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NOAA, National Marine Fisheries Service

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U.S.A Fisheries and Research on Tuna and Tuna-like Species in the North Pacific Ocean

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Executive Summary

Various U.S.A. fishing fleets harvest tuna and tuna-like species in the north Pacific Ocean (NPO) from coastal waters of North America to the archipelagoes of Hawaii, Guam and the Commonwealth of the Northern Mariana Islands (CNMI) in the central and western Pacific Ocean (WCPO). Small-scale gillnet, harpoon, tropical pole-and-line, troll, and handline fleets operate primarily in coastal waters, whereas large-scale purse seine, albacore troll and pole-and-line, and longline fleets, which account for most of the tuna catches, operate both within U.S.A. Exclusive Economic Zones and on the high seas. Thousands of small-scale troll and handline vessels operate in waters around the tropical Pacific Islands; however, these fleets account for only a minor fraction of the total tuna catch.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries continued to conduct research in 2013 on Pacific tunas and associated species at its Southwest and Pacific Islands Fisheries Science Centers and also in collaboration with scientists from other organizations. Fishery monitoring and socio-economic research was conducted on tunas, billfishes, and bycatch species in U.S.A. Pacific coastal and high-seas fisheries. As in previous years, fishery monitoring and angler effort information were compiled in 2013, and economic performance indicators in the Hawaii longline and small-boat fisheries were assessed.

Stock assessment research on tuna and tuna-like species was conducted primarily through collaboration with participating scientists of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC) and international Regional Fisheries Management Organizations (RFMOs).

NOAA Fisheries successfully completed biological and oceanographic research on tunas, billfishes, and sharks. These research efforts provided empirical information to quantify fish movements, habitat preferences, post-release survival, feeding habits, and age and growth. Important results included: (i) analyses of albacore (*Thunnus alalunga*) otolith microchemistry and population structure; (ii) billfish research on vertical habitat and foraging depth; (iii) studies of shark survival after capture and release and oxytetracycline age validation of juvenile shortfin mako (*Isurus oxyrinchus*) sharks; (iv) continued shark tagging studies; and (v) ongoing studies on sea turtles and sharks focused on bycatch mitigation.

I. Introduction

Various U.S.A. fisheries harvest tuna and tuna-like species in the North Pacific Ocean. Large-scale purse seine, albacore troll, and longline fisheries operate both in coastal waters and on the high seas. Small-scale gillnet, harpoon, handline and pole-and-line fisheries as well as commercial and recreational troll and hook and line fisheries usually operate in coastal waters. Overall, the range of

U.S.A. fisheries in the North Pacific Ocean is extensive, from coastal waters of North America to Guam and the Commonwealth of the Northern Mariana Islands (CNMI) in the western Pacific Ocean and from the equatorial region to the upper reaches of the North Pacific Transition Zone.

In U.S.A. Pacific fisheries for tunas and billfishes, fishery monitoring responsibilities are shared by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries or federal agency) and by partner fisheries agencies in the states of California, Oregon, Washington, Hawaii, and territories of American Samoa, Guam, and the CNMI. Federal monitoring is conducted by the West Coast Regional Office (WCRO) and the Southwest Fisheries Science Center (SWFSC) in California, and the Pacific Islands Regional Office (PIRO) and the Pacific Islands Fisheries Science Center (PIFSC) in Hawaii. NOAA Fisheries monitors the landings and sales records, federally-mandated logbook statistics on fishing effort and catch, observer data, and biological sampling data. In California, Washington, and Oregon, landings receipts are collected by state agencies and maintained in the Pacific Fisheries Information Network (PacFIN) system (http://pacfin.psmfc.org/). Some state agencies also collect logbook and size- composition data. In the WCPO, monitoring by partner agencies also involves market sampling and surveys of fishing activity and catch and is coordinated by the Western Pacific Fishery Information Network (WPacFIN), a federally funded program managed by the PIFSC. The management of data on U.S.A. Pacific fisheries for tuna and tuna-like species is coordinated among the SWFSC, WCRO, PIFSC, and PIRO.

This report provides information on the number of active vessels by fleet and their catches of tunas and billfishes in the NPO based on the data available through 15 March 2014. Data for 2012 and 2013 however, are considered preliminary and are subject to change. Although the report is focused on tunas and billfishes, many of the fisheries include catch of other pelagic fish important to the fishing fleets and local economies; catch data for these species are not included in this report but are included in the ISC data submissions.

NOAA Fisheries also conducts scientific research programs in support of marine resource conservation and management both domestically and internationally. These studies include stock assessments, biological and oceanographic studies, socio-economic analysis, and more. This report includes summaries of recent and ongoing scientific work by NOAA Fisheries of relevance to the ISC.

II. Fisheries

A. Purse Seine

Currently, the U.S.A. purse-seine fishery consists of two separate fleets, one composed of large purse-seine vessels that operate in the WCPO, and a small coastal purse seine fleet that operates in the eastern Pacific Ocean (EPO). Historically, the purse-seine fishery started in EPO the mid-1900s and most catch came from that ocean area until 1993 when vessels moved to the WCPO in response to dolphin conservation measures in the EPO. Vessels also moved to the WCPO because fishing access was granted by the South Pacific Tuna Treaty (SPTT) in 1987. The WCPO fleet operates mainly in areas between 10°N and 10°S latitude and 130°E and 150°W longitude, with the majority of the fishing effort south of the equator. The EPO fleet operates off the coast of Southern California and outside the exclusive economic zone (EEZ) of Mexico, off Baja California. The number of unique U.S.A. purse-seine vessels (WCPO and EPO) fishing north of the equator decreased from a high of 74 in 1988 to 11 in 2006 (Table 1) then increasing to 41 in 2009. In 2013, there were 40 purse seine vessels fishing in the North Pacific. Prior to 1995 the fleet fished mainly on free-swimming schools of tunas in the WCPO and on schools associated with dolphins in the EPO. Since 1995 most catches have been made on fish aggregation devices (FADs) and other floating objects in the WCPO. The EPO purse-seine fishery targets mostly coastal pelagics, but targets tunas opportunistically. Larger vessels from the WCPO occasionally fish in the EPO.

In the EPO, the Inter-American Tropical Tuna Commission (IATTC) monitors the purse seine fleets fishing in the EPO. U.S.A. purse-seine vessels fishing in the WCPO have been monitored by NOAA Fisheries under the SPTT since 1988. Logbook and landings data are submitted as a requirement of the Treaty (coverage 100%). Landings are sampled for species and size composition as vessels land their catches in American Samoa by NOAA Fisheries personnel and by SPC samplers in other ports (coverage approximately 1-2% of landings). The Forum Fisheries Agency (SPTT Treaty Manager) places observers on 100% of the vessel trips. In the EPO, logbooks are submitted by vessel operators to NOAA Fisheries or the IATTC, and landings are obtained for each vessel trip from canneries or fish buyers. IATTC observers are placed on all large purse-seine vessels. Data are not available for 2013.

B. Longline

The U.S.A. longline fishery targeting tunas and tuna-like species in the NPO is made up of the Hawaii-based fleet, the California-based fleet, and the American Samoa-based fleet. Vessels operated freely in an overlapping area managed by two domestic management regimes until 2000 when domestic regulations placed restrictions on moving between the two domestic management regimes. The Hawaii-based component of the U.S.A. longline fishery currently comprises a majority of the vessels, fishing effort, and catch.

Regulatory restrictions, due to interactions with endangered sea turtles, curtailed Hawaii-based longline effort for swordfish (*Xiphias gladius*) in 2000 and 2001 followed by a prohibition altogether in 2002 and 2003, during which the Hawaii-based longline fishery targeted tunas exclusively. The Hawaii-based fishery for swordfish (shallow-set longline) was reopened in April 2004 under a new set of regulations to reduce sea turtle interactions. The year 2005 was the first complete year in which the Hawaii-based longline fishery was allowed to target swordfish. In the following year, the shallow-set longline fishery reached the annual interaction limit of 17 loggerhead sea turtles (*Caretta caretta*) and the fishery was closed on March 20, 2006. The majority of vessels that targeted swordfish converted to deep-set longline and targeted tunas for the remainder of the year. In the Hawaii-based shallow-set longline fishery in 2012, the interaction limits for leatherback (*Dermochelys coriacea*) and loggerhead sea turtles were increased for the Hawaii shallow-set longline fishery to 26 and 34, respectively. Neither cap has subsequently been attained, though both the leatherback and the loggerhead interaction limits were reached in separate previous years and the fishery shut down.

The number of vessels in the California-based fishery has always been low compared to the Hawaii-based fishery, and was composed mainly of vessels that targeted swordfish. Most vessels with landings to California also participated in the Hawaii-based fishery. The California-based shallow-set longline fishery for swordfish was closed in 2004, resulting in relocation of most of those vessels back to Hawaii. Only one vessel fished exclusively in the California longline fishery between 2005 and 2013 using deep-set longline to target tunas. Additionally, up to nine Hawaii permitted vessels have landed from 300 t to over 500 t of swordfish to the West Coast caught with shallow-set longline gear in recent years.

The longline fishery extends from outside the U.S.A. West Coast EEZ to 175°W longitude and from the equator to 35°N latitude in 2012 (Figure 1 and 2). The number of vessels participating in the longline fishery increased from 36 in 1985 to a high of 141 vessels in 1991 (Table 1).Since then, the number of vessels has remained relatively stable. Approximately 136 vessels participated in 2013. In Hawaii and California, swordfish are generally landed dressed (headed, tailed, and gutted). Tunas and large marlins are landed gilled and gutted while other bony fishes are usually landed whole. Sharks are landed headed and gutted. In Hawaii, the landed catch biomass is the reported total fish weight by species recorded at the fish auction. Dressed weights are converted to whole weight for reporting of total catches using standard conversion factors.

Catch levels and catch-species composition in the U.S.A. longline fishery have changed over the past years in response to fishery and regulatory changes. The majority of the longline catch now consists of tunas and billfishes and exceeded 10,000 t in 1993, 1999, 2000, 2008, 2011 and 2013 (Table 2). Bigeye tuna dominates the tuna catch with landings over 4,000 t during the past nine years. The 2013 bigeye tuna catch was 6,444 t. Swordfish has been the dominant component of the billfish catch since 1990 and reached a peak of 5,936 t in 1993 before decreasing to 1,185 t in 2004. The U.S.A. 2013 swordfish catch by longline was 1,285, 176 t below the recent three- year average.

The Hawaii-based longline fishery is monitored by combined sampling efforts of the NOAA Fisheries and the State of Hawaii's Division of Aquatic Resources (DAR). Longline fishermen are required to complete and submit federal longline logbooks for each fishing operation. The logbook data include information on fishing effort, area fished, catch by species and amount, and other details of the fishing operations. Logbook coverage for the Hawaii-based longline fishery is at or near 100% coverage of vessel by trip. The Hawaii DAR also requires fish dealers to submit reports of landings data, and coverage for the longline fishery and the reporting rate for dealers are very close to 100%. Observers contracted by NOAA Fisheries are also placed on longline vessels to monitor protected species interactions, vessel operations, and multi-species catches.
These observers are required by court decree to be aboard Hawaii-based longline vessels at a rate of coverage of no less than 20% for deep-set (tuna-target) vessels and 100% for shallow-set (swordfish-target) vessels. Information on the sizes of tuna fish caught in the Hawaii-based longline fishery indicate, that in general, a higher proportion of smaller tuna and tuna-like fish species are captured in the shallow-set longline fishery (Figures 3-5).

The California-based longline fishery is monitored by NOAA Fisheries and the California Department of Fish and Wildlife (CDFW). Data are collected for 100% of longline landings by the CDFW. Logbooks, developed by the fishing industry (similar to the federal logbooks used in Hawaii), were submitted voluntarily to NOAA Fisheries until 1994 when logbooks became mandatory. Landed swordfish were measured for cleithrum to fork length by CDFW port samplers until 1999. NOAA Fisheries has placed observers on all California-based longline trips since 2002. The observers collect data on fishing location, protected species interactions, fish catch, disposition of catch and bycatch, and size measurements of catch and bycatch (retained catch and discards).

C. Albacore troll and pole-and-line

The U.S.A. albacore troll and pole-and-line fishery in the NPO started in the early 1900s. The fishery operates in waters between the U.S.A. west coast and 160°E longitude (Figure 6). Fishing usually starts in May or June and ends in October or November. In 2013, 702 vessels participated in the fishery, down from 841 in 2012 (Table 1).

The troll and pole-and-line fishery catches almost exclusively albacore with minor incidental catches of skipjack, yellowfin, and bluefin (*Thunnus orientalis*) tunas, eastern Pacific bonito (*Sarda chiliensis lineolata*), yellowtail (*Seriola lalandi*), and mahi mahi (*Coryphaena hippu*rus). Since 1985, the albacore catch has ranged from a low of 1,845 t in 1991 to a high of 16,962 t in 1996 (Table 2). In 2012 and 2013, 14,149 t and 12,325 t were caught, respectively. U.S.A. troll and pole-and-line vessels voluntarily submitted logbook records to NOAA Fisheries from 1973 until 1995 when those vessels fishing on the high-seas were required to submit logbooks.
Since 2005, all vessels have been required to submit logbooks under a provision of the Highly Migratory Species Fishery Management Plan (HMS FMP). NOAA Fisheries and various state fisheries agencies monitor 100% of the fleet's landings through receipts (fish tickets). Since 1961, a port sampling program has been in place for collecting size data from albacore landings along the U.S.A. Pacific coast. Size distribution for 2013 is shown in Figure 7. State fishery personnel collect the size data according to sampling instructions provided by NOAA Fisheries, who maintain the database. In recent years, cooperative fishermen have also collected size data on selected fishing trips to augment data collected through the port sampling program.

D. Tropical pole-and-line

The tropical pole-and-line fishery targets skipjack around the Hawaiian Islands. The number of vessels participating declined from a high of 27 in 1985 to a low of one in 2012. Skipjack tuna is usually the largest component of the catch by Hawaii pole-and-line vessels. The highest skipjack tuna catch for this fishery was 3,450 t in 1988 (Table 2). The highest yellowfin tuna catch for the pole-and-line fishery was 2,636 t, recorded in 1993. One or two vessels have participated in the tropical pole-and-line fishery since 2010.

Hawaii DAR monitors the tropical pole-and-line fishery using Commercial Fish Catch reports submitted by fishers and Commercial Marine Dealer reports submitted by fish dealers.

E. Tropical Troll and Tropical Handline

Tropical troll fishing fleets for tuna and tuna-like species operates in Hawaii, Guam, and the CNMI. Tropical handline fishing fleets also operates in Hawaii. The vessels in these fisheries were relatively small coastal vessels (typically around 8 m in length) and primarily made one-day fishing trips in coastal waters. Historically, the number of U.S.A troll and handline vessels combined ranged from 1,878 in 1988 to 2,502 in 1999, and there were 2,179 troll vessels and 534 handline vessels in 2013 (Table 1). The operations range from recreational, subsistence, and part-time commercial to full-time commercial. The small vessel catches generally were landed fresh and whole, although some catches were gilled and gutted.

Weights of individual fish were obtained when fish were landed for commercial sale. The size distributions of tunas (skipjack and yellowfin) and marlins (striped marlin and blue marlin, *Kajikia nigricans* and *Makaira mazara*) caught in the Hawaii fishery in 2013 were also summarized (Figures 8 and 9).

The total retained catch from these tropical troll and handline fisheries combined ranged from 1,162 t in 1992 to 2,277 t in 2013 (Table 2). Yellowfin and skipjack tuna made up 42% and 24% of the total troll and handline catch in 2013, respectively. The next largest species catch components were bigeye tuna, and blue marlin.

The Guam Division of Aquatic and Wildlife Resources (DAWR) monitors the troll fishery using a statistically designed creel survey and commercial landings data. The Guam DAWR, with the assistance of NOAA Fisheries, extrapolated the creel survey data to produce estimates of total catch, fishing effort, and fishermen participation estimates by gear type. Similarly, the Hawaii tropical troll and handline fisheries catch and effort summaries are compiled from Hawaii DAR Commercial Fish Catch reports and Commercial Marine Dealer reports. The CNMI monitors the tropical troll fishery in the CNMI region using creel surveys and commercial landings.

F. Drift Gillnet

The U.S.A. drift gillnet fisheries operate in areas within the EEZ in California waters and historically off the coast of Oregon. Swordfish, sharks, and a small amount of tunas and other pelagic species are caught by pelagic drift gillnet vessels. The number of vessels participating in this fishery has steadily decreased from a high of 220 in 1986 to 18 in 2013. Swordfish catches are the major portion of the catch and peaked in 1985 at 2,990 t. Since then, swordfish catches have fluctuated while decreasing to 182 in 2004 and rebounding to 490 in 2007 (Table 2). The preliminary estimate of swordfish caught in the drift gillnet fishery for 2013 is 89 t.

Gillnet fishery landings data (100% coverage) are collected by state agencies in California and Oregon (no landings have occurred in Oregon since 2004). Logbook data for gillnet fisheries are required to be submitted to the CDFW for all trips. CDFW also collected length data for swordfish landings between 1981 and 1999 from less than 1% of the landings. NOAA Fisheries observers on drift gillnet vessels have also collected data on fishing location, protected species interactions, fish catch, disposition of catch and bycatch, and length since about 1990; observer coverage is about 20% of effort.

G. Harpoon

The harpoon fishery targets swordfish and operates in areas within the EEZ in California waters between 32°N and 34°N latitude. The number of vessels participating in the fishery greatly decreased from 113 in 1986 to 13 in 2013 (Table 1). Trends in swordfish catches have fluctuated from a high of 305 t in 1985 to 6 t in 2013 (Table 2).

Landings and logbook data for the harpoon fishery are collected by the CDFW with 100% coverage of the fleet. Length measurements were taken by CDFW until 1999, covering less than 1% of swordfish landings.

H. Sport

Sport (recreational) catch and effort data are available from commercial passenger fishing vessels (CPFVs) and private vessels that target tunas and other pelagic fish. Data for CPFV and private vessels are obtained through surveys and maintained in the Recreational Fisheries Information Network (RecFIN) database (http://www.recfin.org/) for California, Oregon, and Washington. Logbook data for CPFVs are obtained from fisheries agencies in California, Oregon, and Washington. Total sport catch is estimated from data collected from RecFIN and state and federal logbook data sets. Catch estimates are computed using average weights multiplied by the reported number of fish caught from CPFV and private vessels. The spatial distribution of reported logbook fishing effort by the 2013 U.S. harpoon, gillnet, and west coast sport fishery in the North Pacific Ocean can be seen in Figure 10.

II. Research

NOAA Fisheries research on tunas and billfishes in the Pacific Ocean has largely been focused on improving understanding of the biology and ecology of the animals to support needs for assessing the effects of fishing and the environment on the population or stock. Described below are highlights of a few studies that have recently been completed or are ongoing by NOAA Fisheries. These studies are carried out largely in cooperation with stakeholders and in collaboration with colleagues both in the U.S.A. and abroad.

Feasibility of a Catch Share Program for Hawaii longline fishery – In 2010 NOAA released a policy to encourage the use of catch shares as a fishery management tool, but to date, none of the fisheries in the U.S. Pacific Islands Region is managed under a catch share program. In response to the NOAA catch share policy, the Western Pacific Fishery Management Council (WPFMC) identified six commercial fisheries, including the high-value Hawaii pelagic longline fishery, the largest in the region, as potential candidates for catch share programs. NOAA conducted a study to examine the baseline economic and operational characteristics of, and the management challenges facing the Hawaii pelagic longline fishery and evaluate the impact of these on the desirability and feasibility of a catch share program for this particular fishery (Pan, 2014; Pan et al., 2014).

Fishery-induced changes in the subtropical Pacific pelagic ecosystem size structure – NOAA Fisheries analyzed a 16-year (1996–2011) time series of catch and effort data for 23 species with mean weights ranging from 0.8 kg to 224 kg, recorded by observers in the Hawaii-based deep-set longline fishery. Over this time period, domestic fishing effort, as numbers of hooks set in the core Hawaii-based fishing ground, has increased fourfold. The standardized aggregated annual catch rate for 9 small (<15 kg) species increased about 25% while for 14 large species (>15 kg) it decreased about 50% over the 16-year period. A size-based ecosystem model for the subtropical Pacific captures this pattern well as a response to increased fishing effort. Further, the model projects a decline in the abundance of fishes larger than 15 kg results in an increase in abundance of animals from 0.1 to 15 kg but with minimal subsequent cascade to sizes smaller than 0.1 kg. These results suggest that size-based predation plays a key role in structuring the subtropical ecosystem. These changes in ecosystem size structure show up in the fishery in various ways. The non-commercial species lancetfish (mean weight 7 kg) has now surpassed the target species, bigeye tuna, as the species with the highest annual catch rate. Based on the increase in snake mackerel (mean weight 0.8 kg) and lancetfish catches, the discards in the fishery are estimated to have increased from 30 to 40% of the total catch (Polovina and Woodworth, 2013).

Growth and Maximum Size of Tiger Sharks in Hawaii – Tiger sharks (*Galecerdo cuvier*) are apex predators characterized by their broad diet, large size and rapid growth. Tiger shark maximum size is typically between 380 and 450 cm Total Length (TL), with a few individuals reaching 550 cm TL, but the maximum size of tiger sharks in Hawaii waters remains uncertain. A previous study suggested tiger sharks grow rather slowly in Hawaii compared to other regions, but this may have been an artifact of the method used to estimate growth (unvalidated vertebral ring counts) compounded by small sample size and narrow size range. Since 1993, the University of Hawaii and NOAA has conducted a research program aimed at elucidating tiger shark biology, and to date 420 tiger sharks have been tagged and 50 recaptured (Meyer et al., 2014). All recaptures were from Hawaii except a single shark recaptured off Isla Jacques Cousteau (24° 13’17”N 109°52’14”W), in the southern Gulf of California (minimum distance between tag and recapture sites = approximately 5,000 km), after 366 days at liberty (DAL). These empirical mark-recapture data were used to estimate growth rates and maximum size for tiger sharks in Hawaii. Tiger sharks in Hawaii were found to grow twice as fast as previously thought, on average reaching 340 cm TL by age 5, and attaining a maximum size of 403 cm TL. The model indicates the fastest growing individuals attain 400 cm TL by age 5, and the largest reach a maximum size of 444 cm TL. The largest shark captured during the study was 464 cm TL but individuals >450 cm TL were extremely rare (0.005% of sharks captured). It was concluded that tiger shark growth rates and maximum sizes in Hawaii are generally consistent with those in other regions, and hypothesized that a broad diet may help them to achieve this rapid growth by maximizing prey consumption rates.

Gear Modification to Reduce Turtle Bycatch **–** Since 2006 NOAA Fisheries has provided funds and technical expertise to support research experiments to identify means to reduce sea turtle bycatch in both longline and gillnet fisheries. During the last year, trials were underway in Brazil, Peru, Mexico and on board a Taiwanese vessel in the North Atlantic Ocean to test the effects of gear modifications (e.g., use of large circle hooks, hook rings, net illumination) on the rates of hooking and entanglement of sea turtles in longline and gillnet fisheries. These trials are also aimed at determining catch rates of target species in order to understand the potential viability of this modification in a commercial fishery.

NOAA conducted a study to examine the effectiveness of illuminating gillnets with ultraviolet (UV) light-emitting diodes for reducing green sea turtle (*Chelonia mydas*) interactions (Wang et al., 2013). The mean sea turtle capture rate was found to be reduced by 39.7% in UV-illuminated nets compared with nets without illumination. In collaboration with commercial, fishermen, UV net illumination in a bottom-set gillnet fishery in Baja California, Mexico was tested. No difference was found in overall target fish catch rate or market value between net types. These findings suggest that UV net illumination may have applications in coastal and pelagic gillnet fisheries to reduce sea turtle bycatch.

Work has expanded to other gillnet fisheries in Peru, Brazil, Chile, and Indonesia. Preliminary results from Northern Peru also suggest the potential utility of illuminating nets with light sources as a means to both maintain target species catch rates and reduce catch of sea turtles (Ortiz et al., in prep).

Post-release Survival of Turtles in Longline Fisheries –NOAA Fisheries aims to improve estimates of sea turtles' post-release fate, specifically shallow longline gear. Currently, methods to estimate post-release survival of turtles involve pop-up satellite archival tags (PSATs) and platform terminal transmitters (PTTs). Research has been conducted using both methods in the North Pacific and South Atlantic Oceans, as well as the Mediterranean Sea.

In a NOAA study in the North Pacific, the likelihood of sea turtle mortality as a result of interactions with longline fishing gear was estimated based on satellite telemetry data, such as the number of days an animal was successfully tracked, or days at liberty (DAL) and dive depth data, as well as anatomical hooking locations (Swimmer et al., 2013).

Pop-up satellite archival tags were deployed on 29 loggerhead sea turtles caught by the North Pacific US-based pelagic longline fishery operating from California and Hawaii between 2002 and 2006. Loggerhead turtles were categorized by observers as shallow-hooked (55%) if the animal was entangled in the line or the hook was in the flipper, jaw or mouth and could be removed, or deep-hooked (45%) if the hook was ingested and could not be removed. The vertical movements of turtles were used to infer potential mortalities. Of the 25 tags that reported data, the DAL ranged from 3 to 243 days (mean =68 days). The DAL was shorter (by nearly 50%) for shallow-hooked (mean=48 days, range: 3 to 127) compared to deep-hooked turtles (mean=94 days, range: 5 to 243), but these changes were not statistically significant (P =0.0658).

Although aspects of these analyses may be considered speculative, these data provide empirical evidence to indicate that deep-hooking is not linked to shorter DAL. DAL, anatomical hooking location, and gear removal were evaluated with inferences about the extent of injuries and rates of infection to estimate an overall post-release mortality rate of 28% (95% bootstrap CI: 16–52%). This range of estimates is consistent with those used to shape some US fisheries management plans, suggesting that conservation goals are being achieved at the expected level and ideally striking a balance between the interests of industry and those of protected species.

These studies have also lead to new findings regarding the movement patterns of loggerhead sea turtles in the Southwestern Atlantic Ocean (Barcelo et al., 2013). In this study, satellite transmitters (PTT) were deployed on juvenile loggerheads captured as bycatch in the Uruguayan and Brazilian pelagic longline fisheries to investigate high-use areas, seasonal movements, and dive patterns. Results support defining the waters off southern Brazil and Uruguay as an identified juvenile loggerhead developmental high-use are in the South Atlantic.

A model of loggerhead turtle habitat and movement in the North Pacific – Habitat preferences for juvenile loggerhead turtles in the North Pacific were investigated with data from two several-year long tagging programs, using 224 satellite transmitters deployed on wild and captive-reared turtles (Abecassis et al., 2013). Animals ranged between 23 and 81 cm in straight carapace length. Tracks were used to investigate changes in temperature preferences and speed of the animals with size. Average sea surface temperatures along the tracks ranged from 18 to 23°C. Bigger turtles generally experienced larger temperature ranges and were encountered in warmer surface waters. Seasonal differences between small and big turtles suggest that the larger ones dive deeper than the mixed layer and subsequently target warmer surface waters to rewarm. Average swimming speeds were under 1 km/h and increased with size for turtles bigger than 30 cm. However, when expressed in body lengths per second (bl s^{-1}), smaller turtles showed much higher swimming speeds (>1 bl s^{-}

[1]) than bigger ones (0.5 bl s^{-1}). Temperature and speed values at size estimated from the tracks were used to parameterize a habitat-based Eulerian model to predict areas of highest probability of presence in the North Pacific. The model-generated habitat index generally matched the tracks closely, capturing the north-south movements of tracked animals, but the model failed to replicate observed east-west movements, suggesting temperature and foraging preferences are not the only factors driving large-scale loggerhead movements. Model outputs could inform potential bycatch reduction strategies.

Redistribution of longline hooks to reduce shark bycatch – The interspecific preferences of fishes for different depths and habitats suggest fishers could avoid unwanted catches of some species while still effectively targeting other species. In pelagic longline fisheries, albacore are often caught in relatively cooler, deeper water (>100 m) than many species of conservation concern (e.g., sea turtles, billfishes, and some sharks) that are caught in shallower water (<100 m). From 2007 to 2011, this study examined the depth distributions of hooks for 1154 longline sets (3,406,946 hooks) and recorded captures by hook position on 2642 sets (7,829,498 hooks) in the American Samoa longline fishery (Watson and Bigelow, 2014). Twenty-three percent of hooks had a settled depth <100 m. Individuals captured in the 3 shallowest hook positions accounted for 18.3% of all bycatch. The study analyzed hypothetical impacts for 25 of the most abundant species caught in the fishery by eliminating the 3 shallowest hook positions under scenarios with and without redistribution of these hooks to deeper depths. Distributions varied by species: 45.5% (n = 10) of green sea turtle (*Chelonia mydas*), 59.5% (n = 626) of shortbill spearfish (*Tetrapturus angustirostris*), 37.3% (n = 435) of silky shark (*Carcharhinus falciformis*), and 42.6% (n = 150) of oceanic whitetip shark (*C. longimanus*) were caught on the 3 shallowest hooks. Eleven percent (n = 20,435) of all tuna and 8.5% (n = 10,374) of albacore were caught on the 3 shallowest hooks. Hook elimination reduced landed value by 1.6–9.2%, and redistribution of hooks increased average annual landed value relative to the status quo by 5–11.7%. Based on these scenarios, redistribution of hooks to deeper depths may provide an economically feasible modification to longline gear that could substantially reduce bycatch for a suite of vulnerable species. The results suggest that this method may be applicable to deep-set pelagic longline fisheries worldwide.

Injury determinations for cetaceans interacting with longline fisheries **–** Cetacean interactions (i.e., hookings and entanglements) with the Hawaii and American Samoa longline fisheries observed during 2007-2011 were compiled, and the number of cetacean deaths, serious injuries, and non-serious injuries by fishery, species, and management area were assessed (Bradford and Forney, 2014). These values form the basis of the mortality and serious injury estimates included in the stock assessment reports of stocks impacted by these fisheries. Injury determinations were made using a revised process for distinguishing serious from non-serious injuries (National Marine Fisheries Service, 2012). In the Hawaii deep-set fishery, 50 cetacean interactions were observed from 2007 to 2011; most involved false killer whales (48.0%), resulted in death or serious injury (73.5%), and occurred outside the U.S. exclusive economic zone, or EEZ (54.0%). In the Hawaii shallow-set fishery, 46 cetacean interactions were observed from 2007 to 2011; most involved Risso’s dolphins (45.7%), resulted in death or serious injury (77.2%), and occurred outside the U.S. EEZ (91.3%). In the American Samoa deep-set fishery, 14 cetacean interactions were observed from 2007 to 2011; most involved rough-toothed dolphins (42.9%), resulted in death or serious injury (92.9%), and occurred within the U.S. EEZ (85.7%).

North Pacific Albacore Electronic Logbooks **–** In 2005, the NOAA Fisheries developed a computer program to allow albacore troll fishermen to enter their logbook data directly into a database rather than completing the traditional paper forms. Since 2006, the program has been used by 5-10 fishermen annually and has received positive feedback on its functionalities and ease of use. During the 2013 season, logs for 63 trips were submitted electronically, or for 4.6% of all trips reported. A new PDF version of the logbook is being developed as an alternative logbook program. The format mimics the current paper form and provides simpler installation, completion and submission processes. Therefore, we hope for greater use of the new electronic logs. Testing should be completed during the 2014 season.

North Pacific Albacore Archival Tagging – The NOAA Fisheries and American Albacore Fishing Association (AFRF) initiated an archival tagging program in 2001 to study the migration patterns and stock structure of juvenile albacore in the North Pacific. Since 2001, a total of 878 archival tags have been deployed. Plans are being made to deploy over 100 tags during the 2014 season. During 2013, three recaptures were reported, each of which had been deployed over two days during a single trip in August 2011. The three fish recaptured in 2013 were at liberty for 684, 693 and 753 days representing some of the longest tracks yet recorded during the study. Of the 3 fish, 2 were recaptured by Japanese pole-and-line fishermen very close to the coast of Japan. The third was recaptured very close to where it was released off the coast of Oregon after two years. Although the sensors of one tag malfunctioned partway through its deployment, these recoveries provide remarkable new information on juvenile albacore behavior over multiple years and in the western and central Pacific Ocean.

Albacore Age and Growth **–** A number of lines of evidence support the hypothesis that there are two different substocks of albacore tuna in the California Current with 40°N as the dividing line between them. A study recently published by NOAA Fisheries scientists in collaboration with the University of San Diego and Texas A&M University examined the daily rings in otoliths of 126 albacore from both regions to determine, age, growth rates and hatching dates (Wells et al., 2013). Overall, fish from the southern region were larger than those in the north as reported in other studies. Calculated age data reveal that the size differences were primarily due to differences in age, although albacore from the southern population were significantly larger than fish from the north at the same age indicating a faster growth rate over some time period. Results showed that fish from both regions had protracted hatch dates from February-September with a peak from April-July and no significant difference between the two purported substocks.

Stable Isotope Analysis of North Pacific Albacore – In order to examine the difference between albacore north and south of 40°N, to identify separation between the two groups and help determine in what water masses they typically forage, onshore versus offshore, NOAA Fisheries is using stable isotope analysis (SIA). SIA analyses on regional prey species, will also help to examine potential differences in foraging ecology and trophic level over longer time periods than is possible using stomach contents alone. Preliminary data suggest there is separation between the northern and southern albacore, with mean $\delta^{13}C$ and $\delta^{15}N$ values from the south showing enrichment compared to northern samples. The $\delta^{13}C$ values show distinct carbon sources being utilized by two potentially separate substocks with limited mixing, while $\delta^{15}N$ values are different but fall short of indicating distinct trophic levels.

Albacore distribution and environmental effects – NOAA Fisheries scientists, in collaboration with scientists of Canada’s Department of Fisheries and Oceans (DFO) are examining the influence of the North Pacific Current on the spatial distribution and availability of North Pacific albacore in the northeast Pacific Ocean in order to improve the development of abundance indices for albacore in the Northeast Pacific. One study examines the influence of subtropical fronts on the spatial distribution of albacore in the Northeast Pacific over the past 30 years by relating albacore catch-per-unit-effort (CPUE) from U.S. and Canadian logbooks with subtropical fronts derived from an analysis of SST gradients using an improved version of the Cayula-Cornillion frontal detection algorithm. Our results suggest that areas with high albacore catch-per-unit-effort (CPUE) tend to occur in regions with high SST gradients, such as the North Pacific Transition Zone (NPTZ) and the North American coast. Approaching the North American coast along the NPTZ, SST gradients drop off substantially around 130°W before increasing rapidly near the coast, which corresponded to a similar pattern in albacore CPUE. In the NPTZ, the centroid of albacore CPUE showed a seasonal shift northwards in summer and southwards in fall, which coincided with seasonal spatial shifts of areas with high SST gradients. A similar pattern was found on an interannual scale, with the exception of several years with limited fishery data in the NPTZ due to changes in fishery operations.

Another study examines coastal upwelling fronts as key habitat for albacore tuna in the Northeast Pacific Ocean. The study uses satellite-derived SST data to characterize coastal fronts in an automatic way and boosted regression trees (BRTs) to relate the effects of these fronts on albacore distribution. The results suggest that albacore CPUE distribution is strongly influenced by SST and chlorophyll at fishing locations, albeit with substantial seasonal and interannual variation. Albacore CPUEs were higher near warm, low chlorophyll oceanic waters, and near SST fronts. Sequential leave-one-year-out cross-validations were performed for all years and it was found that the relationships in the BRT models were robust for the entire study period. Spatial distributions of model-predicted albacore CPUE were similar to observations, but the model was unable to predict very high CPUEs in some areas.

***Deep-set Longline Survey to Investigate Swordfish-Sea Turtle Habitat Separation* –** Heightened focus on minimizing bycatch of protected species has lead U.S. fisheries managers to implement combinations of gear restrictions and time-area closures and the California drift gillnet (CADGN) fishery has declined dramatically since a large time-area closure was implemented in 2001. NOAA Fisheries is exploring gear alternatives for targeting swordfish off California by shifting longline gear to deeper water in order to capitalize on the difference in daytime depths between the species and minimize bycatch: swordfish typically spend the daylight hours in waters deeper than 200 m whereas leatherbacks remain above 120 m. On three cruises from 2011-2013, NOAA collaborated with longline fishers aboard the chartered *F/V Ventura II* off central and southern California to investigate the efficacy of targeting swordfish during the day using a deep-set longline (DSLL) and conducted 47 sets, with average hook depths of 230-247 m and soak times 2.7-4 hours, 111 marketable fish (including 8 swordfish, 67 opah and 23 pomfret) and 352 non-marketable fish (including 328 blue sharks and 17 king of the salmon) were caught. Short soak times were used to maximize fish condition for tagging. This study concluded that it is possible to catch swordfish and other marketable species below turtle habitat with a DSL. However, swordfish catch was low. Given the experimental and small-scale nature of this research, these results are promising, but should not be projected beyond the study and warrant more research.

Juvenile Mako and Blue Shark Survey – In July 2013, the SWFSC conducted its twentieth juvenile shark survey for mako and blue sharks since 1994. Working aboard F/V Ventura II, a team of scientists and volunteers fished a total of 5,946 hooks during 28 daytime sets within seven focal areas of the SCB. The survey catch totaled 257 shortfin makos, 14 blue sharks, 11 pelagic rays (Pteroplatytrygon violacea), 8 opah (Lampris guttatus), and 1 ocean sunfish (Mola mola). The preliminary data indicate that the nominal survey catch rate was 1.08 sharks per 100 hook-hours for shortfin mako and 0.06 sharks per 100 hook-hours for blue sharks. The mako shark nominal CPUE was higher than the previous year. However, there is a declining trend in nominal CPUE for both species over the time series of the survey.

In addition to survey longline sets, other fishing methods were used to maximize time on the water and increase the opportunity for catching other highly migratory large pelagic species (HMS). Longline gear was modified for ancillary sets in an effort to cover a greater vertical distribution of the water column by using longer branchlines and more hooks per basket.

In all, 35 longline sets were completed. A total of 317 animals were caught. Most animals were brought onboard, measured, tagged, and sampled for DNA biopsies before they were released. Conventional spaghetti tags were released on 267 sharks to allow for movement and stock structure data collection. In addition, sharks tagged with conventional tags were also injected with oxytetracycline and tagged with plastic dorsal tags containing information for fishers upon recapture of the animal to retain a portion of the vertebrae for ongoing age and growth studies. Biological collections included DNA samples from most sharks captured, as well as stomachs, digestive tracts, and blood from a small number of sharks that did not survive.

***Swordfish Deep-Set Buoy Gear (DSBG) Research* –** NOAA Fisheries and the Pfleger Institute of Environmental Research (PIER) are conducting research using a deep-set vertical hook and line configuration (buoy gear) to target swordfish within the exclusive economic zone off the coast of California. To minimize interactions with species of concern, the deep-set gear was designed to fish below the thermocline (270 to 350m) during daylight hours. Gear trials were conducted during the 2011 and 2012 swordfish seasons and additional deep set bouy gear (DSBG) field experiments in 2013 focused on improving the test configuration, enhancing deployment and retrieval efficiency and preparing for cooperative trials in 2014. These data will be used in 2014 to trial DSBG from cooperative fisher platforms and to assess the domestic market niche for buoy caught swordfish.

Shortfin Mako Shark Tagging - In 2012 the NOAA Fisheries began a collaboration with Fishtrack to deploy SPOT tags on larger makos during the longline survey. Four makos have been released with tags sponsored by Fishtrack. The tracking data are posted in near-real-time on their website (http://www.fishtrack.com/live-track/). Tags of two sharks tagged in 2012 and one tagged in 2013 were still reporting as of April 2014.

Record Shortfin Mako Shark Studied - On 3 June 2013, a record-breaking female shortfin mako shark (total length = 373 cm, mass = 600.1 kg) was captured by a recreational angler off Huntington Beach, California, and was subsequently donated to NOAA Fisheries and California State University Long Beach for research. Samples of various tissue types were collected and analyzed to gain more information about the shark's anatomy, physiology, ecology, and life history. The shark was found to have an approximately three-year old female sea lion carcass in its stomach. The spiral valve contents included two species of cestode parasite including 20 specimens of a tetraphyllidea tapeworm and two of a trypanorhyncha tapeworm. Two damaged specimens of a capillaria nematode were also found, but as the genus is not known to parasitize sharks, it is likely that they were ingested along with their teleost hosts. Two ageing methods, thin sectioning with microscopy and x-ray imaging, were used to age the vertebrae of this mako, producing counts of 26 and 27 band pairs, respectively. The shark was estimated to be 13-22 years old. Organic contaminants and total mercury were measured in the liver and muscle tissue of the shark and were found to be substantially greater than most animals previously measured in southern California (total DDTs: 0.2 mg/g wet weight; total PCBs: 0.03 mg/g wet weight). This rare opportunity allowed for the collection of important data and contributes to our knowledge about the life history characteristics of large shortfin mako sharks.

III. NOAA Fisheries Literature from the Past Year

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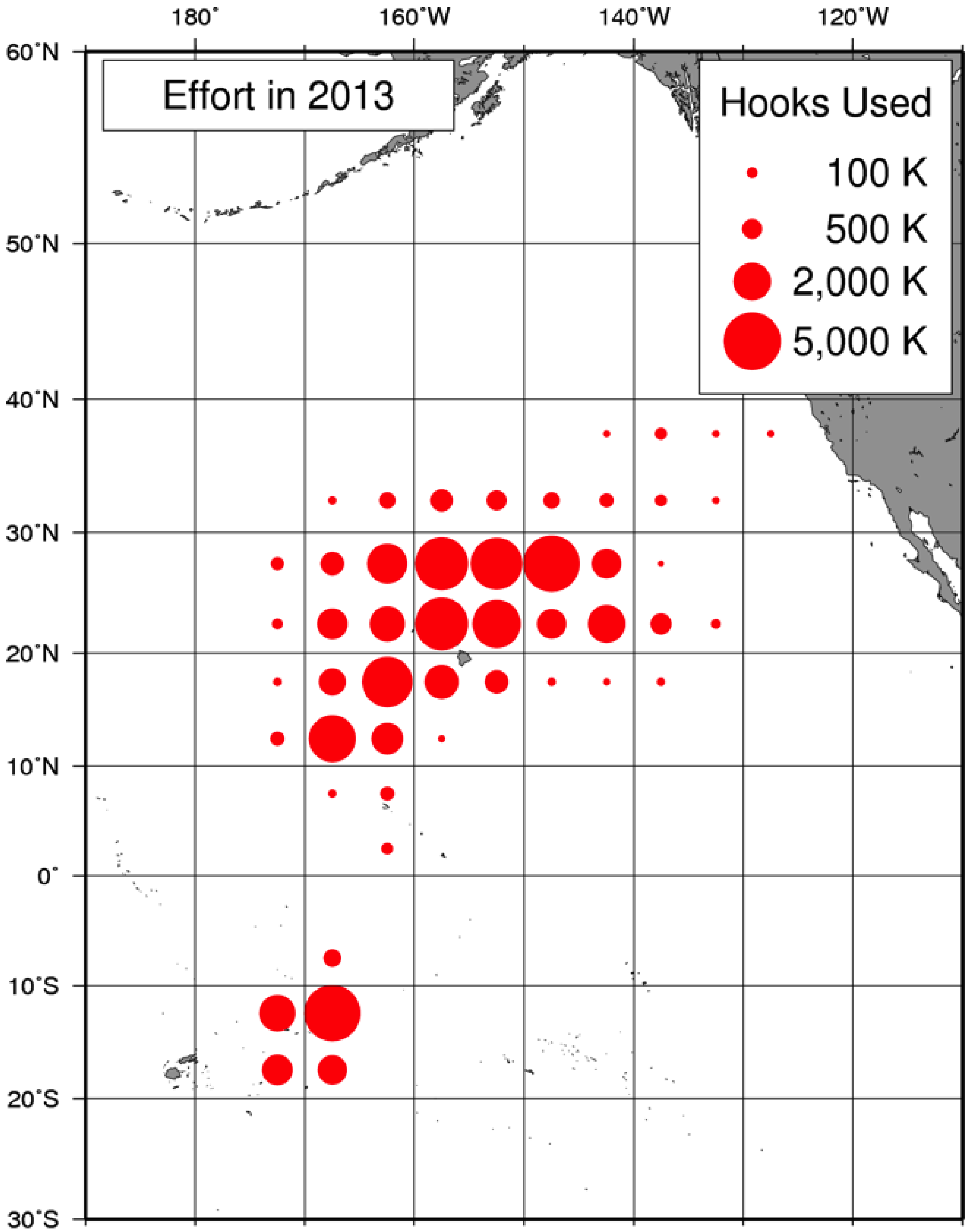


Figure 1. Spatial distribution of reported logbook fishing effort by the 2013 U.S. longline fishery in the North Pacific Ocean, in 1,000s of hooks. The size of circles is proportional to the amount of effort. Effort in some areas is not shown in order to preserve data confidentiality.

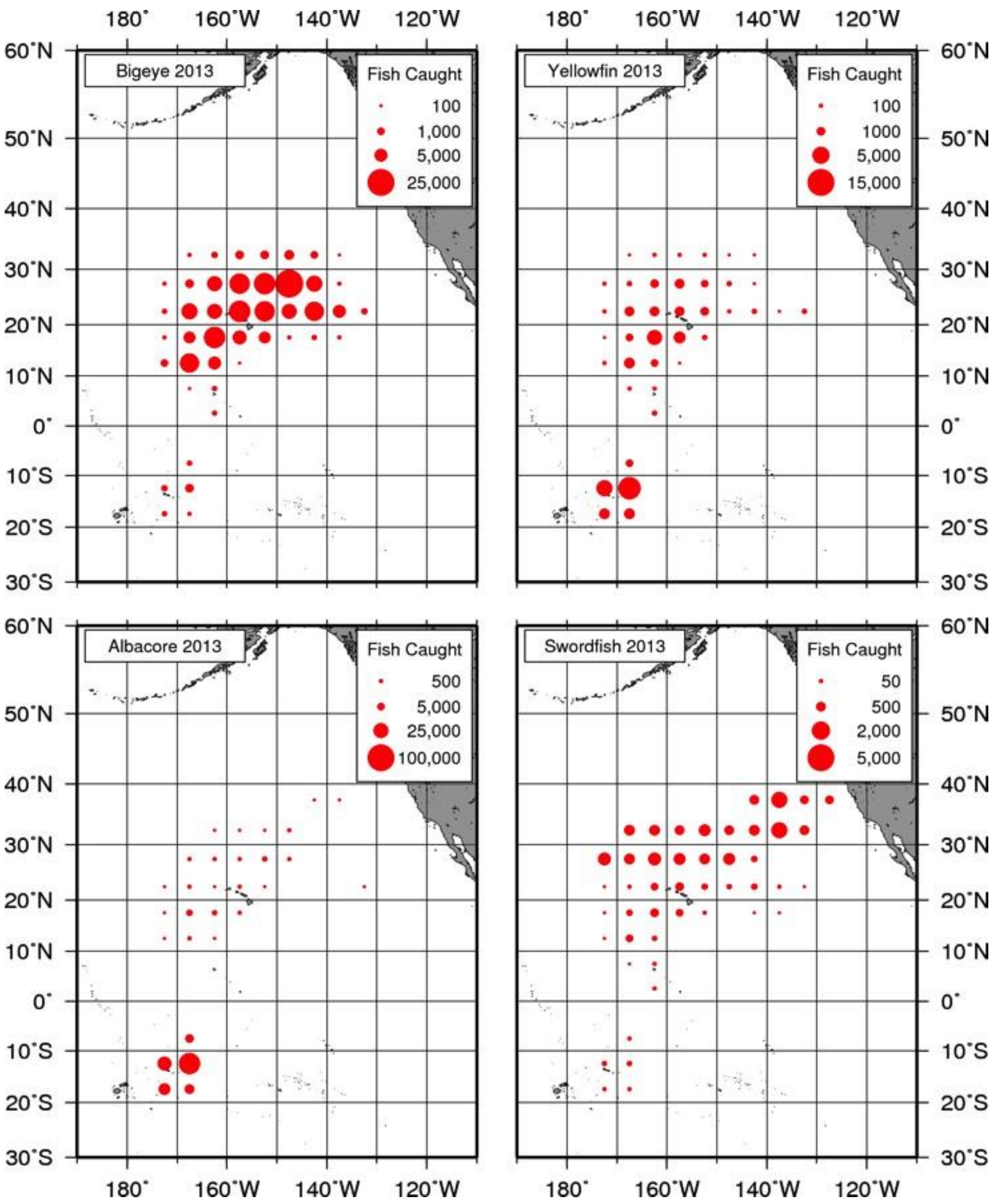


Figure 2. Spatial distribution of reported logbook fishing catch by the U.S. longline fishery in the North Pacific Ocean, in numbers of fish, in 2013 for bigeye, albacore, yellowfin and swordfish. The size of circles is proportional to the amount of effort. Effort in some areas is not shown in order to preserve data confidentiality.

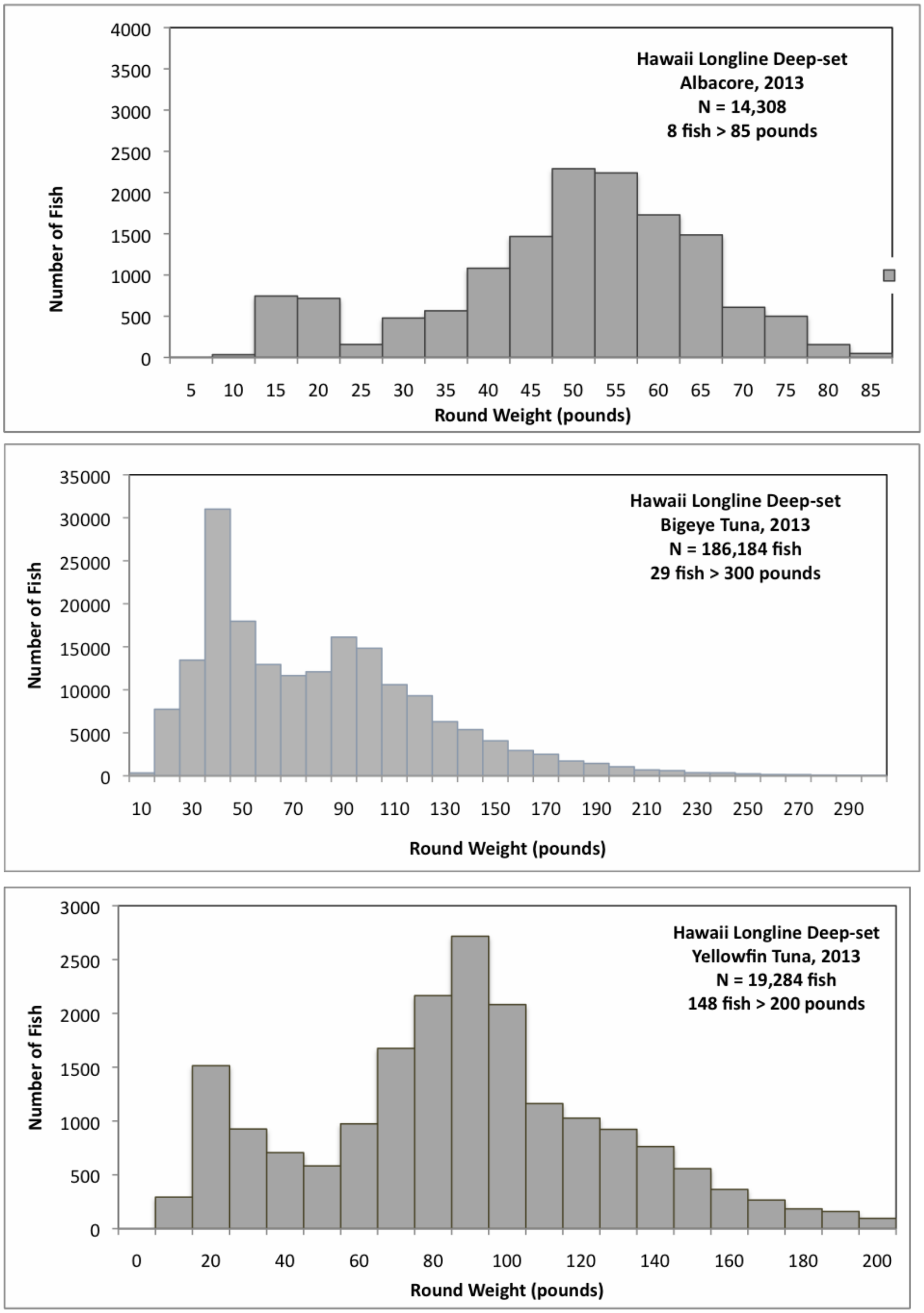


Figure 3. Size distribution of (top) albacore (*Thunnus alalunga*), (middle) bigeye tuna (*Thunnus obesus*), and (bottom) yellowfin tuna (*Thunnus albacares*) caught by the Hawaii-based deep-set longline fishery in the north Pacific Ocean, 2013.

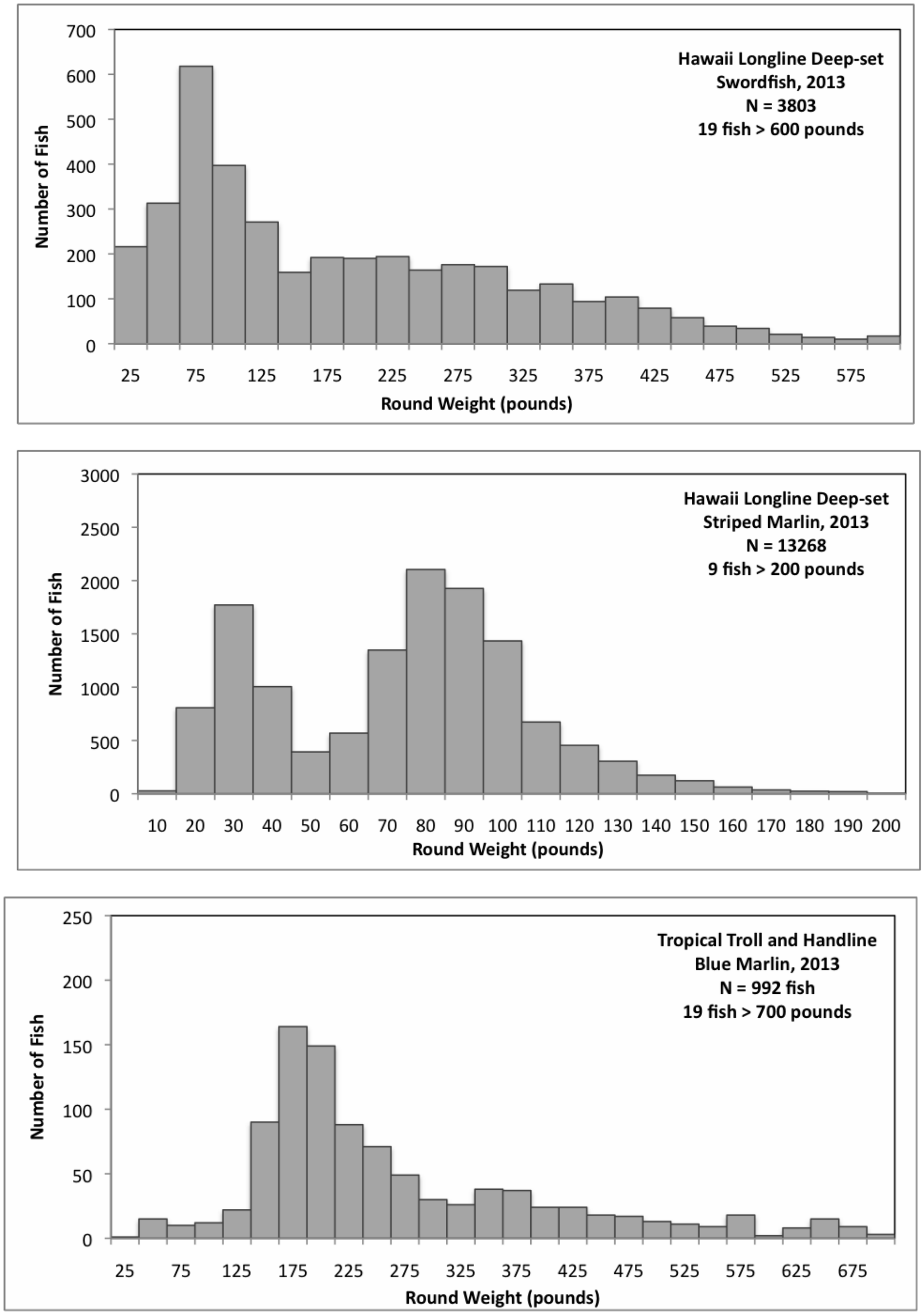
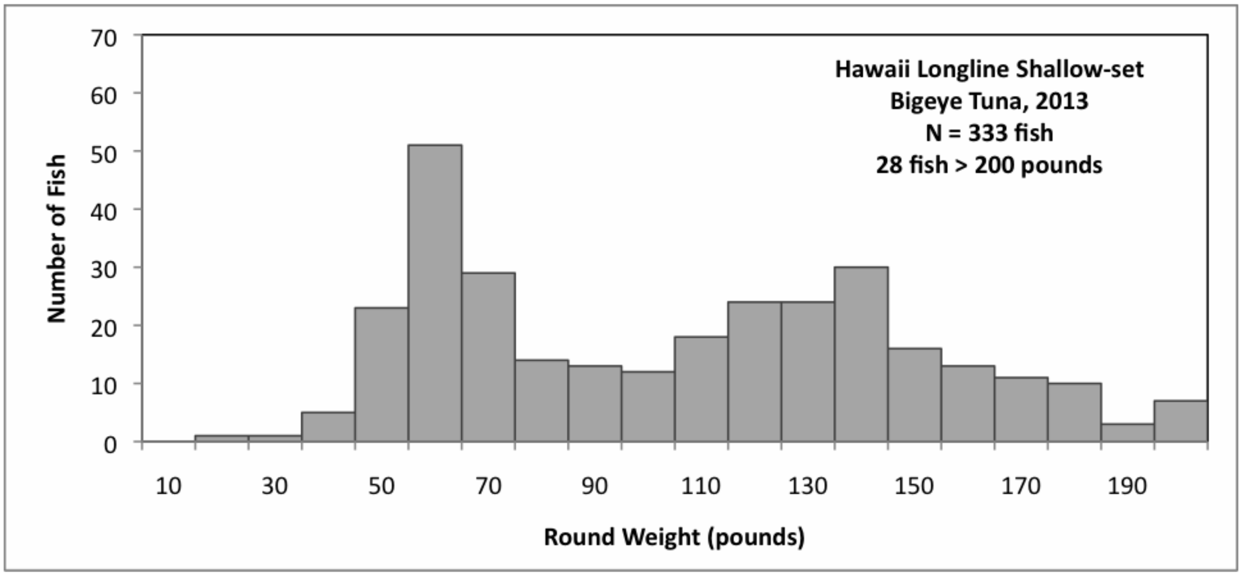


Figure 4. Size distribution of (top) swordfish (*Xiphias gladius*), (middle) striped marlin (*Tetrapturus audax*) , and (bottom) blue marlin (*Makaira nigricans*) caught by the Hawaii-based deep-set longline fishery in the north Pacific Ocean, 2013.



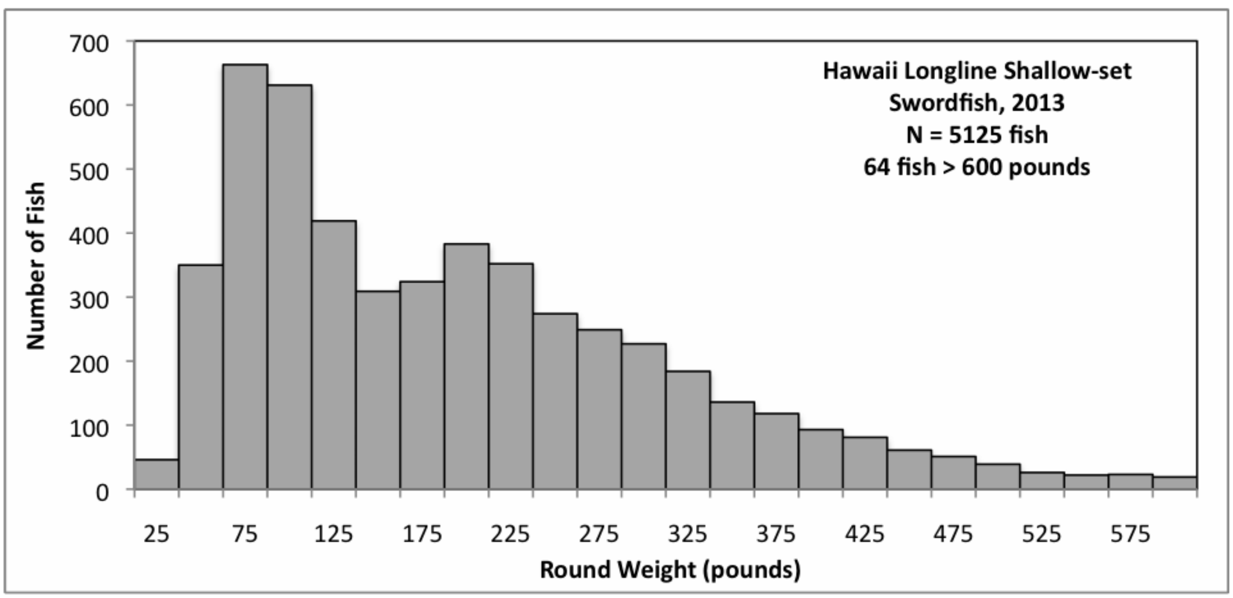


Figure 5. Size distribution of (top) bigeye tuna (*Thunnus obesus*), and (bottom) swordfish (*Xiphias gladius*) caught by the Hawaii-based shallow-set longline fishery in the north Pacific Ocean, 2013.

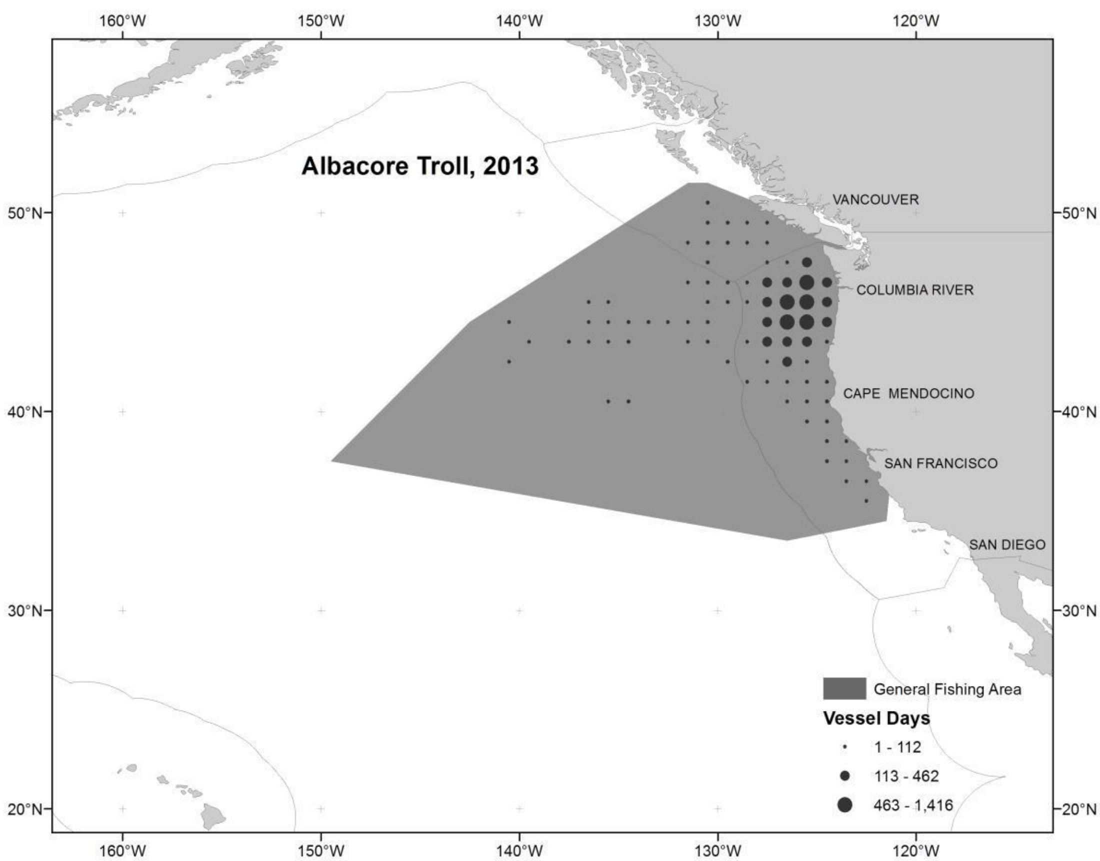


Figure 6. Spatial distribution of reported logbook fishing effort by the 2013 U.S. albacore troll and pole-and-line fishery in vessel days. The size of circles is proportional to the amount of effort. Effort in some areas is not shown in order to preserve data confidentiality.

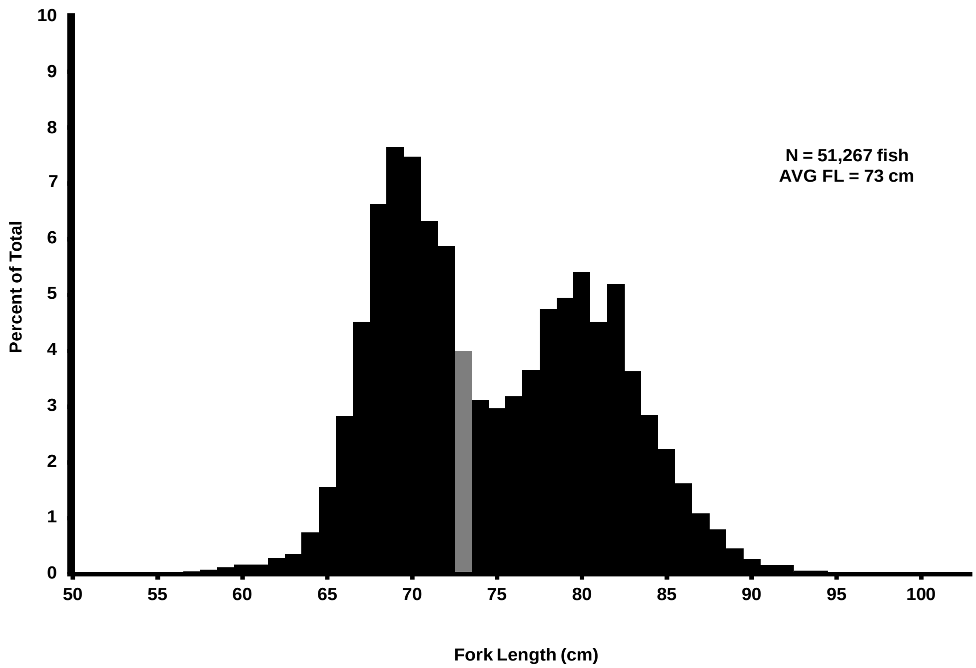
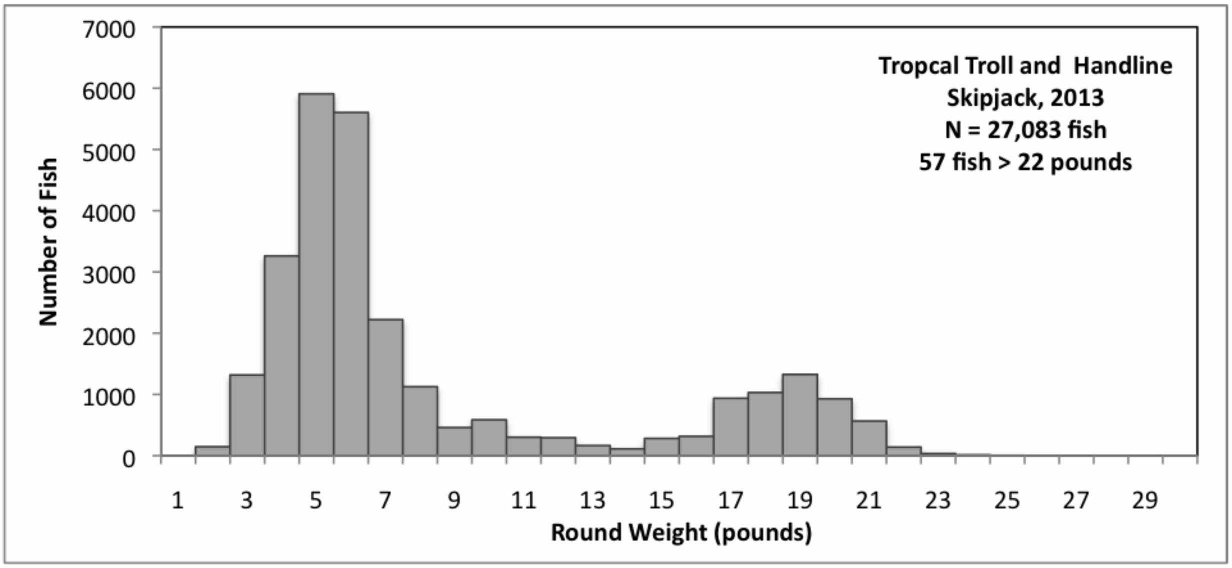


Figure 7. Size distribution of albacore catch by the U.S.A. north Pacific albacore (*Thunnus alalunga*) troll and pole-and-line fishery in 2013.



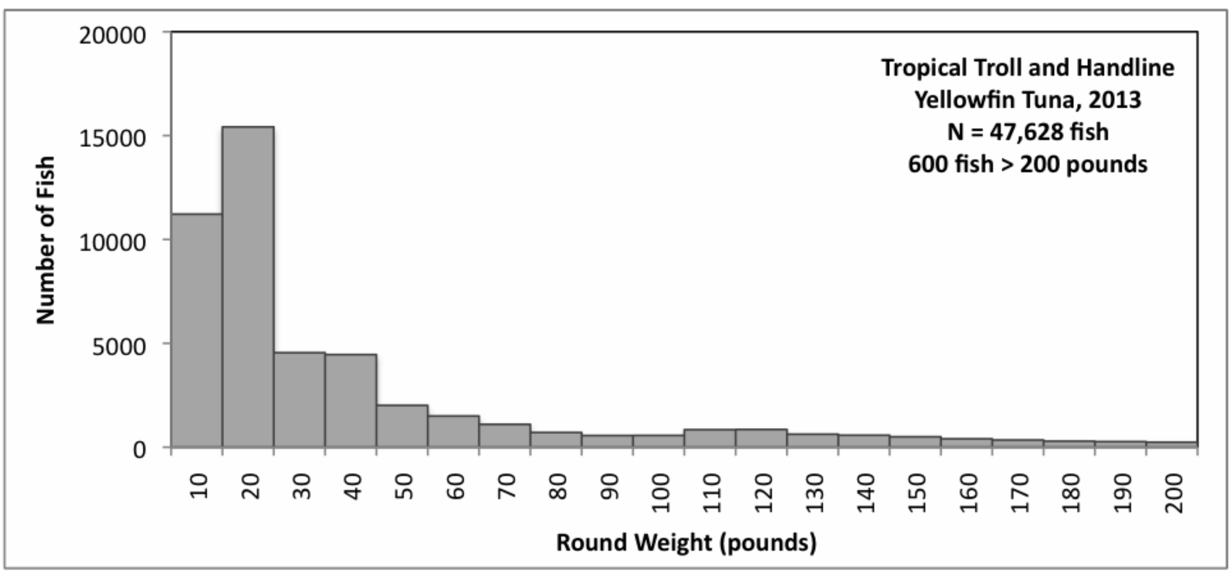
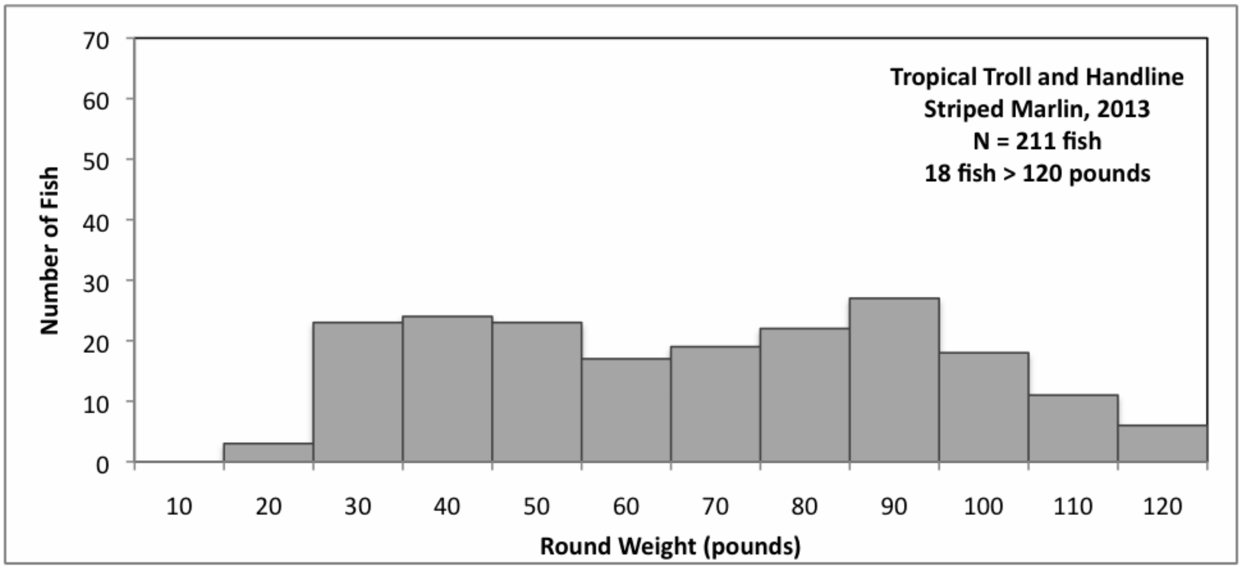


Figure 8. Size distribution of (top) skipjack tuna (*Katsuwonus pelamis*) and (bottom) yellowfin tuna (*Thunnus albacares*) caught by the Hawaii troll and handline fisheries, 2013.



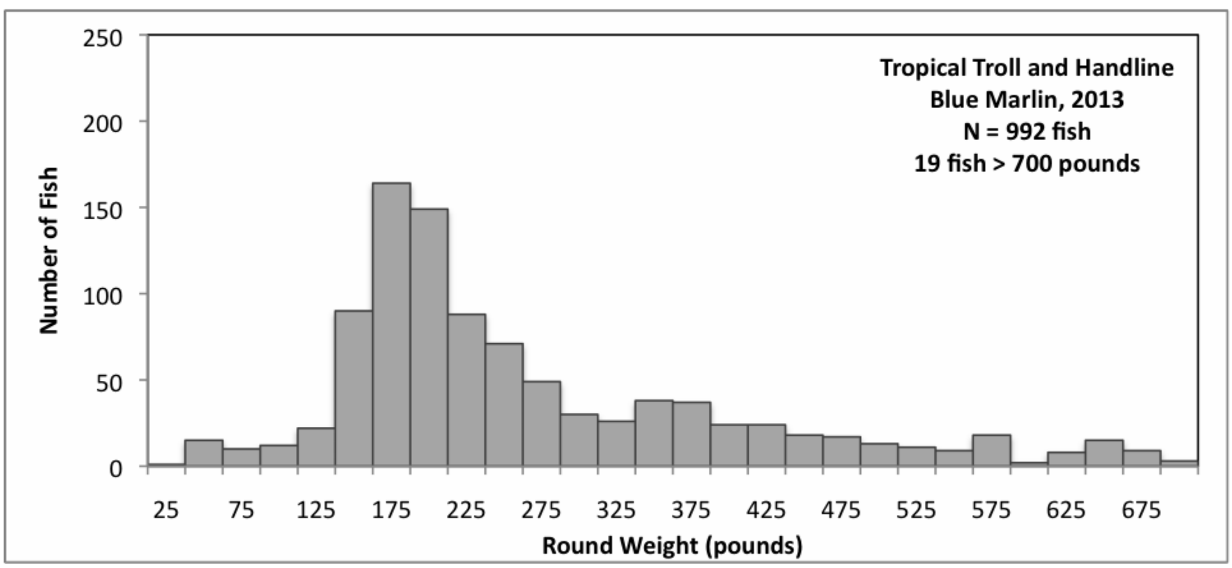


Figure 9. Size distribution of (top) striped marlin (*Tetrapturus audax*) and (bottom) blue marlin (*Makaira nigricans*) caught by the Hawaii troll and handline fisheries, 2013**.**

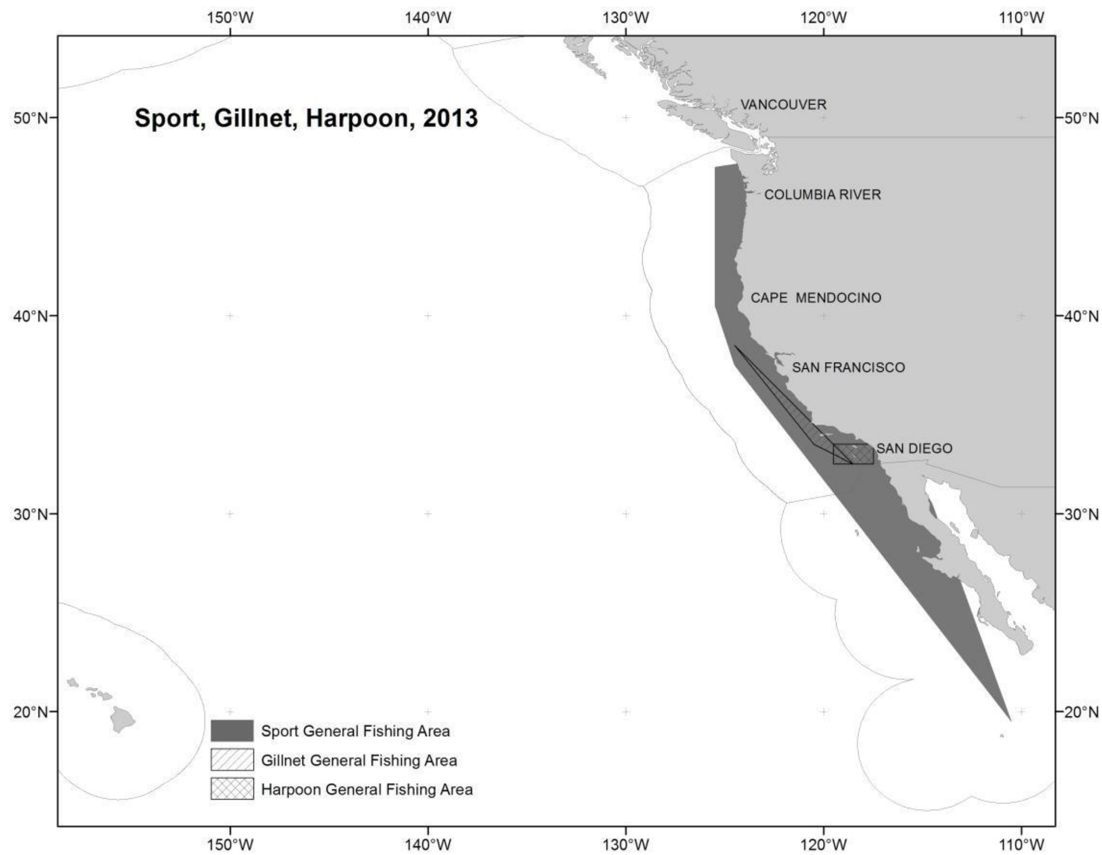


Figure 10. Spatial distribution of reported logbook fishing effort by the 2013 U.S. harpoon, gillnet, and west coast sport fishery in the North Pacific Ocean.

Table 1. Number of vessels fishing in the North Pacific Ocean in various U.S. fisheries. Data for 2013 are preliminary[1.] -- indicates data are not available.

Year	Purse Seine [2]	Longline	Albacore Troll and Pole-and-Line	Tropical Pole and Line	Tropical Troll [3]	Tropical Handline	Gillnet	Harpoon
1990	71	138	368	12	2,042		146	49
1991	59	141	172	12	2,117		123	32
1992	72	124	602	11	2,160		113	48
1993	68	122	608	13	2,132		105	44
1994	72	127	721	11	2,210		112	49
1995	65	116	471	11	2,387		127	39
1996	61	114	676	9	2,411		100	30
1997	68	117	1,172	9	2,400		104	31
1998	68	122	841	9	2,370		87	26
1999	42	140	776	9	2,502		78	30
2000	40	130	645	7	2,229		77	26
2001	43	125	860	9	2,208		64	23
2002	31	123	644	13	2,045		45	29
2003	29	128	729	14	1,960		37	34
2004	28	126	695	11	2,012		33	29
2005	23	126	541	10	1,917		37	24
2006	11	128	601	11	1,916		45	24
2007	22	130	676	3	1,869	424	49	28
2008	36	130	525	3	1,978	475	51	32
2009	46	128	687	6	2,083	552	35	28
2010	37	125	635	2	2,042	480	26	26
2011	39	129	656	2	2,100	508	22	17
2012	40	129	841	1	2,084	576	17	9
2013	40	136	702	2	2,179	534	18	13

[1] Estimations of west coast vessels targeting ISC species is currently under revision.
[2] Number of Purse Seine vessels are counts of unique vessels from EPO and WCPO fisheries
[3] Number of tropical troll vessels for 1987-2006 include tropical handline vessels

Table 2. U.S. catches (metric tons) of tunas and tuna-like species (FAO codes) by fishery in the North Pacific Ocean, north of the equator. Data for 2013 are preliminary. Species codes: ALB = albacore, YFT = yellowfin tuna, SKJ = skipjack tuna, BET = bigeye tuna, PBF = Pacific bluefin tuna, SWO = swordfish, BUM = blue marlin, MLS = striped marlin, BIL = other billfish, TUN = other tunas, ALV = common thresher shark, PTH = pelagic thresher shark, BTH = bigeye thresher shark, SMA = shortfin mako shark, BSH = blue shark, SKH = other sharks . Zeros indicate less than 0.5 metric tons. -- indicates data are not available.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	TUN	SWO	BUM	MLS	BIL [5]	ALV	PTH	BTH	SMA	BSH	SKH	TOTAL
Purse Seine [1]																	
1990	71	63,722	53,213	674	1,380												119,060
1991		26,789	50,107	415	410												77,721
1992		29,668	74,234	3,709	1,928												109,539
1993		23,805	60,485	3,035	580												87,905
1994		10,516	30,183	2,472	906												44,077
1995		16,934	60,036	5,803	657												83,430
1996	11	6,653	20,646	6,884	4,639												38,833
1997	2	20,866	37,525	8,702	2,240												69,335
1998	33	20,831	25,258	3,645	1,771												51,538
1999	48	4,989	18,710	3,236	184												27,167
2000	4	1,670	5,508	454	693												8,329
2001	51	5,362	17,794	1,122	292												24,621
2002	4	6,612	4,002	580	50												11,248
2003	44	3,562	21,212	3,528	22												28,368
2004	1	3,810	6,860	1,437													12,108
2005		6,792	19,171	3,992	201												30,156
2006		1,112	5,075	1,492													7,679
2007	77	1,112	5,075	1,492	42												7,797
2008	--	2,725	11,045	555													14,325
2009	31	3,694	14,378	512	410												19,025
2010	--	7,136	41,523	1,557		--	0	1	1	15	--	--	--	--	--	34	50,267
2011	--	3,996	30,348	1,893		65	0	6	0	10	--	--	--	0	--	30	36,348
2012		5,837	42,479	1,038													49,354
2013	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Longline [2]																	
1990	177	1,098	5	1,514			2,437	378	538	58							6,205
1991	312	733	30	1,555	2		4,535	297	663	69							8,196
1992	334	346	22	1,486	38		5,762	347	459	142							8,936
1993	438	633	36	2,124	42		5,936	339	471	100							10,119
1994	544	610	53	1,827	30	5	3,807	362	326	99							7,663
1995	882	984	101	2,099	29		2,981	570	543	182							8,371
1996	1,185	634	41	1,846	25	2	2,848	467	418	115							7,581
1997	1,653	1,143	106	2,526	26	2	3,393	487	352	143							9,831
1998	1,120	724	76	3,274	54	9	3,681	395	378	172							9,883
1999	1,542	477	99	2,820	54	10	4,329	357	364	242							10,294
2000	940	1,137	93	2,708	19		4,834	314	200	152							10,397
2001	1,295	1,029	211	2,418	6		1,969	399	351	136							7,814
2002	525	572	127	4,396	2		1,524	264	226	160							7,796
2003	524	809	207	3,618	1		1,958	363	538	248							8,266
2004	361	715	142	4,339	1	9	1,185	283	376	200							7,611
2005	296	712	91	4,999	1		1,622	337	511	216							8,785
2006	270	958	94	4,466	1		1,211	409	611	174							8,194
2007	250	844	93	5,822	0	0	1,735	262	276	160	44			128	8	7	9,629
2008	354	875	120	5,959	0	0	2,014	349	427	238	41			133	7	4	10,521
2009	203	527	136	4,628	1	0	1,817	360	258	124	30			120	9	6	8,219
2010	421	568	153	5,440	0	0	1,676	306	165	131	18			94	7	3	8,982
2011	708	937	207	5,701	0	0	1,623	373	362	249	19			68	13	2	10,262
2012	660	887	245	5,873	0	0	1,395	298	282	173	14			68	16	1	9,912
2013	326	711	226	6,444	1	0	1,285	384	391	226	5			51	1	0	10,051

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	TUN	SWO	BUM	MLS	BIL [5]	ALV	PTH	BTH	SMA	BSH	SKH	TOTAL
Albacore Troll and Pole-and-Line																	
1990	2,718																2,718
1991	1,845																1,845
1992	4,572																4,572
1993	6,254	137	62			1											6,454
1994	10,978	769	352														12,099
1995	8,125	211	1,157														9,493
1996	16,962	606	393		2												17,963
1997	14,325	4	2		1												14,332
1998	14,489	1,246	2		128												15,865
1999	10,120	52	16		20												10,208
2000	9,714	3	4		1	1											9,723
2001	11,349	1	1		6												11,357
2002	10,768				1												10,769
2003	14,161		2														14,163
2004	13,473	1															13,474
2005	8,479																8,479
2006	12,547																12,547
2007	11,908																11,908
2008	11,761																11,761
2009	12,340		0		0									0			12,340
2010	11,689		0														11,690
2011	10,143		0		0												10,143
2012	14,149		0		0									0		0	14,149
2013	12,325		0		0										0		12,325
Tropical Pole-and-Line																	
1990		154	553			2											709
1991		942	1,840														2,782
1992		1,928	1,744			2											3,674
1993		2,636	2,850			5											5,491
1994		1,844	2,422			18											4,284
1995		394	2,393														2,787
1996		696	1,331			1											2,028
1997		468	1,755														2,223
1998		2,206	1,067														3,273
1999		57	601	4													662
2000		3	320	1													324
2001		4	448														452
2002		2	420			2											424
2003		35	587			4											626
2004		18	279							1							298
2005		68	353			1											422
2006		4	294			3											301
2007		23	272			1											296
2008		23	293			4											320
2009		17	214			1											232
2010																	-
2011																	-
2012																	
2013																	

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	TUN	SWO	BUM	MLS	BIL [5]	ALV	PTH	BTH	SMA	BSH	SKH	TOTAL
Tropical Troll [3]																	
1990	15	891	138	25		11		295	27	17							1,419
1991	72	802	237	25		9		346	41	25							1,557
1992	54	602	167	13		10		260	37	17							1,160
1993	71	861	157	3		6		311	67	20							1,496
1994	90	870	138	7		8		298	35	22							1,468
1995	177	978	152	20		7		315	52	29							1,730
1996	188	934	224	7		5		409	53	18							1,838
1997	133	770	196	26		4		378	37	17							1,561
1998	88	766	143	9		6		242	26	19							1,299
1999	331	1,019	181	24		4		293	27	33							1,912
2000	120	1,080	415	207		15		235	15	20							2,107
2001	194	878	523	226		13		291	44	32							2,201
2002	235	632	355	586		6		225	30	13							2,082
2003	85	735	268	213		25		210	29	18							1,583
2004	157	746	251	381		45		188	31	23							1,822
2005	175	679	259	295		14		187	20	15							1,644
2006	95	508	296	303		12		160	21	14							1,409
2007	3	501	266	63		8	1	127	13	12							994
2008	1	451	481	74		7		198	14	14							1,240
2009	3	471	412	59		12	0	15	10	8							990
2010	2	426	416	118		25		148	19	12						1	1,167
2011	4	496	385	110		16		199	16	18						1	1,245
2012	3	644	381	155		18	1	141	11	16						1	1,371
2013	2	524	534	147		4	1	137	8	16						1	1,374
Tropical Handline																	
1990							5		0								5
1991							6		0								6
1992							1		1								2
1993							4		1								5
1994							4		0								4
1995							6		0								6
1996							5		1								6
1997							7		1								8
1998							7		0								7
1999							9		1								10
2000																	-
2001																	-
2002									0								-
2003							10		0								10
2004							7		2								9
2005							5		0								5
2006							4		0								4
2007	94	254	7	324		1	5	1									686
2008	28	227	9	148		1	6	1									420
2009	97	317	11	136		3	5	1									570
2010	53	265	7	340		4	3	2			1			1			676
2011	84	357	9	296		1	5	2									754
2012	253	381	12	298		1	6	2			1			1			955
2013	46	440	14	392		1	6	3			1						903

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	TUN	SWO	BUM	MLS	BIL[5]	ALV	PTH	BTH	SMA	BSH	SKH	TOTAL
Gillnet																	
1990	29	1	1	1	11	2	1,131				266	1	30	229	0		1,702
1991	17	1	3	3	4	3	944				542		31	125	0		1,673
1992		4	1	1	9	6	1,356				256	0	18	118	1		1,770
1993		7	2		32	9	1,412				243	1	41	87	0		1,834
1994	38				28	2	792				292	0	32	80	0		1,264
1995	52	2	70	1	20	1	771				234	5	30	79	0		1,265
1996	83	2	2		43		761				298	1	20	85	0		1,295
1997	60	3	2	5	58		708				291	35	29	118	0		1,309
1998	80	2	3	4	40	2	931				332	2	11	85	0		1,492
1999	149			2	22	1	606				285	10	5	52	0		1,132
2000	55	1		2	30		649				252	3	4	64	0		1,060
2001	94	5	1		35		375				319	1	1	30			861
2002	30	1			7		302				271	2		69			682
2003	16		9	6	14		216				280	4	6	57	0		608
2004	12	1			10		182				94	2	5	38			344
2005	20	2			5		220				167	0	10	25			449
2006	3	1	2		1	1	443				132	0	4	38			625
2007	4	0	0		2		490				184	2	5	37	9		733
2008	1	0	0		1		405				128		6	27			568
2009	4	1	0		3		253				38		7	21			326
2010	5				1		62				41		1	10			120
2011	5		0		18		119				55	0	1	8			206
2012	8		1	0	4		118				37			9		1	177
2013	5		0		7		89				44		0	15		0	160
Harpoon																	
1990							64				0			3			67
1991							20				0			1			21
1992							75				0			3			78
1993							168							1			169
1994							157				0			1			158
1995							97				0			1			98
1996							81				0			1			82
1997							84							3			87
1998							48				0		0	1			49
1999							81							0			81
2000							90							0			90
2001							52							1			53
2002							90				0			0			90
2003							107							0			107
2004							69							1			70
2005							77							1			78
2006							71				2			0			73
2007							59							0			59
2008							48							1			49
2009							50				0			1			51
2010							37				0			0			37
2011							24				0			0			24
2012							5				0			0			5
2013							6							0			6

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	TUN	SWO	BUM	MLS	BIL [5]	ALV	PTH	BTH	SMA	BSH	SKH	TOTAL
Sport																	
1990	24				65				23								112
1991	6				92				12								110
1992	2				110				25								137
1993	25				298				11								334
1994	106				89				17								212
1995	102				258				14								374
1996	88				40				20								148
1997	1,018				156				21								1,195
1998	1,208				413				23								1,644
1999	3,621				441				12								4,074
2000	1,798				342				10								2,150
2001	1,635				356				0								1,991
2002	2,357				654				0								3,011
2003	2,214				394				0								2,608
2004	1,506				49				0								1,555
2005	1,719				79				0								1,798
2006	385				96				0								481
2007	461				14				0								475
2008	418				93												511
2009	944	766	2		180												1,892
2010	862	276			121												1,259
2011	421	324			498												1,243
2012	1,212	708			615												2,535
2013	839	433	4		984												2,260
Other [4]																	
1990	20	508	147		81	1	43				90		0	141	20		1,051
1991	20	235	137		0		44				42		0	91	1		570
1992	40	1,119	1,014		14	2	47				35		3	19	1		2,294
1993	194	2,031	2,279		29		161				25		2	32	0		4,753
1994	66	3			1		24				37		4	46	12		193
1995	4	5	263		0		29				34		1	14	5		355
1996	10			4	0		15				21		0	9	0		59
1997	12		83		48		11				27	0	3	11	0		195
1998	15	43			59	1	19				22	0	0	12	1		172
1999	61				88		27				32	1	0	9	0		218
2000	24	1			11		33				44	0	0	12	0		125
2001	39				1		19				40	1	0	10	0		110
2002	13	27	1		2	1	3	1			30			12	0		90
2003	8	8	2	3	3		11				21		0	9	0		65
2004	3	27	2	132	0		44	5			21		0	13	0		247
2005	1				1		5				11	0		8	0		26
2006	0	349	12		0		5				24	0	0	7	0		397
2007	0	0	0		0						20	0	0	6	0		26
2008	0	2	0	5	0		19				19	0	0	5			50
2009		7	1		2		0				66	0	1	7	1		85
2010	0	0			0						55		0	10	0		65
2011	0	1			100	0					20		0	8	0		130
2012	2	0	0		38		1				30	1		11	0		84
2013	0	3	1		2		7				18	6		12	0		48

[1] Purse Seine catches include EPO and WCPO fisheries, except where less than 3 vessels fished in the EPO. Estimates include retained and discarded species. Estimates for 2010 through 2011 are based on calculated proportion of north Pacific catch from logbooks applied to total catches. Estimates for 2012 are based on 2011 proportions of catch north of the equator. Estimates from 2013 are not available.

[2] Longline includes American Samoa, Hawaii, and California fisheries. Thresher and mako shark catches are not reported at the species level iin the longline fishery but are listed under ALV and SMA, respectively.

[3] Tropical troll 1985-2006 includes tropical handline catches

[4] Other catches may include commercial and sport catches

[5] BIL catches for Tropical Troll and Longline include Black Marlin, Sailfish, Spearfish, and other billfishes