southern California Bight, there has been increasing concern about the fate of the west coast swordfish fishery and the ability of the U.S. to harvest this important resource. Protections for some sensitive and vulnerable species come at the expense of harvesting a healthy fish stock that could provide benefits to the nation, including jobs, food security, and recreational opportunities. The challenge now is to find new ways to balance these two important mandates and create a truly sustainable fishery.



*DGN sets from July 1990-May 2001 before the Pacific sea turtle conservation areas (top) and DGN sets from August 2001-January 2010, after the closures were established (bottom).*



# Session Summary

Key points made by presenters in this session included:

- The biology and life history characteristics of the North Pacific swordfish stock indicate that it is a relatively productive fishery resource. Swordfish are apex predators that exhibit rapid growth, early maturity, and high fecundity.
- Swordfish location and depth distribution can be fairly well predicted based on ocean productivity and environmental factors.
- North Pacific swordfish stocks are healthy. Overfishing is not currently occurring on either stock. The biomass of both the eastern and western stocks are estimated to be well above the level resulting in maximum sustainable yield.
- Many fishing nations target North Pacific swordfish, including Japan, Taiwan, Korea, Mexico, and the United States. The Japanese distant water longline fleet dominates the swordfish fishery in the North Pacific, accounting for over half of the annual landings. The U.S. fleet accounts for less than a quarter of the landings.
- Pacific-wide, the majority of North Pacific swordfish is caught with longline gear (as opposed to DGN and harpoon). The U.S. west coast swordfish fleet primarily uses DGN gear, largely because longlining is prohibited in the west coast EEZ. The recent increase in U.S. west coast swordfish landings is the result of increased offloading by the Hawaii-based longline fleet.
- Overall, the U.S. west coast DGN swordfish fleet has declined considerably in the past decade in terms of landings, value, effort (fishing days), and participating vessels. Declines in DGN fishing days per year are projected to continue. The PLCA, established to protect leatherback sea turtles from DGN interactions, combined with the ban on longline gear in the west coast EEZ, has significantly restricted access to some of the most productive swordfish fishing grounds off of California and greatly limited opportunity for the United States to harvest an abundant stock in its waters.
- Foreign countries have become the dominate suppliers of North Pacific swordfish, including to U.S. consumers. Foreign fisheries interact with many of the same protected species as U.S. fisheries, such as endangered leatherback sea turtles, and generally have higher bycatch rates than U.S. fisheries.

# Forming Partnerships: Spotlight on U.S. West Coast Fisheries

*A film by John Dutton Media*



This film highlights the U.S. west coast swordfish fishery. Faced with closure in the mid 90's, DGN fishermen, scientists, and regulators worked together in hopes to reduce the potential for interactions with marine mammals. They modified the DGN gear with extenders to deepen the nets and pingers to alert marine mammals to the presence of the nets in the water column. The film also profiles an entrepreneurial longline fisherman who created a direct-from-boat fish market, attracting thousands of visitors from all over southern California and opening new income avenues not only for himself, but also for the harbor and businesses in the area. Interviews with scientists and seafood consumers address sustainable fishing issues as well as considerations for buying U.S. caught fish versus imported fish.

To watch the video on YouTube, visit:

<http://youtu.be/GGdztOYFDCA>

To find more information about John Dutton Media, see:

<http://johnduttonmedia.com/videochannel/>

