HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM
SWORDFISH MANAGEMENT DATA REPORT AND FUTURE MANAGEMENT RECOMMENDATIONS

Introduction

In September 2011 the Council received a report from the National Marine Fisheries Service (NMFS) on the results of a 2-day informational workshop they hosted in San Diego, California, on May 10-11, 2011, titled *U.S. West Coast Swordfish Workshop: Working Towards Sustainability*. Attendees included West Coast fishermen, processors, distributors, conservation organizations, fishery managers, natural resource economists, and legislative aides. The genesis for the workshop came from a NMFS analysis that forecasted a continued decline in West Coast-based swordfish fishing effort and landings through 2020, while continued deliveries of swordfish to the West Coast are expected. In response, The Council directed the Highly Migratory Species (HMS) Management Team and Advisory Subpanel to provide the following information to inform a decision on whether to make modifications to the current management regime for the west coast swordfish fishery:

1. All relevant new information on bycatch and bycatch mitigation in swordfish fisheries, including the amount and reasons for changes in bycatch in the Hawaii based longline fishery since 2000 and the DGN fishery since 2001, and information about new gears, such as the buoy-based gear used in Florida area fisheries and currently being trialed in southern California waters;
2. Current research on the distribution of sea turtles and their critical habitat off the west coast and its relevance to potential fishery management changes, including a potential change to the configuration of the Pacific Leatherback Conservation Area (PLCA); and
3. Based on the information in 1 and 2 above, comparisons of protected species bycatch estimates between current, status quo west coast swordfish fisheries, the gear types described above, fisheries in place at the time of HMS FMP adoption and possible future fishery designs.

This report addresses the Council's information request by a presenting a comprehensive look at the current status of the west coast swordfish fishery and includes:

1. Conservation and management issues, consumption and demand trends, swordfish stock status, protected species bycatch in swordfish fisheries, and current mitigation measures
2. Background on Council involvement in management of west coast swordfish fisheries
3. A summary of HMS permit holder responses to a questionnaire and informal port meetings exploring potential management options
4. Current and future research objectives and needs

Background

The NMFS-sponsored Swordfish Workshop highlighted several areas of concern and opened avenues for further discussion with stakeholders including consideration of potential gear and operational modifications coupled with potential management changes to revitalize the fishery while minimizing protected species bycatch. Since that time, there has been continuing constructive dialogue with west coast HMS fishermen including a Revitalizing the Swordfish Fishery Questionnaire sent out by the California Department of Fish and Game (Summary of Results in Appendix A) and two informal port

meetings with fishermen in Morro Bay and Monterey. (Agenda Item B.1.b, Attachment 1, March 2012, describes the results of these port meetings)

Swordfish are primarily harvested in the Pacific using pelagic longline gear with Japan accounting for over half of the annual landings. U.S. swordfish fisheries in the Pacific comprise roughly 20% of the Pacific-wide landings. Domestically, swordfish are harvested using shallow set longline gear off Hawaii and on the high seas, along with large mesh drift gillnets (DGN) off California and, to a lesser extent, harpoons during the summer-fall months in the Southern California Bight. Due to protected species bycatch concerns, NMFS- approved observers were first placed on DGN vessels starting in 1990 to gather data on interaction rates. Since then, the number of active vessels participating in the DGN fishery has ranged from a high of 154 vessels in 1992, to a low of 53 in 2010. Similarly, effort in the fishery based on total annual vessel days, has consistently declined since 1990 from a high of approximately 5,400 vessel days at sea in 1993 to approximately 760 days in 2009 and 492 days in 2010 (see Figure 1). Using data available in 2011, NMFS forecasts that DGN fleet effort in 2015 will hover around 500 days and will further decline to about 300 to 450 fishing days by 2020 (see Figure 2).

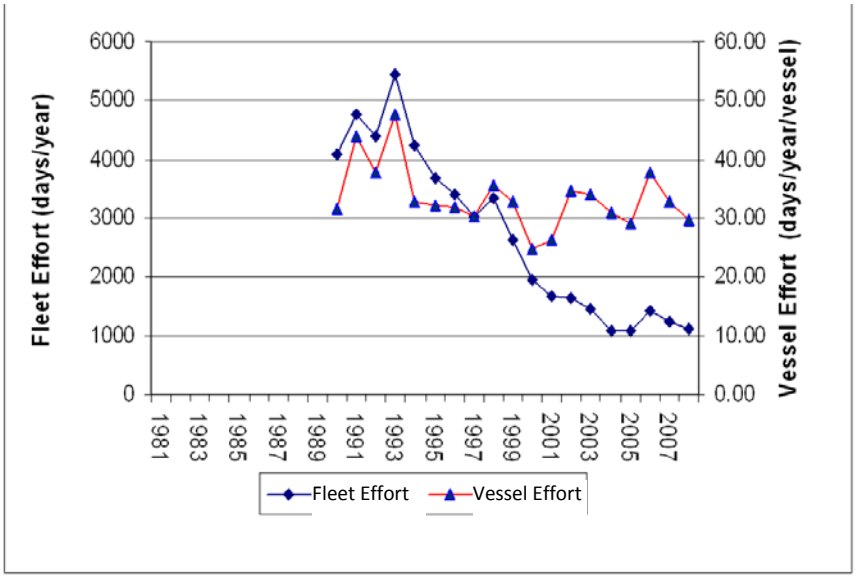

Figure 1. Fleet and vessel effort for the drift gillnet fishery. (Source: NMFS SWR).

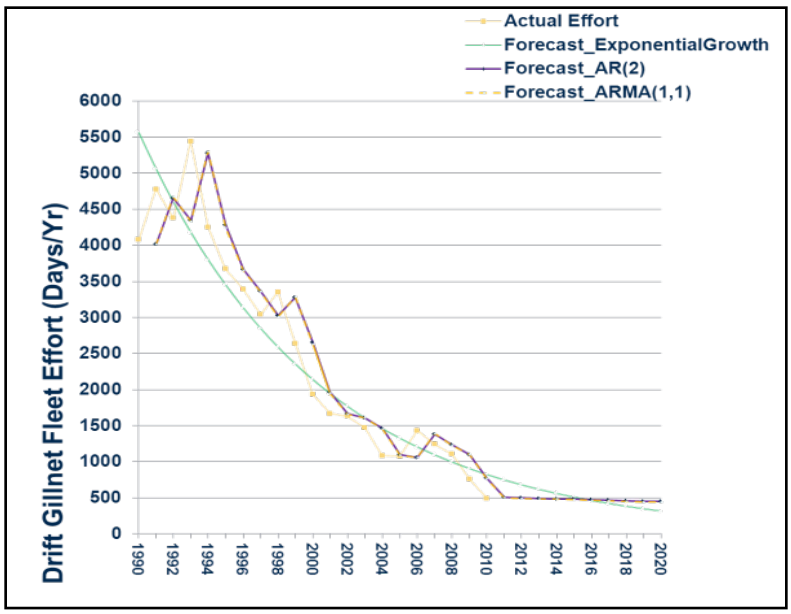

Figure 2. Forecast of change in drift gillnet fishing effort through 2020 (Source: NMFS SWR).

The current decline in DGN effort does not appear, however, to be associated with the status of the North Pacific swordfish stock as the most recent stock assessment for Pacific swordfish stocks indicate that the exploitable biomass of both sub-stocks is above biomass levels necessary to achieve maximum sustainable yield (see Stock Assessment Results in Appendix B). Industry representatives attribute the decline in vessel participation and annual effort to regulations implemented to protect threatened and endangered marine mammals, seabirds, and sea turtles.

Despite the declining trend in U.S. harvested supply, consumption of swordfish products in the United States remains high and is met primarily by foreign imports and secondarily by domestic landings from both California and Hawaii fisheries (see Figure 3). U.S. landings only supply fraction of total annual swordfish consumption in the United States. This trade deficit has implications for U.S. jobs, west coast communities, and local U.S. food production and security. Additionally, scientists are now investigating the effects of foreign swordfish harvest on protection and recovery of sea turtles that migrate through international waters and encounter fishing fleets that are not employing the same (if any) protective measures required of U.S. fishermen including adequate monitoring and enforcement oversight.

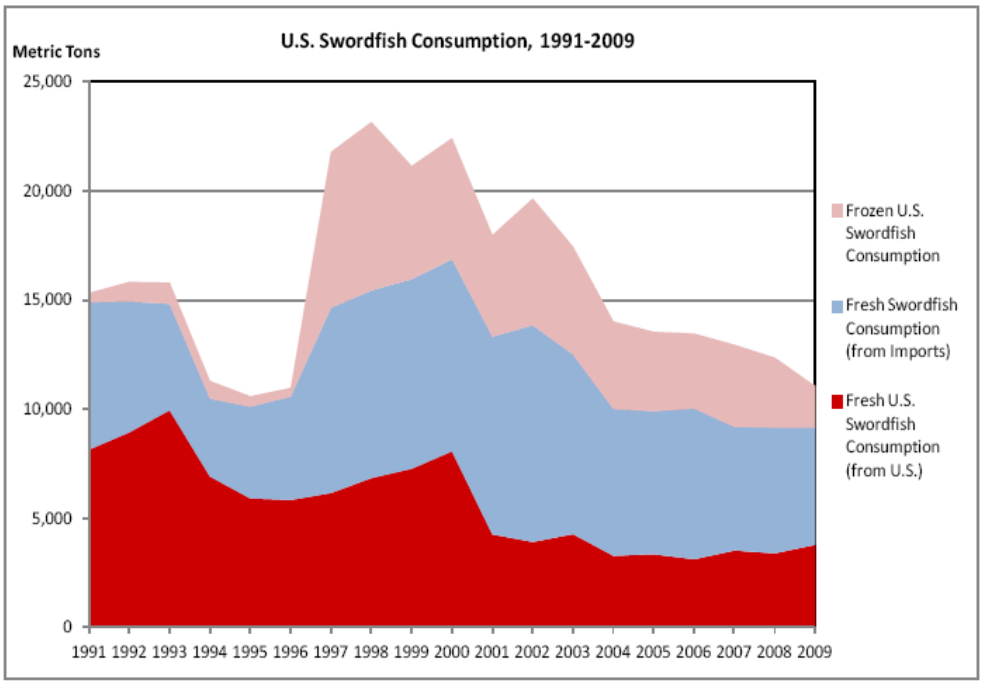

Figure 3. U.S. swordfish consumption, 1991-2009. (Source Chan, H.L. and M Pan. 2012. Spillover effects of environmental regulation for sea turtle protection: The case of the Hawaii shallow-set longling fishery. U.S. Dep. Commerce, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-30, 38 p + appendices.)

History of Council Swordfish Management Decisions

Partial disapproval of the HMS FMP in 2004 resulted in the closure of the shallow-set longline fishery (SSLL) for swordfish that had been operating out of the west coast at that time. This closure resulted from the ESA section 7 consultation on the FMP which found that the fishery jeopardized the continued existence of loggerhead sea turtles. A large fraction of the west coast fleet was composed of vessels that had deregistered from their Hawaii limited access longline permit and moved over to California when the Hawaii fishery closed in 2001 (also because of sea turtle incidental take). However, also in 2004 the Hawaii fishery re-opened with a variety of mitigation measures to address incidental take of sea turtles, so those vessels returned to Hawaii and have been fishing from there ever since. In disapproving the portion of the FMP authorizing the SSLL fishery, Rod McInnis, the NMFS Regional Administrator, encouraged the Council to pursue the adoption of mitigation measures along the line of what had been implemented in the Hawaii fishery which would allow the west coast fishery to re-open. While the HMSMT began investigating the development of a limited entry program and other measures in 2004-05, this effort was never completed, in part because a hiatus in funding caused the Council to suspend activities related to the HMS FMP during this period.

From 2006 to 2008 the Council reviewed two proposed exempted fishing permits intended to explore management changes for both the SSLL fishery and the California drift gillnet (DGN) fishery, which also targets swordfish along with thresher shark.

The EFP for the DGN fishery was developed by the HMSMT and HMSAS in cooperation with DGN fishery participants. It would have allowed a small number of vessels to fish in the Pacific Leatherback Conservation Area (PLCA) under full observer coverage and caps on protected species takes that would trigger termination of fishing under the EFP. The PLCA was implemented in 2001 in response to an ESA

consultation on the DGN fishery that found jeopardy in the take of leatherback sea turtles. The PLCA seasonally closes a very large area (from south of Monterey in California to central Oregon) that encompasses some of the prime fishing grounds for the DGN fishery. The PLCA was drawn to encompass all the observed takes in the DGN fishery, because there was very little information at the time on the actual distribution and migratory patterns of the leatherback sea turtle. The DGN EFP was intended to explore whether the fishery could be prosecuted in some areas within the PLCA without encountering leatherback sea turtles and the use of mitigation measures (such as caps on turtle takes) to ensure that such activities would not trigger an ESA jeopardy finding. In 2006 and 2007 the Council recommended that NMFS issue the EFP but the permit was never issued.

The Council considered a second EFP to authorize a single vessel to fish in the west coast EEZ targeting swordfish with SSLL gear. The purpose of the EFP was to make an initial assessment of the economic viability of longline gear as an alternative to DGN gear with potentially lower bycatch mortality. The EFP would be issued with a range of mitigation measures to address protected species bycatch and other impacts. The Council recommended issuance of the EFP in 2007 and 2008 but the permit was never issued.

In 2009 the Council considered a limited entry program, various gear requirements along the lines of those required for the Hawaii fishery, and sea turtle take caps as part of a package to authorize a SSLL fishery outside the west coast EEZ (since longline fishing is prohibited inside the EEZ under the HMS FMP). The HMSMT evaluated and provided input to the applicant's proposal, which the Council considered in April 2009. At that time the Council voted to not proceed with further consideration of this management change.

While the Council has been unsuccessful in addressing constraints on west coast swordfish fisheries, primarily due to protected species impacts, the Hawaii SSLL fishery has re-opened and resumed operations. Figure 4 shows landings by the Hawaii longline fishery since 2000, noting the period when the SSLL fishery was closed. (Note that the deep-set tuna longline fishery has a small trip retention limit for swordfish accounting for the landings during the years when the SSLL fishery was closed.). In 2009 NMFS approved Amendment 18 to Western Pacific Council's Pelagics Fishery Ecosystem Plan and issued regulations (74 FR 65460), which lifted an annual effort limit on the SSLL fishery of 2,120 sets and increased the incidental take limit (turtle cap) for loggerhead sea turtles to 46, consistent with the no jeopardy finding in the Biological Opinion for that action, which was based on an estimated 5,500 sets per year.

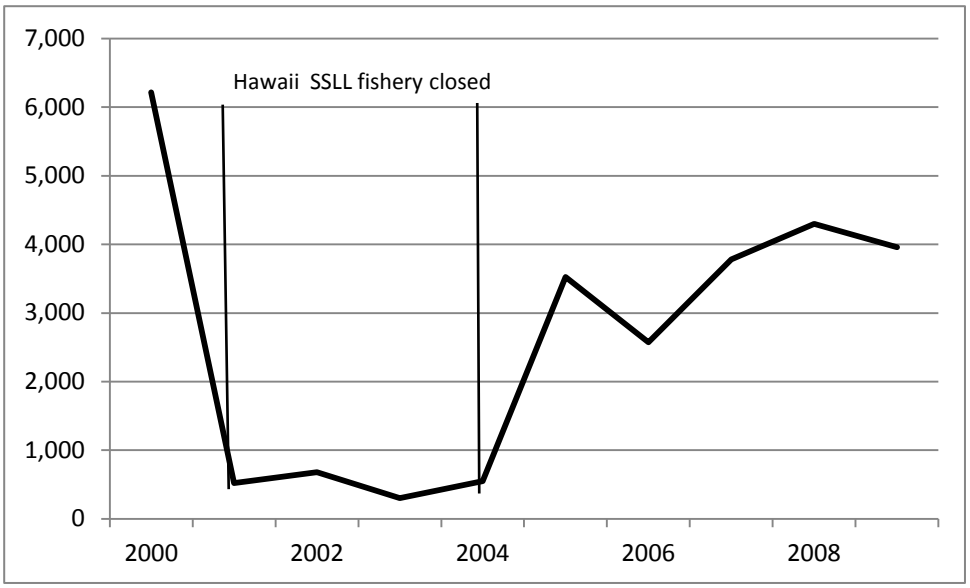

Figure 4. Hawaii swordfish longline landings, 2000-09 (mt). (Source: Pelagic Fisheries of the Western Pacific Region, 2009 Annual Report. WPFMC, 2011.)

However, the action was challenged in Federal Court by several environmental organizations. Eventually, the plaintiffs and NMFS agreed to settlement terms that on January 31, 2011, were approved under a stipulated injunction and order entered by the Court. Under the terms of settlement, that portion of the 2009 rule increasing the maximum annual incidental take of loggerhead sea turtles by the fishery to 46 was vacated and remanded to the agency. On March 11, 2011, consistent with the requirements of the stipulated injunction, the previous annual limit of 17 was reinstated through agency rulemaking (76 FR 13297). In addition, that portion of the 2008 BiOp addressing loggerhead and leatherback sea turtles was vacated and remanded to the agency. All remaining provisions of the 2009 rule remained in effect, including the removal of the annual set limits. The injunction required NMFS to prepare a new biological opinion and incidental take statement (ITS) for the fishery within 135 days of taking final action on a joint NMFS and U.S. Fish and Wildlife Service (USFWS) proposed rulemaking to designate nine distinct population segments (DPS) of loggerhead sea turtles and to change the listing status of loggerhead sea turtles under the ESA. The new biological opinion was released on January 30, 2012. The ITS finds that in a 2-year period the fishery could incur 68 interactions (14 killed) with loggerheads and 52 interactions (12 killed) with leatherbacks. The biological opinion concluded that this level of take would not jeopardize the continued existence of these species.

Hawaii longline vessels are also landing swordfish on the west coast. As discussed below, in the last 2 years swordfish landings on the west coast by these vessels have exceeded total swordfish landings by west coast vessels managed under the HMS FMP.

Recent Trends in Hawaii SSLL Landings to the West Coast

The HMSMT analyzed recent trends in Hawaii shallow-set longline swordfish landings to the West Coast. Federal regulations allow longline vessels to use shallow-set gear to catch swordfish seaward of the 200 mile West Coast EEZ limit and land their catch to California ports, provided they possess both a Hawaii Fisheries Ecosystem Plan (HI FEP) permit and a West Coast HMS FMP permit, and they follow both sets of permit regulations.

The following graph shows the recent share of overall California swordfish landings caught by vessels fishing under HI FEP permits (cross-hatched shading); the remaining share of landings were due to all

California fisheries combined (solid shading). The California fishery share of landings dropped off from over 95% during 2005-2007 to a level below 20% in 2011, suggesting that California market demand has been increasingly met in recent years by supply from the Hawaii fishery.

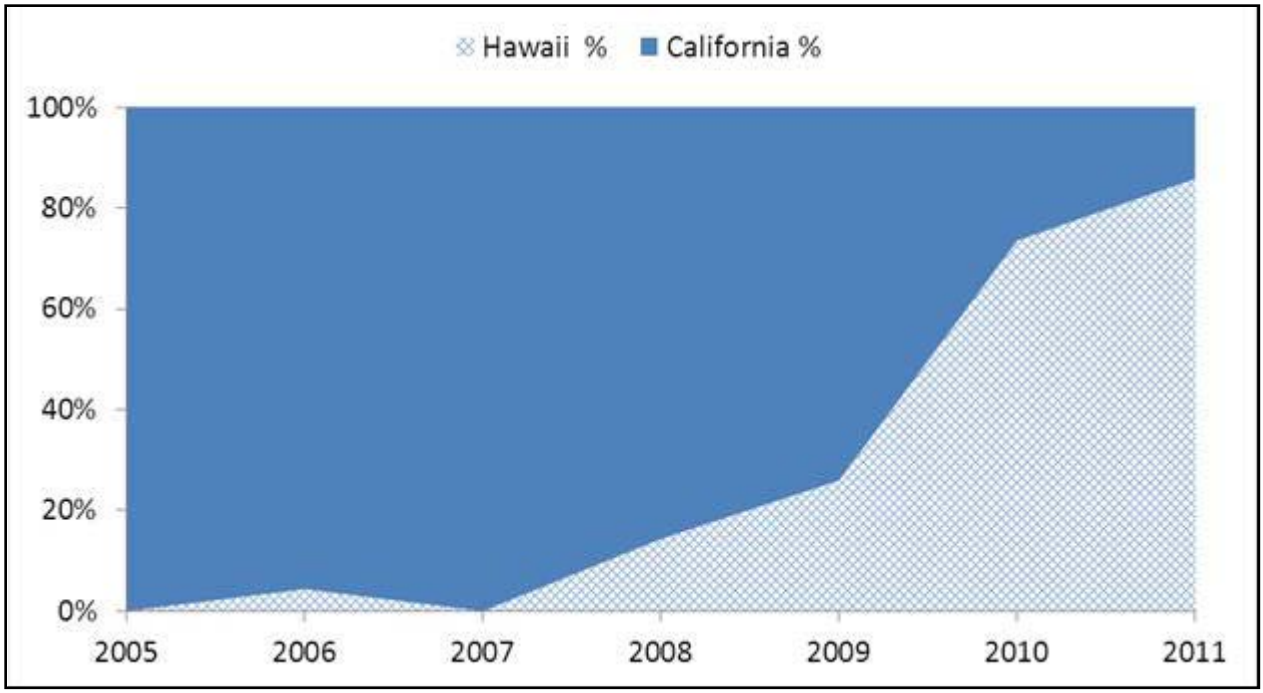

Figure 5. Hawaii and California fishery share of California swordfish landings.

Bycatch Estimates from Hawaii SSLL Vessels Landing on West Coast

The HMSMT has requested observer records from the NMFS Hawaii Observer Program for those Hawaii SSLL vessels that have made landings to west coast ports. At the time this report went to print those estimates were still forthcoming and it is hoped that they will be received in time to include in the HMSMT's Supplemental Report to the Council on Friday March 2.

Research conducted by Watson et al. (2002) on the effects of hook type and bait selection on sea turtle interaction rates in the U.S. Atlantic Coast SSLL swordfish fishery demonstrated significant reductions in the capture rates of both loggerhead and leatherback sea turtles when using circle hooks and mackerel bait compared to using J-hooks and squid bait (88% and 63% reductions respectively).

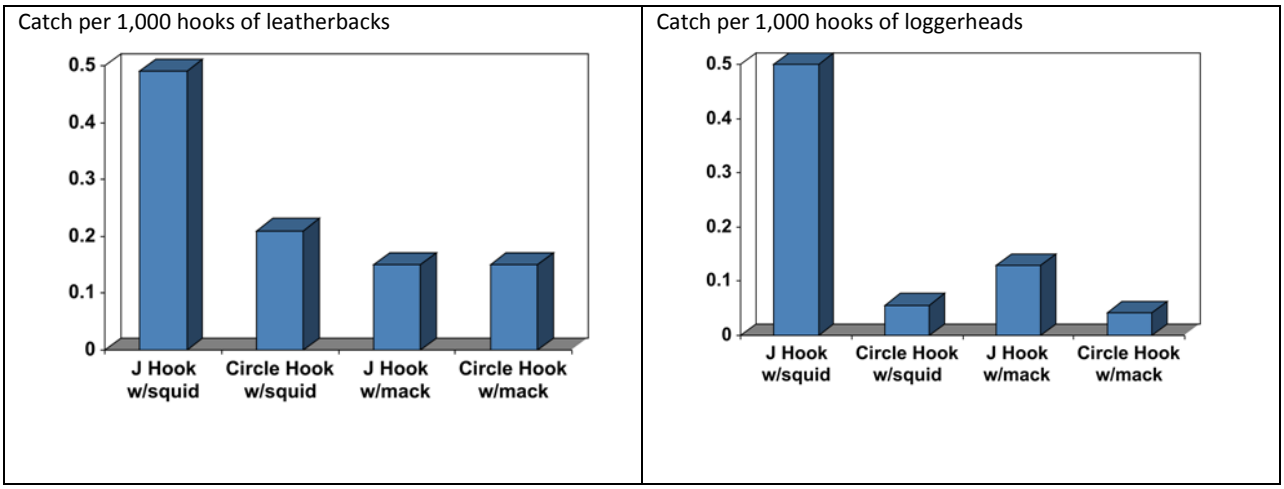

Figure 6. Catch rates of leatherback and loggerhead sea turtles in the U.S. Atlantic Shallow Set Longline Swordfish Fishery with varying hook and bait types. (Watson, et al. 2002).

The Hawaii SSLL swordfish fishery began using circle hook and mackerel bait in the 2004 fishing season when it re-opened after closure in 2001. As with the Watson study, observer records demonstrated a significant decrease in the catch rates for both loggerhead and leatherback sea turtles (Gilman, 2006).

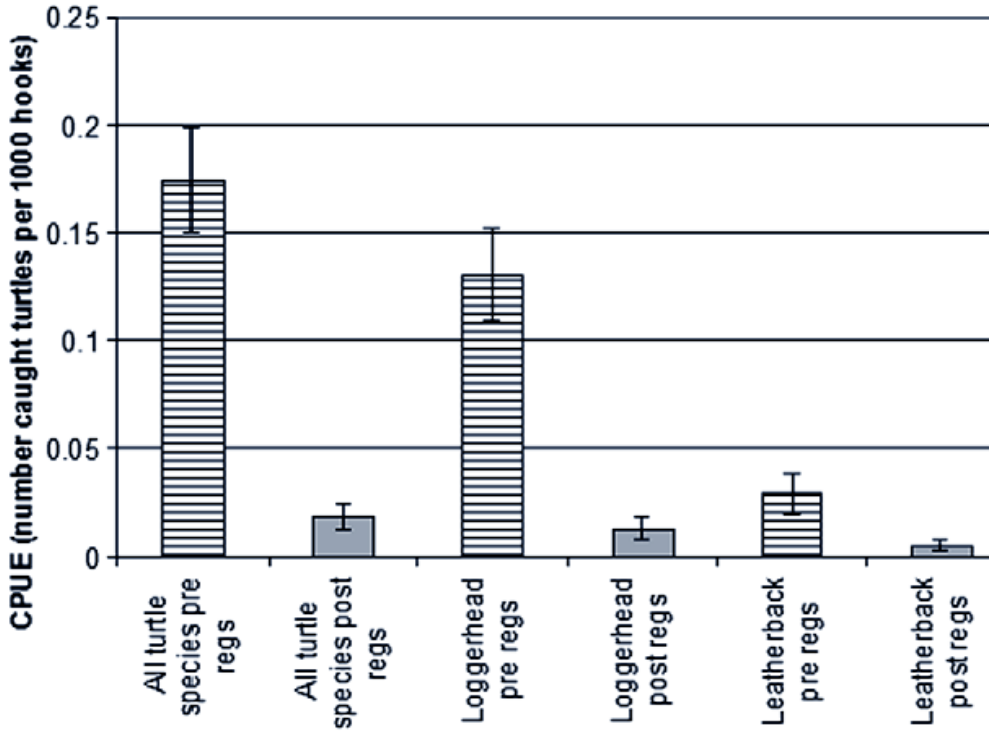

Figure 7. Catch rates of leatherback and loggerhead sea turtles in the Hawaii Shallow Set Longline Swordfish Fishery prior to use of circle hooks and mackerel bait (hatched) and after use of circle hooks and mackerel bait (shaded). (Gilman et al., 2006)

Bycatch Estimates from the West Coast DGN Fishery

Tables of the observed catch of finfish and protected species in the swordfish DGN fishery since 1990 are provided in Appendix C. Regulations prohibiting fishing in the PLCA between Aug. 15 and Nov. 15 went into effect in 2001. The data show that for a number of marketable non-target species, including shortfin mako and common thresher sharks, and opah, nominal catch per set has increased since the closure while swordfish nominal catch rate remains relatively unchanged. For bycatch species, there has been an increase in common mola catch, whereas blue shark catch has declined. For protected species, the numbers of interactions by species are very low precluding reliable statistical comparisons of interaction rates. However, when classified into larger taxonomic groups, nominal catch rates for turtles, mammals, and pinnipeds have each declined since implementation of the PLCA closure, restrictions limiting the extenders to no less than 36 ft, and the required use of pingers. Because data have not been available from within the PLCA for most of the past decade, interpretation of the changes in nominal catch rates is problematic and may not be reflective specifically of an effect of the closed area, particularly for these highly migratory species that inhabit a very vagile pelagic environment. The conclusion is that fewer protected species have been caught in the past decade and that analyses should be revised based on current fishery practices, current effort and the relative distribution and abundance of protected species and other species of concern.

Comparison of Bycatch Estimates from SSLL and DGN gears

A direct comparison of the bycatch with the two gear types is not possible because of the geographic separation between the two fisheries. The DGN fishery had operated in the U.S. EEZ from the U.S./Mexico border to the Oregon/Washington border but is now constrained primarily to the Southern California Bight due to the PLCA. The swordfish longline fishery operates outside the U.S. west coast EEZ on the high seas. Moreover, the California Current, where the DGN fishery primarily operates, is a highly productive boundary current system that may have a greater diversity and abundance of fish vulnerable to the fishery activities. Nonetheless, the observer data cited above are informative in demonstrating some differences.

Economic Viability of Harpoon Fishery and Market Demand

Conservation NGO representatives have suggested that harpoon should be the only gear allowed to target swordfish off the West Coast, based on the presumption that the fishery incurs little or no protected species bycatch. Anecdotal information shared by swordfish fishermen present at the January 2012 HMSMT meeting and on numerous other occasions suggests that harpoon is not an economically viable substitute for other gears historically used to target swordfish on the West Coast, including drift gillnet and longline. Harpoon fishing for swordfish entails high search costs, possibly involving the use of a spotter airplane, to locate swordfish on the surface where they can be speared. The relatively low rate at which swordfish can be located and harpooned (catch per unit effort) compared to other targeting strategies, and a season restricted by nature to the warm summer months and to the calm waters of the Southern California Bight, further limit the economic viability of harpoon as a swordfish gear.

Despite open access status, the available evidence indicates the West Coast harpoon fishery did not substitute for the sharp decrease in swordfish supply in recent years from the West Coast drift gillnet and longline swordfish fisheries. The following graph compares recent West Coast swordfish landings by the West Coast longline[1], drift gillnet and harpoon fisheries.

[1] The HMS FMP did not authorize longline effort on swordfish; hence the West Coast longline swordfish fishery data series ends in 2004.

The graph reflects a long-term pattern of declining participation in the California drift gillnet and longline fisheries for swordfish. For instance, the number of shallow-set longline vessels that landed in California was 40 in 2003 (Table 4-53, 2010 HMS SAFE Report, September 2011), but sharply declined to fewer than 10 vessels in each year since the HMS FMP went into effect in 2004 without authorizing shallow-set longline as a legal gear. Similarly, the numbers of drift gillnet vessels with HMS landings to California dwindled from 154 in 1992 down to 53 in 2010 (ibid.).

Harpoon landings remained relatively flat over the period, showing minimal supply response to significant reductions in longline and drift gillnet landings. The gap between market demand and supply at recent world swordfish market prices was unmet by the harpoon fishery.

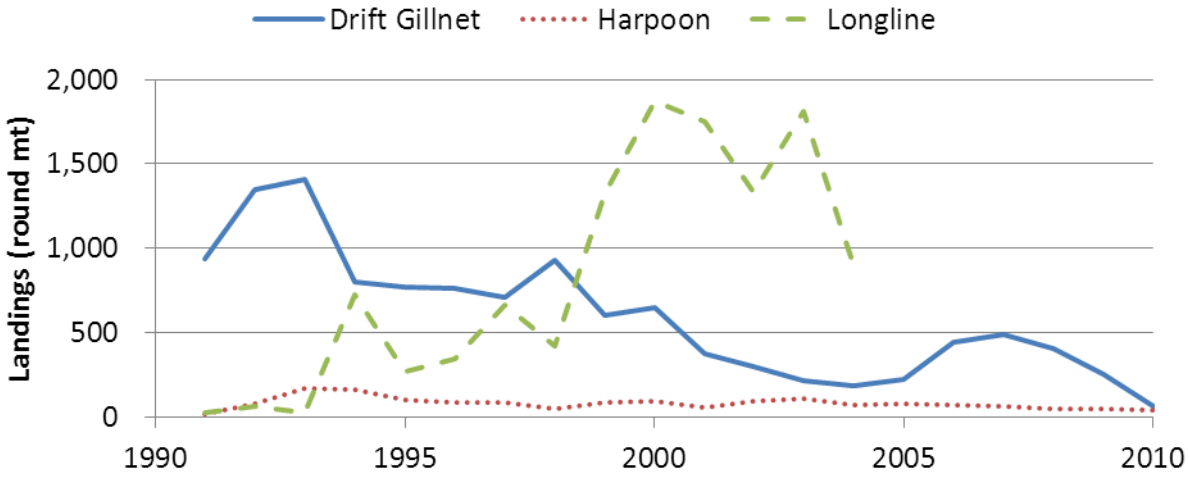

Figure 8. West coast commercial swordfish landing by west coast fisheries, for the years 1991-2010. (Source: Table 4-28, 2010 HMS SAFE Report, September 2011.)

DGN Latent Permit Issues

The HMSMT discussed latent permits in the drift gillnet fishery[2] at their January 2012 meeting. An issue raised when a limited entry permit system for swordfish was considered at the April 2008 Council meeting concerned the possibility that newly authorized longline effort, coupled with an increase in drift gillnet effort due to latent permits coming back into use, might result in an unacceptably high combined level effort for the two fisheries. According to the CDFG permits database, 82 DGN permits could potentially have been fished during the 2010 season.

The graph shown below tracks attrition from activity of 80 existing permits as of the 2009 fishing season, based on the last year they showed a record of landings in the California logbook database. No landings records were found in any year since 1985 for three of the permits, while the other 96.3% (77/80) registered activity since 1985, corresponding to the leftmost point on the graph. By 1996, only 80% (64/80) of the permits showed current or later activity. Slightly below 40% (31/80) of existing permits as of 2009 showed effort in 2009 or later, implying that slightly over 60% of existing permits as of 2009 were latent.

[2] A latent permit is not currently in use, but could allow a vessel to prosecute future drift gillnet fishing effort.

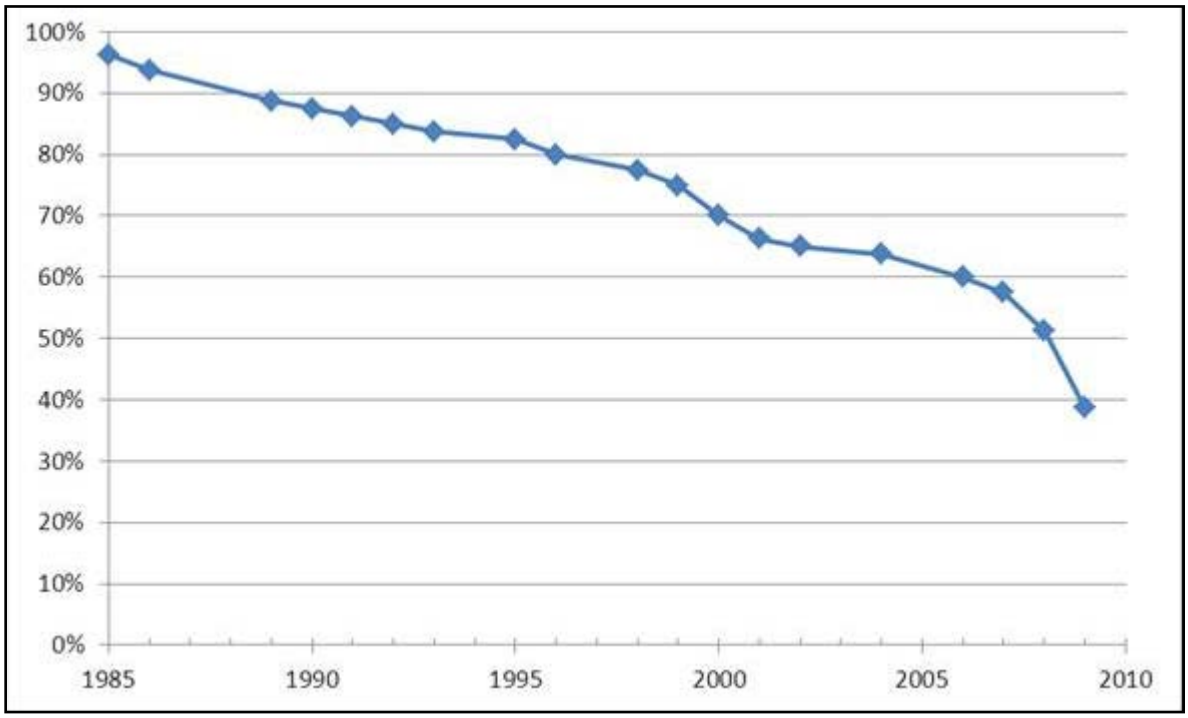

Figure 9. Attrition of existing permits in 2009 from active use.

Numbers of DGN permits issued are compared to active DGN vessels in the following chart, based on data from the 2010 HMS SAFE Report, Table 2-3. The graph shows a persistent excess of available permits over the number of active vessels all the way back to the late 1980s, with only a couple of years where the gap temporarily closed. The gap has grown slightly in absolute terms over recent years, but by more in percentage terms, due to the overall pattern of attrition from the DGN fishery in terms of both numbers of permits issued and active vessels.

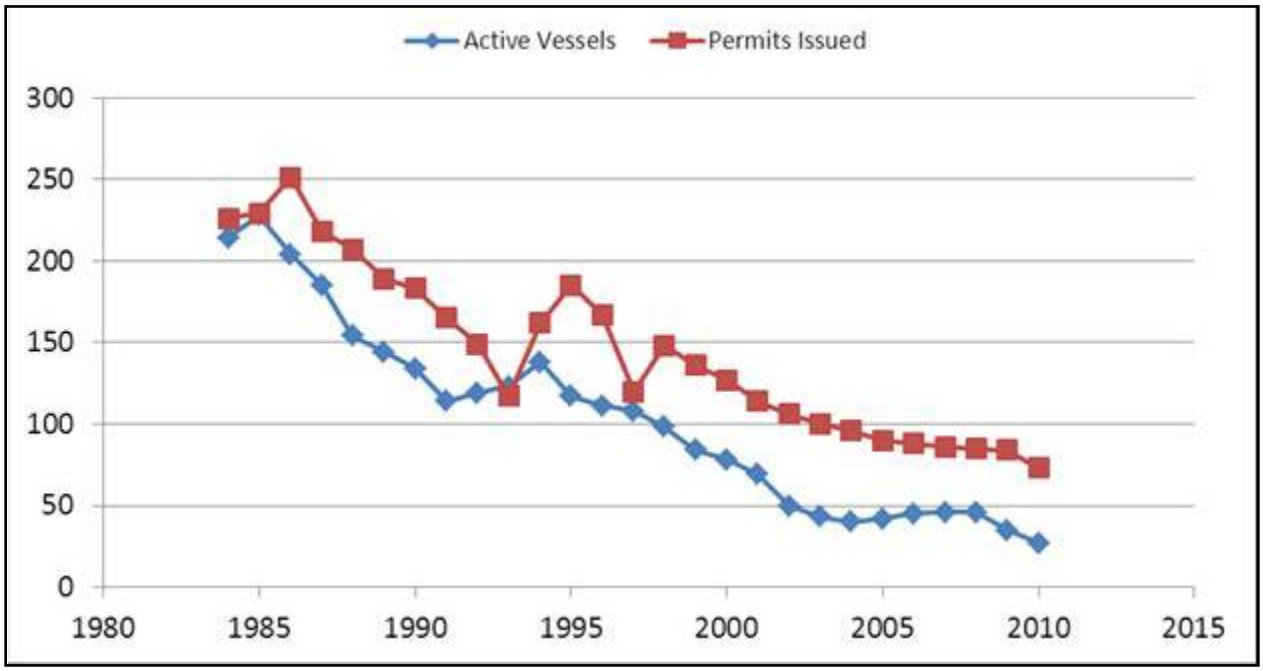

Figure 10. Annual drift gillnet permits and number of active vessels, 1984-2010.

If the Council reconsidered a West Coast-based longline fishery, the HMSMT could develop alternative strategies to connect changes in permitted longline fishing effort to drift gillnet permits, so combined effort for the two fisheries remained in compliance with federal and state conservation laws, including the RMSA, the ESA and the MMPA.

Recent Federal Actions Impacting Sea Turtle Populations

Designation of Leatherback Sea Turtle Critical Habitat

In January, 2012, NMFS issued a final rule to designate critical habitat for leatherback sea turtles in two areas, one including an area from Point Arena to Point Arguello off the coast of central California (16,910 square miles) and one off the Pacific Northwest, from Cape Flattery, Washington to Cape Blanco, Oregon (25,004 square miles) representing a total of approximately 41,914 square miles of marine habitat (see Figure 11). In October, 2007, NMFS received a petition from three environmental organizations to revise the leatherback critical habitat by adding areas in the Pacific Ocean. Following a proposed rule published in 2010 and a response to comments, NMFS determined that the principal biological or physical features that were essential to the conservation of the species should include prey only. Because NMFS could not identify specific migratory corridors used by leatherbacks to access areas of high prey density, the agency eliminated "migratory pathways" as an essential physical feature as it had proposed in 2010. Under section 4(b)(2) of the Endangered Species Act, NMFS was also required to identify specific management considerations or protections as a result of the designation. NMFS identified several activities that may require consultation under Section 7 of the ESA to determine whether they threaten the habitat (i.e. prey) of leatherbacks including: point source pollution (including pesticide application), oil spill response, power plants, desalination plants, tidal/wave/energy projects and liquid nitrogen gas facilities.

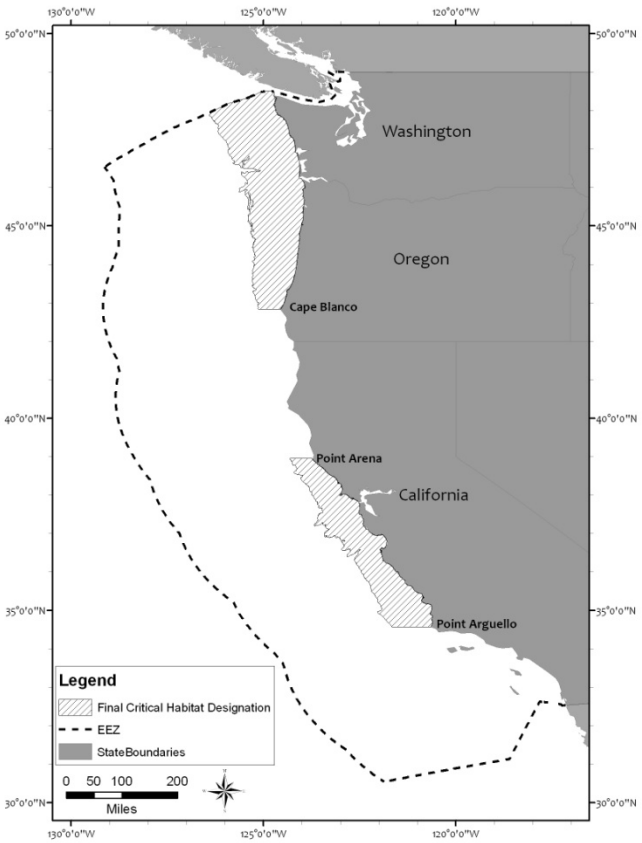

Figure 11. Final critical habitat designation for leatherback sea turtles on west coast.

Listing of Loggerhead Sea Turtles as Distinct Population Segments

In September, 2011, NMFS and the U.S. Fish and Wildlife Service published a final rule to list nine distinct population segments (DPS) of the loggerhead sea turtle. Two DPSs occur within the United States, including the North Pacific DPS (listed as endangered) and the Northwest Atlantic DPS (listed as threatened). Under the ESA, the Services are required to consider whether there are geographic areas that are essential to conserve the species. Generally, critical habitat can be concurrently proposed at the time of listing or within a year after the date of the listing. Currently, a critical habitat review team has been formed and met in late January 2012. The team plans to submit a proposed rule in September or October of 2012.

Swordfish Buoy Gear

Dr. Chugey Sepulveda of the Pfleger Institute of Environmental Research (PIER) will present to the Council an overview of current research underway in collaboration with NOAA Fisheries on the use and viability of deep-set swordfish buoy gear in the Southern California Bight. The gear and operational methods employed were derived from the existing U.S. Atlantic Coast Swordfish shallow-set Buoy Fishery with modifications for use as deep-set gear fishing in nearshore waters below the thermocline (see Figure 12).

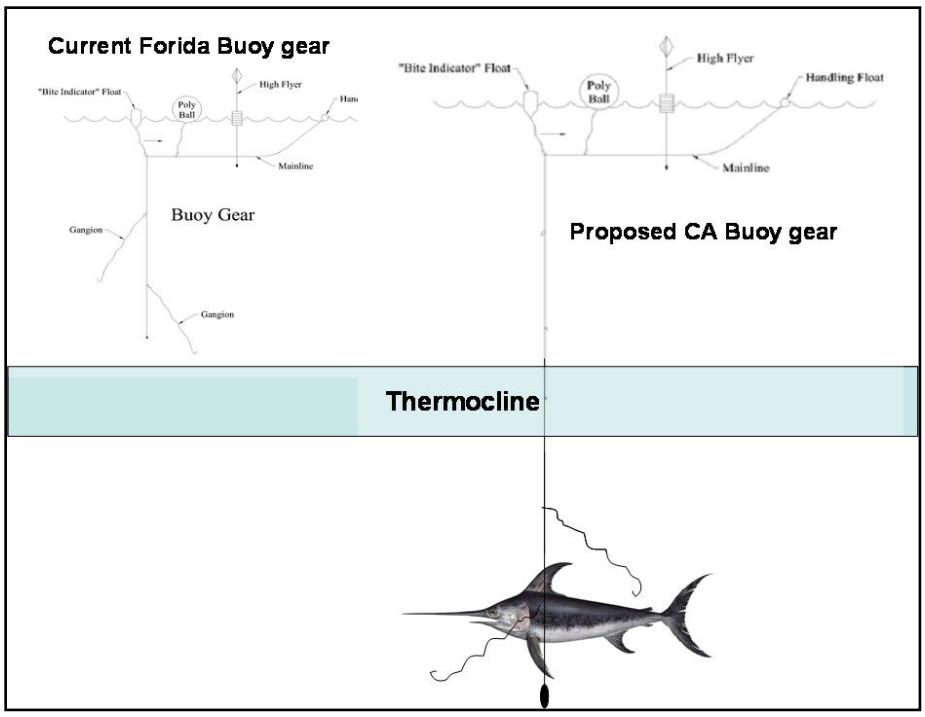

Figure 12. Graphic showing deployment of buoy gear.

The objective of fishing deep-set buoy gear below the thermocline during the day is to capitalize on the habitat separation and behavioral preferences (e.g., thermal ranges) between target swordfish and non-target species of concern (see Figure 13).

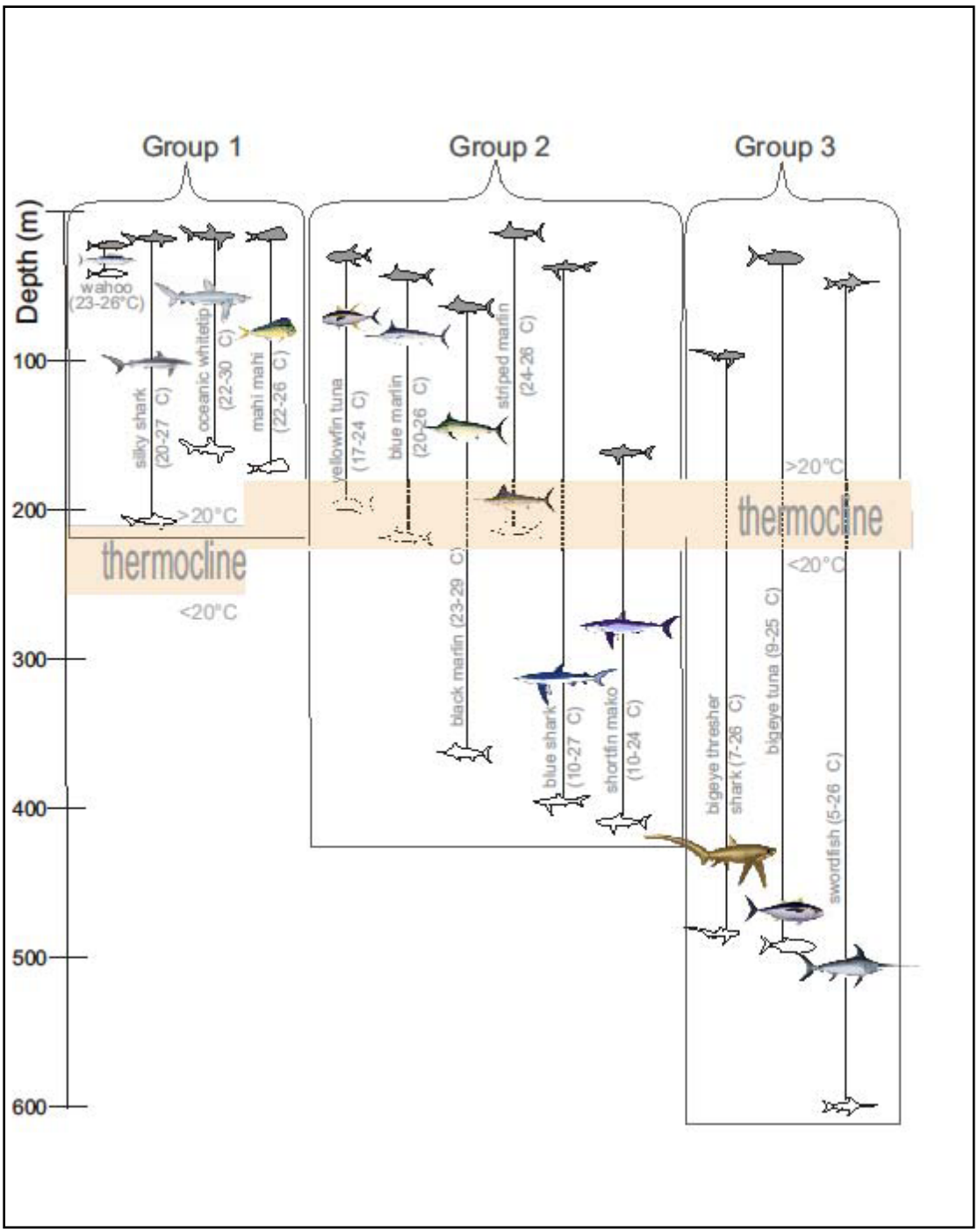

Figure 13. Schematic illustration depicting the thermal partitioning recently shown through the deployment of electronic tags (Bernal et al., 2009). Grey fish symbols show the approximate vertical distribution by each species at night whereas the white fish symbols show daytime depth distribution.

Domestic History and Current Management of Florida Atlantic Coast Buoy Fishery

Commercial buoy gear used to harvest swordfish on the Atlantic Coast was authorized in 2006 for Swordfish Directed and Handgear permit holders. Buoy gear is defined as consisting of one or more floatation devices supporting a single mainline to which no more than two hooks or gangions are

attached. The buoy gear fishery is usually prosecuted at night. Authorized permit holders may not possess or deploy more than 35 floatation devices, and may not deploy more than 35 individual buoy gears per vessel. Buoy gear must be constructed and deployed so that the hooks and/or gangions are attached to the vertical portion of the mainline. Floatation devices may be attached to one, but not both ends of the mainline, and no hooks or gangions may be attached to any floatation device or horizontal portion of the mainline. If more than one floatation device is attached to a buoy gear, no hook or gangion may be attached to the mainline between them. Individual buoy gears may not be linked, clipped, or connected together in any way. Buoy gears must be released and retrieved by hand. All deployed buoy gear must have some type of monitoring equipment affixed to it including, but not limited to, radar reflectors, beeper devices, lights, or reflective tape. If only reflective tape is affixed, the vessel deploying the buoy gear must possess on board an operable spotlight capable of illuminating deployed floatation devices. If a gear monitoring device is positively buoyant, and rigged to be attached to a fishing gear, it is included in the 35 floatation device vessel limit and must be marked appropriately.

Recent Catch, Landings, and Discards

Buoy gear effort and catch data for the U.S. Atlantic Coast are available for 2007 through 2010 (see Table 1, Table 2, and Table 3). Prior to 2007, buoy gear catch data were included in handline catch data. The preliminary logbook and observer data show that the gear is very effective at targeting swordfish without capturing significant quantities of non-target species. Of the 14,322 fish captured, approximately 13,445 (~94%) were swordfish (Table 3). In each year about 1 of 3 swordfish caught were released alive, due to small size, indicating that the fish are caught in good condition.

Table 1. Atlantic Coast Buoy Gear Effort. Source: NMFS Pelagic Logbook Program

	2007	2008	2009	2010
Number of Vessels	42	44	53	57
Number of Trips	745	598	708	632
Avg. Buoy Gears Deployed per Trip	11.0	11.2	11.9	11.9
Total Number of Hooks Set	11,742	8,922	11,595	8,855
Avg. Number Hooks per Gear	1.4	1.3	1.4	1.2

Table 2. Atlantic Coast Buoy Gear Landings in Pounds Dressed Weight. Source: NMFS Pelagic Logbook Program

	2007	2008	2009	2010
Swordfish	183,982	122,700	154,674	153,520
Dolphin	966	1,031	1,427	419
Oilfish	346	414	245	270
Shortfin mako shark	308	797	932	466
Wahoo	63	227	623	75
Bigeye tuna	150	0	0	0
Blacktip shark	9	0	0	0
King mackerel	0	194	67	576
Yellowfin tuna	0	0	350	0
Hammerhead Shark	0	0	350	1,190
Silky shark	0	0	20	48
Greater Amberjack	0	0	10	201
Bonito	0	0	86	120
Blackfin tuna	0	0	0	115

Table 3. Atlantic Coast buoy gear catches and discards in numbers of fish. Source: NMFS Pelagic Logbook Program

	2007	2008	2009	2010
Kept				
Swordfish	2,849	1,843	2,085	1,950
Dolphin	63	103	113	29
Oilfish	7	10	5	10
Bigeye tuna	5	0	0	0
Blackfin tuna	3	7	2	7
Wahoo	2	6	44	2
Bonito	0	7	11	6
King mackerel	0	53	4	7
Shortfin mako	3	4	8	4
Hammerhead shark	1	0	1	6
Blacktip shark	1	0	0	0
Silky shark	0	1	1	1
Yellowfin tuna	0	0	9	0
Greater amberjack	0	0	1	7
Released Alive				
Swordfish	1,559	1,018	763	1,031
Blue marlin	1	0	1	1
White marlin	0	3	0	0
Sailfish	2	1	0	1
Hammerhead shark	14	7	35	52
Blue shark	0	2	1	0
Thresher shark	0	1	1	2
Dusky shark	4	0	0	12
Night shark	16	1	34	39
Oceanic whitetip shark	0	1	0	0
Bigeye thresher shark	4	0	0	0
Tiger shark	1	2	1	1
Sandbar shark	1	0	1	2
Longfin mako shark	4	3	2	7
Shortfin mako shark	0	1	2	6
Blacktip shark	0	0	8	4
Silky shark	0	0	13	12
Oilfish	0	0	1	0
Greater amberjack	0	0	1	0
Discarded Dead				
Swordfish	129	80	51	87
Silky shark	9	0	0	0
Hammerhead shark	1	0	0	1
Blackfin tuna	0	0	1	0
Blue marlin	0	0	1	0
Night shark	0	0	0	1

Prohibiting Imports from Countries with Less Stringent Regulations

In March 2008, two environmental organizations petitioned the U.S. government to use the authority of the Marine Mammal Protection Act (MMPA) to ban swordfish imports from nations whose bycatch of marine mammals exceeds U.S. standards. On April 30, 2010, NOAA Fisheries published an advance notice of proposed rulemaking (ANPR) to implement the MMPA fish import provisions. NOAA Fisheries is drafting a proposed rule and Environmental Assessment to define "U.S. standards" for bycatch that parallels our domestic marine mammal bycatch management program. The rule would require nations that export fish and fish products to the United States to estimate the size of marine mammal stocks that interact with their fisheries, to estimate the marine mammal bycatch in those fisheries, and to reduce that bycatch to sustainable levels.

The rule includes a consultative procedure with the affected nation as well as a capacity building program to assist with monitoring and assessing marine mammals stocks. Ultimately, the Secretary of Commerce would make a final determination as to whether affected nations have established programs and taken action to address marine mammal bycatch in their commercial fisheries that are comparable in effectiveness to programs and actions taken in the US. The proposed rule itself would not prohibit importation of any fish or fish products, as the MMPA vests this authority with the Secretary of the Treasury. However, consistent with regulations implementing the High Seas Driftnet Moratorium Protection Act, the proposed rule would establish a process for the Secretary of Commerce to develop recommendations to the Secretary of the Treasury on the prohibition of certain fish and fish products from an exporting nation found to have not taken actions comparable in effectiveness to the United States.

Market-related Initiatives

MSC Certification for Swordfish Longline Fishery

http://www.worldfishing.net/news101/swordfish-longline-msc-certified

"The Southeast US North Atlantic swordfish pelagic longline and buoy gear fishery has received Marine Stewardship Council certification after a rigorous, independent assessment by MRAG Americas. The certification covers swordfish landed for Day Boat Seafood LLC, which is now eligible to bear the blue MSC ecolabel. The Unit of Certification combines pelagic longline and buoy gear types working with Day Boat Seafood LLC. All the swordfish landed - approximately 200t per year - is sold fresh in domestic markets. The fishery operates year round with some seasonal variation in an area off the Florida east coast. It is managed by the US Federal Government under the Magnuson-Stevens Act and in conformance with ICCAT (International Commission for the Conservation of Atlantic Tunas) management requirements. In addition, other US federal laws and regulations under the US National Marine Fisheries Service (NMFS) apply to the fishery, including endangered species. As part of the certification, nine conditions, or improvement actions are required that address issues raised during the process by the certification team, stakeholders, and peer review scientists. Progress in meeting the conditions is required and will be assessed during the annual surveillance audits. Debbie Lewis, Director of Compliance and Sustainability for Day Boat Seafood said: "We are proud our swordfish longline and buoy gear fishery has been awarded MSC certification, because it recognizes the dedication of the Florida east coast fishermen who have fished in a sustainable manner for the last decade, contributing to the revitalization of the North Atlantic swordfish population. We hope the benefits this certification brings will inspire other swordfish fisheries around the world to adopt similar measures. We wish to acknowledge the management practices of the National Marine Fisheries Service, Atlantic Highly Migratory Species Management Division, and the conservation organizations and stakeholders that worked with us to make this certification possible."

Ongoing and Needed Future Research

The SWFSC and SWR have been conducting research on different approaches to reducing protected species bycatch while maintaining swordfish catch rates at an economically viable level. One approach is to avoid areas where sea turtles are caught. With sufficient data on habitat use, areas to avoid can potentially be delineated in a dynamic fashion as with PIFSC "Turtlewatch" program. A second approach is modifying gear to reduce catch in areas where swordfish and sea turtle habitats overlap. Research updates and needs associated with both approaches are detailed below.

Leatherback and Swordfish Habitat Utilization

Leatherbacks

Considerable progress has been made on understanding the habitat use of leatherbacks and areas of high residency along the West Coast. Both tracks and aerial surveys show a preference for near-shore foraging areas that are typically characterized by convergence zones that aggregate their jellyfish prey. Long-term tracks reveal that offshore occurrence in the U.S. EEZ is generally associated with migrations either to or from the near-shore foraging grounds, although some offshore foraging is also apparent. While preliminary data reveal a tendency to remain at shallow depth while nearshore, additional information is needed to better characterize vertical habitat use both near and offshore and during different behavioral modes.

In a synthesis of over 125 satellite-linked telemetry deployments on leatherback turtles, Benson et al. (2011) characterized movements within the California Current Large Marine Ecosystem relative to a suite of oceanographic variables. Leatherbacks were most likely to engage in foraging behavior within upwelled modified waters of relatively high chlorophyll concentration over shelf and shelf break waters (<1500 m) at the 15^{o} C isotherm. Throughout the Pacific and Indo-Pacific, leatherback foraging activity occurred at mesoscale eddies, coastal retention areas, current boundaries, or stationary fronts, characterized by low eddy kinetic energy or low sea surface height. Such features are known mechanisms for aggregating gelatinous leatherback prey.

Although the telemetry data were useful for elucidation of large-scale movements and characterization of foraging habitats, less information was obtained about environmental cues that may influence turtles to leave neritic waters and begin their seasonal migration southwest through traditional DGN fishing grounds during the late fall months. This was likely a result of the transmitter attachment method (shoulder harness) that prompted the sampled turtles to prematurely engage in migratory behavior. A newly developed direct attachment technique was performed in Monterey Bay during October 2011 and results were encouraging. Following capture and transmitter attachment, the sampled leatherback remained over neritic central California waters for over 30 days before beginning migratory behavior. The cue for departure appeared to be the sharp seasonal decrease of sea surface temperatures. The onset of sea surface temperatures below 12^{o} C within the neritic habitat prompted the sampled turtle to leave abundant sea jelly prey and move 85 miles southwest during a 36 hour period. Better characterization of sea jelly prey densities and additional satellite tag deployments are needed to determine if reduced sea surface temperatures create foraging conditions that are energetically unfavorable for leatherbacks, thus prompting their transit through traditional DGN fishing grounds during late October and November.

Swordfish

Recent publications on swordfish provide insight into vertical habitat use along the U.S. West Coast south of Point Conception with implications for fisheries and identifying habitat separation. Sepulveda et al.

(2010) used fine-scale tracking of nine swordfish to characterize vertical movement and examine the implications for harpoon and DGN fisheries. Relevant to harpoon fisheries was the fact that only 8% of the daytime time was spent at the surface and there was no predictable pattern in basking events. Relevant to the DGN fishery was the nighttime depth distribution and its overlap with DGN gear. At the current 11 m dropper lengths the authors estimated that 54% of the time swordfish were shallower than the net.

Dewar et al. (2011) compared data from 31 tags deployed across a range of oceanographic regimes to better characterize factors influencing vertical movements. They found that variability in swordfish daytime depths was linked to water clarity such that swordfish are shallower near-shore than offshore. One implication of these findings is that daytime depths (200-400 m) in the California Current, at least south of point Conception, are within striking distance of deep-set longlines. This is not the case offshore where daytime depths of 600 m are more typical.

Both studies were focused in the southern California Bight; there are currently no data on vertical habitat use north of Point Conception, where the biggest concern about leatherback sea turtle bycatch exists. Additional satellite tag deployments are needed to better characterize habitat of swordfish north of Point Conception. In addition to vertical habitat, a better understanding of the geographic distribution of swordfish north of Point Conception is necessary to better characterize habitat overlap.

Low-bycatch gear development

Current gear studies focus on the potential for exploiting vertical habitat separation between turtles and swordfish. While swordfish forage deep in the water column during the day, leatherbacks tend to remain relatively close to the surface while in coastal waters. In one study, researchers are testing the potential to use buoy gear (see section above). In the second, deep-set long line gear is being used to target swordfish deep during the day. This gear is commonly used to target bigeye tunas. The goals of this study are to 1) target swordfish deep during the day, 2) use satellite tags and catch depth to characterize the daytime habitat use of swordfish and other marketable species north of Point Conception, 3) determine the composition of catch for deep day gear for both marketable and bycatch species, 4) conduct an economic analysis of cost and catch value, and 5) refine methods to target depths of 200 m and deeper.

Results from the first experimental daytime deep-set longline cruise conducted in 2011 are promising. Over the course of the cruise, 11 sets were conducted at least 50 nmi off shore. Circle hooks (18/0) with finfish bait were used and the average hook depth was 230 m. A range of marketable species were caught including swordfish, opah, and tuna. No turtles, marine mammals or birds were caught although there was some finfish bycatch. While the economic analysis has not been conducted, the captain felt the catch would have been profitable. For this first cruise most sets were conducted south of Point Conception due to weather constraints. During subsequent cruises, sets will be conducted farther north to meet the goals stated above.

Development of information products on leatherback distribution similar to Hawaii Turtle Watch program

Key to the development of any product like PIFSC “TurtleWatch” is accurate information on habitat use in time and space. Because leatherback distributions are not as strongly linked to SST (the basis for “TurtleWatch”), a more complex model will be required. It may also be of value to include vertical habitat, given the shift in depth as leatherbacks move farther offshore. As a part of research into potential adaptive management strategies like “TurtleWatch”, scientists in both the SWFSC Fisheries Resources and Protected Resources Divisions have been moving forward to model DGN fishing effort and swordfish distributions using logbook and observer data. Using relatively new modeling approaches (boosted

regression trees), models of fishing effort have provided high predictive value (~64%). A new research effort centers on the idea of dynamic ocean management (DOM) where management measures shift with time based on 1) ocean features, 2) how species of interest interact with these features, and 3) economics. The DOM model will use these 3 factors to determine where a fishing fleet can maximize its catch of target species and profit while avoiding bycatch. Different from other static or semi-dynamic management measures such as time-area closures, the goal is to improve efficiency by creating an integrated product that helps fishers optimize their effort.

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Appendix A - Revitalizing Swordfish Fishery Questionnaire

In December 2012, the California Department of Fish & Game, with input from NOAA Fisheries, mailed out a questionaire to all California swordfish permittees, asking for their opinions of the future directions of the swordfish fishery on the West Coast. Those contacted included harpoon permitees (n=54), and shark/swordfish drift gillnett permitees (n=80). Permittees returned their answers via mail, fax or email. Answers received were summarized below.

There were 48 respondents to the questionnaire, including 15 harpoon and 27 DGN permittees. Of the DGN permittees, 19 had not been fishing for swordfish for at least a year, with eleven of those for three or more years (latent permittees). There were different responses from harpoon and DGN; harpoon respondents unanimously feel the fishery is viable as it is (e.g., as a harpoon fishery), and most would like to completely ban DGN (although at least one suggested a buyout). A few harpoon fishermen would like to ban spotter planes. Several remember harpoon fishing being much better before DGN was allowed and feel it diminished their fishery, although others recognize the success of harpoon fishing is highly dependent on oceanic conditions from year to year.

DGN respondents felt that it's not viable for them to move into harpoon because:

- the high expense of fuel and paying for spotter planes (if used);
- they feel that they don't catch enough or make enough money for the effort involved in harpooning;
- harpooning does not provide enough fish for the market; and
- weather conditions are too rough most of the year north of Point Conception.

Other reasons given are that their boats are not designed or are too big for harpooning, and that harpooning is a "hobby."

If DGN respondents had a chance to change the rules, they would ideally do away with the leatherback conservation area or at least, change the borders or closure times to make it a bit easier to access the swordfish. They said that the area is closed right at the time when most swordfish are in the area. If the rules do not change, many see themselves as leaving the fishery, either by being put out of business, retiring, changing fisheries completely, or finding another line of work.

The reasons given for latent permittees keeping their permits, even if they have not been actively fishing included: hoping closed areas will re-open; hoping the economics will change or regulations will change so they can get back into the fishery. Respondents who are not fishing are involved in other fisheries or are doing something else terrestrially. Most of the DGN respondents don't fish DGN fulltime, but are also involved in albacore, salmon and crab fisheries, especially when swordfish years are bad.

Of those who expressed potential interest in a buyout program, 22 DGN respondents said that if they were offered some sort of value for boat or gear, it would take 50-100% of the value of their boat, and in some cases, their gear and/or whatever they would have made fishing (up to $100-200k/year), in order to get them out of the fishery – 13 expressed interest in some kind of buyout, but did not specify an amount. Some might be interested in exchanging their DGN permit for a permit for a fishery they could not normally get (e.g., groundfish, squid, or crab, federal or another state). As far as changing gear, most responded "No, but maybe" with some kind of financial incentive. Some expressed interest in switching to another gear type such as longline; however, for many, their boats are too small to fish outside the EEZ. There was slightly more interest in longline if it could be fished within the EEZ. Some responded they don't really know enough about new types of gear, but there was some mention of the Florida buoy gear and how well it works (but one harpooner mentioned that this gear takes very small fish).

Appendix B – Current Swordfish Stock Status (from PFMC 2010 HMS SAFE, September 2011)

The status and stock structure of NPO swordfish was assessed by the ISC Billfish Working Group in 2009 (ISC 2009). Modeling was based on a two stock hypothesis comprised of a northwest and central North Pacific stock and a southeastern North Pacific stock separated by an irregular boundary extending from Baja California, Mexico to the southwest. Fishery data used in 2009 for the eastern region (IATTC area) were deemed incomplete. Thus, in 2010, the ISC Billfish Working Group conducted an update to the 2009 assessment for the EPO region only that included new EPO fishery data (Brodziak 2010). Below is a summary of the results of the EPO assessment update from the ISC Tenth Plenary Report (ISC 2010). The full assessment report can be downloaded from http://isc.ac.affrc.go.jp/pdf/BILL/BILL_Apr10_FINAL_WP02.pdf.

"Based on the 2009 stock assessment results, the exploitable biomass of the WCPO SWO stock [in the North Pacific] was estimated to be about 75,000 t in 2006 (B_{2006}), roughly 30 percent above B_{MSY}. The exploitation rate on the WCPO stock in 2006 was estimated to be 14 percent with a total catch of roughly 9,900 t or roughly 69 percent of MSY (MSY=14,400 t). There was very high probability that B_{2006} was above B_{MSY}, a 93 out of 100 chance, and there was a 0 out of 100 chance that the exploitation rate in 2006 exceeded the rate to produce MSY. Based on the 2010 stock assessment update results for the EPO stock only, the exploitable biomass of the EPO SWO stock was estimated to be about 69,000 t in 2006, over 200 percent above B_{MSY}. Exploitation rate on the EPO stock in 2006 was estimated to be 6 percent with a total catch of roughly 3,900 t or roughly 78 percent of MSY (MSY=5,000 t). There was very high probability that B_{2006} was above B_{MSY}, a 99 out of 100 chance, and there was a two out of 100 chance that the exploitation rate in 2006 exceeded the rate to produce MSY. The exploitable biomass of the WCPO SWO stock was 31 percent above B_{MSY} and the exploitation rate was 46 percent below F_{MSY} in 2006. Similarly, exploitable biomass of the EPO SWO stock was over two-fold greater than B_{MSY} and the exploitation rate was 62 percent below F_{MSY} in 2006. Catch of swordfish by U.S. West Coast fisheries constitutes about 5.8 percent of the Eastern Pacific-wide catch.

Appendix C – Observer Data from the California DGN Fishery

Table C.1. Observed finfish catch in the California drift gillnet fishery, 1990-2010.*

Species	1990 - 2000				2001 - 2010				Nominal Catch Per Set Trend
	Number Caught	Percent Retained	Percent Returned Alive	Number Caught per 100 Swordfish	Number Caught	Percent Retained	Percent Returned Alive	Number Caught per 100 Swordfish	
Marketable Catch (Percent Retained greater than 50)									
Tuna, Albacore	14329	83.6	0.1	112	2364	87.9	0	51.4	⇓
Swordfish, Broadbill	12790	98.9	0		4599	96.9	0.2		⇔
Shark, Shortfin Mako	4808	97.3	1.3	37.6	2613	92.5	2.6	56.8	⇑
Shark, Common Thresher	4148	99.6	0.1	32.4	2059	98.7	0.7	44.8	⇑
Opah	3160	96.7	0.2	24.7	1952	95.9	0.1	42.4	⇑
Tuna, Bluefin	3141	92.1	0	24.6	697	90.8	0	15.2	⇓
Louvar	564	84.2	0.5	4.4	217	88	0.5	4.7	
Pomfret, Pacific	424	65.1	0.7	3.3	158	76.6	1.3	3.4	
Shark, Bigeye Thresher	408	91.9	0.5	3.2	231	52.8	0.9	5	
Bonito, Pacific	351	60.1	0.3	2.7	750	37.1	3.3	16.3	⇑
Tuna, Yellowfin	274	87.2	0	2.1	244	83.2	0	5.3	
Mackerel, Jack	135	69.6	1.5	1.1	24	58.3	8.3	0.5	
Shark, Pelagic Thresher	77	97.4	0	0.6	1	100	0	0	
Yellowtail	46	95.7	0	0.4	37	100	0	0.8	
Barracuda, California	29	72.4	3.4	0.2					
Tuna, Bigeye	20	100	0	0.2					
Seabass, White	7	85.7	0	0.1	2	50	0	0	
Shark, Soupfin	5	80	0	0	1	100	0	0	
Shark, Longfin Mako					5	100	0	0.1	
Non-marketable Catch									
Mola, Common	31743	0.4	92	248.2	21113	0.1	95.3	459.1	⇑
Shark, Blue	19313	0.6	31.4	151	2699	0.8	36	58.7	⇓
Tuna, Skipjack	7161	41.4	0.1	56	2394	36.6	1	52.1	
Mackerel, Pacific	4770	30.4	1.5	37.3	1658	17.6	4.4	36.1	
Mackerel, Bullet	2941	29.3	0.2	23	187	45.5	0.5	4.1	⇓
Fish, Unidentified	423	4	3.1	3.3	21	0	23.8	0.5	
Marlin, Striped	308	19.5	1.3	2.4	104	0	0	2.3	
Scombrid					96	6.3	0	2.1	
Hake, Pacific	253	3.6	7.1	2	4	0	0	0.1	
Stingray, Pelagic	242	0.4	74.8	1.9	109	1.8	77.1	2.4	
Fish, Other Identified	175	14.3	35.4	1.4	11	27.3	45.5	0.2	
Remora	98	1	93.9	0.8	21	0	95.2	0.5	
Mackerel, Unidentified	93	7.5	0	0.7	1	0	0	0	
Shark, Salmon	84	25	0	0.7	30	10	10	0.7	
Shark, Smooth Hammerhead	42	23.8	0	0.3	6	33.3	0	0.1	
Sardine, Pacific	40	12.5	0	0.3	12	50	8.3	0.3	
Marlin, Blue	39	5.1	0	0.3	10	0	0	0.2	
Ray, Pacific Electric	32	3.1	62.5	0.3	13	0	69.2	0.3	
Oilfish					9	11.1	22.2	0.2	
Ray, Manta	14	0	35.7	0.1	1	0	0	0	
Ray, Unidentified	11	9.1	36.4	0.1					
Ray, Bat	9	0	88.9	0.1	11	0	90.9	0.2	
Oarfish	8	12.5	0	0.1					
Anchovy, Northern	7	14.3	28.6	0.1					
Stingray, Round	7	0	85.7	0.1	1	0	100	0	
Marlin, Black	5	0	0	0					
Ray, Mobula	4	50	50	0	3	0	33.3	0.1	
Shark, Pacific Angel	4	0	50	0					
Shark, Prickly	4	0	75	0	2	0	50	0	
Shark, Unidentified	4	0	0	0					
Rockfish, Unidentified	2	0	50	0	4	0	100	0.1	
Billfish, Unidentified					5	0	0	0.1	
Other Non-marketable Fish	39				18				

* Number of observed sets for the periods 1990-2000 and 2001-2010 was 5,973 and 2,224, respectively. Total estimated effort for the periods 1990-2000 and 2001-2010 was 40,952 and 11,951 sets, respectively. Species listed by common name include finfish that were caught four or more times during either period. Other non-marketable fish include species for which three or fewer individuals were caught during either period.

Table C.2. Observed protected species catch in the California drift gillnet fishery, 1990-2010

Species	1990-2000		2001-2010	
	Number of Interactions	Number Released Uninjured	Number of Interactions	Number Released Uninjured
	Seaturtles			
Turtle, Leatherback	23	9	1	1
Turtle, Loggerhead	14	10	2	2
Turtle, Unidentified	3	2		
Turtle, Olive Ridley	1	1		
Turtle, Green/Black	1			
	Pinnipeds			
Sea Lion, California	122	3	64	1
Seal, Northern Elephant	109		5	
Sea Lion, Unidentified	3	1		
Sea Lion, Steller	2			
Pinniped, Unidentified	2			
	Cetaceans			
Dolphin, Short-Beaked Common	288		77	
Dolphin, Northern Right Whale	56		12	
Dolphin, Risso's	29		5	
Dolphin, Pacific White-sided	25		11	
Porpoise, Dall's	22			
Beaked Whale, Cuviers	21	1		
Dolphin, Unidentified Common	21	1	1	
Dolphin, Long-Beaked Common	12		9	
Whale, Short-finned Pilot	11		1	
Whale, Sperm	8	3	2	
Beaked Whale, Hubbs'	5			
Beaked Whale, Unidentified	3			
Dolphin, Bottlenose	3		1	
Whale, Minke	3	1		
Beaked Whale, Mesoplodont	2			
Cetacean, Unidentified	2			
Whale, Gray	2		1	
Whale, Humpback	2	2	1	1
Whale, Pygmy Sperm	2			
Beaked Whale, Baird's	1			
Beaked Whale, Stejneger's	1			
Dolphin, Striped	1			
Dolphin, Unidentified	1			
Whale, Fin	1			
Whale, Killer	1			
Whale, Unidentified	1		1	1
	Seabirds			
Fulmar, Northern	16	13	20	18
Bird, Unidentified	4		1	
Alcid, Unidentified			1	