12th Meeting of the
International Scientific Committee
for Tuna and Tuna-Like Species in the North Pacific Ocean
Sapporo, Hokkaido, Japan
18-23 July 2012

U.S. Fisheries and Research on Tuna and Tuna-like Species in the North Pacific Ocean[1]

NOAA, National Marine Fisheries Service

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Executive Summary

U.S. fisheries harvest tuna and tuna-like species in the North Pacific 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. The small-scale gill net, harpoon, tropical pole-and-line, troll and handline fisheries operate primarily in coastal waters, whereas the large-scale purse seine, albacore troll, and longline fisheries that account for most of the catch operate both within U.S. Exclusive Economic Zones and on the high seas. Skipjack tuna (*Katsuwonus pelamis*) landings in the North Pacific Ocean decreased from 42,089 t in 2010 to 36,300 t in 2011, mostly due to a decrease in the purse-seine catches of this species. Total U.S. purse-seine landings declined from 50,216 in 2010 to 41,990 in 2011. The thousands of trollers and handliners operating in the tropical Pacific Islands represent by far the largest number of vessels but contribute a small fraction of the catch.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries conducted research on Pacific tuna and associated species at its Southwest and Pacific Islands Fisheries Science Centers and in collaboration with scientists from other organizations. Fishery monitoring and socio-cultural research was conducted on tunas, billfishes, and animals caught as bycatch in Pacific coastal and high seas fisheries. In 2011, catch and angler effort information, shark catch in the Hawaii longline fishery was analyzed, albacore catch and effort in the albacore troll fishery was analyzed, and economic indicators in the Hawaii longline and small boat fisheries were assessed.

Stock assessment research was conducted almost entirely in collaboration with member scientists of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC) and other international Regional Fisheries Management Organizations.

NOAA Fisheries biological and oceanographic research on tunas, billfishes, and sharks addressed fish movements, habitat preferences, post-release survival, feeding habits, and age and growth. Significant results include analyses of albacore age and growth and population structure. Billfish research includes migration and life-history studies. Several studies on sharks focused on their survival after capture and release. Shark tagging studies continued, and provide an increasing body of migration data. Several studies on sea turtles and sharks focused on bycatch mitigation.

I. Introduction

Various U.S. fisheries harvest tuna and tuna-like species in the North Pacific Ocean. Large-scale purse seine, albacore (*Thunnus alalunga*) troll, and longline fisheries operate both in coastal waters and on the high seas. Small-scale gill net, 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. 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. 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. On the federal side, monitoring is conducted by the Southwest Regional Office (SWRO) 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 placed in the Pacific Fisheries Information Network (PacFIN) system. Some state agencies also collect logbook and size-composition data. In the central and western Pacific Ocean, 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. Pacific fisheries for tuna and tuna-like species is coordinated among the SWFSC, SWRO, PIFSC, and PIRO.

This report provides information on the number of active vessels by fleet and their catches of tunas and billfishes in the North Pacific Ocean based on the data available through 15 March 2012. Data for 2011, 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

The U.S. purse seine fishery consists of two separate components, one that operates in the western-central Pacific Ocean (WCPO), and another that operates in the eastern tropical Pacific Ocean (ETP). The ETP purse seine fishery started in the mid-1900s and most catch came from there until 1993 when vessels moved to the WCPO in response to dolphin conservation measures in the ETP. Vessels also moved to the WCPO because fishing access was granted by the South Pacific Tuna Treaty. The WCPO fishery operates mainly in areas between 10°N and 10°S latitude and 130°E and 150°W longitude. The ETP fishery operates off the coast of Southern California and outside the exclusive economic zone (EEZ) of Mexico off Baja, California. The number of U.S. vessels participating in the U.S. purse seine fishery and fishing north of the equator decreased from a high of 74 in 1988 to 11 in 2006 (Table 1) increasing to 41 in 2009. In 2011, there were 22 vessels participating. Before 1995 the fleet fished mainly on free-swimming schools of tunas in the WCPO and on schools associated with dolphins in the ETP. Since 1995 most catches have been made on fish aggregation devices (FADs) and other floating objects.

U.S. purse seine vessels fishing in the WCPO have been monitored by NOAA Fisheries under the South Pacific Regional Tuna Treaty 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 samplers in other ports (coverage approximately 1-2% of landings). Species composition samples are used to separate bigeye tuna (*Thunnus obesus*) from yellowfin tuna in the reported landings. The Forum Fisheries Agency (Treaty Manager) places observers on 100% of the vessel trips.

U.S. purse seine catches of tunas north of the equator are shown in Table 2. Catches in the North Pacific Ocean, over the past five years (most of the catch is south of the equator), have been primarily skipjack tuna (*Katsuwonus pelamis*) (~57% of retained catch) and yellowfin tuna (*Thunnus albacares*) (11% of retained catch). Skipjack tuna catches peaked in 1988 at 78,250 t (metric tons) then decreased to 4,002 t in 2002 in the North Pacific. In 2010 41,523 t and in 2011 35,662 t of skipjack tuna were caught by U.S. purse seiners in the North Pacific. Yellowfin tuna catches in the North Pacific generally decreased from a high of 123,044 t in 1987 to 1,112 t in 2006 and 2007. In 2010 7,136 t and in 2011 5,108 t of yellowfin tuna were caught by U.S. purse seiners in the North Pacific. Figure 1 shows the spatial distribution of reported fishing effort in 2010 by the U.S. purse seine fleet in the WCPO.

The Inter-American Tropical Tuna Commission (IATTC) monitors U.S. purse seine vessels fishing in the ETP by large-scale U.S. purse-seine vessels. Logbooks (coverage is 100%) are submitted by vessel operators to NOAA Fisheries or the IATTC, and landings (coverage is also 100%) are obtained from each vessel, canneries or fish buyers. IATTC observers are placed on all large purse seine vessels.

B. Longline

The U.S. longline fishery targeting tuna and tuna-like species in the North Pacific Ocean is made up of the Hawaii-based fishery, the California-based fishery, and the American Samoa-based fishery. 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. 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. The Hawaii-based shallow-set longline fishery has stayed below the annual sea turtle interaction limit and remained open throughout the entire year from 2007-2011. In 2011, the Hawaii longline fishery reached the leatherback take cap in November and had to be shut down.

The number of vessels in the California-based fishery has always been relatively low when compared to the Hawaii-based fishery, and was composed mainly of vessels that targeted swordfish. Most vessels also participated in the Hawaii-based fishery. The California-based longline fishery for swordfish was closed in 2004 and resulted in relocation of most of those vessels back to Hawaii. Only one vessel has fished exclusively in the California longline fishery between 2005 and 2011 targeting tunas.

The longline fishery extended from outside the U.S. West Coast EEZ to 175°W longitude and from the equator to 35°N latitude in 2011 (Figure 2 and 3). 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 129 vessels participated in 2011. 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 is weighed at the fish auction. Dressed weights are converted to whole weight for reporting of total catches.

Catch levels and catch-species composition in the U.S. longline fishery have changed considerably over the past years in response to fishery and regulatory changes. The majority of the catch now consists of tunas and billfishes and exceeded 10,000 t in 1993, 1999, 2000 and 2008 (Table 2). Bigeye tuna dominates the tuna catch with landings over 4,000 t in the past eight years. The 2011 bigeye tuna catch was 5,850 t. Swordfish has been the dominant component of the billfish catch from 1990 and reached a peak of 5,936 t in 1993 before decreasing to 1,185 t in 2004. The 2011 swordfish catch was 1,620 t.

The Hawaii-based longline fishery is monitored by NOAA Fisheries and the State of Hawaii's Division of Aquatic Resources (DAR). Longline fishers are required to complete federal longline logbooks for each fishing operation. The logbook data include information on effort, area fished, catch, and other details of operation. Logbook coverage for the Hawaii-based longline fishery is estimated at 100%. DAR also requires fish dealers to submit landings data, and coverage for the longline fishery is very close to 100%. Observers contracted by NOAA Fisheries are placed on longline vessels to monitor protected species interactions, vessel operations, and catches. The observers are required 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. Sizes of fish caught in the Hawaii-based longline fishery are shown in Figures 4 through 6. In general, smaller fish are captured more in the shallow-set longline fishery.

The California-based longline fishery is monitored by NOAA Fisheries and the California Department of Fish and Game (CDFG). Longline landings data are collected from 100% of the fleet by the CDFG landing receipt program. Logbooks, developed by the fishing industry (similar to the federal logbooks used in Hawaii), were submitted voluntarily to NOAA Fisheries until 1994. Landed swordfish were measured for cleithrum to fork length by CDFG port samplers until 1999. NOAA Fisheries currently places observers on all California-based longline trips. The observers collect data on protected species interactions, fish catch and measure the sizes of fish caught (retained and discarded).

C. Albacore troll and pole-and-line

The U.S. albacore troll and pole-and-line fishery in the North Pacific Ocean started in the early 1900s. The fishery operates in waters between the U.S. west coast and 160°E longitude. Fishing usually starts in May or June and ends in October or November. The number of vessels participating in the fishery ranged from a low of 172 in 1991 to a high of 1,172 in 1997 (Table 1). In 2011, 687 vessels participated in the fishery. Figure 7 shows the spatial distribution of the albacore troll fishery in 2011.

The troll and pole-and-line fishery catches almost exclusively albacore with minor incidental catches of skipjack, yellowfin and bluefin tunas (*Thunnus orientalis*), eastern Pacific bonito (*Sarda chiliensis lineolata*), yellowtail (*Seriola lalandi)*, and mahi mahi (*Coryphaena hippurus*). 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 2010, 12,634 t and in 2011, 11,172 t were caught. Figure 8 shows the size distribution of albacore caught.

U.S. troll and pole-and-line vessels voluntarily submitted logbook records to NOAA Fisheries until 1995 when those vessels fishing on the high-seas were required to submit logbooks. Starting in 2005, all vessels must submit logbooks as a requirement of a Highly Migratory Species Fishery Management Plan (HMS FMP). Landings are monitored by NOAA Fisheries and various state fisheries agencies through landing receipts and coverage is 100% of the fleet. Landings are also sampled for fork length by state agency port samplers along the U.S. West Coast and by NOAA Fisheries personnel in American Samoa. Since 1961, the port sampling program has been in place for collecting size data from albacore landings along the U.S. Pacific coast. State fishery personnel collect the size data according to sampling instructions provided by the SWFSC, where the database is maintained. In recent years, cooperative fishermen have also collected size data on selected fishing trips following a random sampling protocol established by SWFSC staff. These data are collected to augment data collected through the port sampling program. Fishermen on five vessels measured 1,010 albacore during the 2010 season. During 2010, two vessels measured 1,940 albacore. The sample information provided by the fishermen helped to fill in gaps missed by 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 2 in 2011. 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. (Note: The 2011 US Report combined tropical pole-and-line and albacore pole-and-line. In this report the albacore pole-and-line is combined with albacore troll and tropical pole-and-line is reported separately in order to be consistent with reporting to WCPFC.)

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 fisheries operate in Hawaii, Guam, and the CNMI. Tropical handline fisheries operate in Hawaii. The vessels in these fisheries are relatively small (typically around 8 m in length) and make mainly day-long trips fishing in coastal waters. The number of troll and handline vessels combined ranged from 1,878 in 1988 to 2,502 in 1999. There were 2,078 troll vessels and 505 handline vessels in 2011 (Table 1). The operations range from recreational, subsistence, and part-time commercial to full-time commercial. Their catches generally are landed fresh and whole, although some catches are gilled and gutted. Weights of individual fish are obtained when fish are landed. Figure 9 shows the size distributions of skipjack and yellowfin tuna caught in this fishery in 2011.

The total retained catch from these tropical troll and handline fisheries combined ranged from 1,163 t in 1992 to 2,199 t in 2001 (Table 1). Yellowfin tuna made up 38% of the troll and handline catch in 2011. The next largest components were bigeye tuna, skipjack tuna, and blue marlin (*Makaira nigricans*). The Hawaii tropical troll and handline fisheries accounted for 84% of the total U.S. tropical troll and handline landings in 2011.

The Guam Division of Aquatic and Wildlife Resources (DAWR) monitors the troll fishery using a statistically designed creel survey. The Guam DAWR, with the assistance of NOAA Fisheries, extrapolates the creel survey data to produce total catch, fishing effort, and participation estimates. 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 using their Commercial Purchase database.

F. Gill Net

The U.S. drift and set gill net fisheries operate in areas within the EEZ in California waters and sometimes off Oregon. Tuna and tuna-like fishes are caught mainly by pelagic drift gill nets, with minor quantities caught incidentally in set gill nets. The number of vessels participating in the pelagic drift gill net fishery decreased from a high of 298 in 1985 to 49 in 2011. 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 catches have gone down since then, decreasing to 61 t in 2010, and preliminary estimate of swordfish caught in the drift gill net fishery for 2011 is 108 t. Figure 10 shows the spatial distribution of the U.S. pelagic gill net fishery in 2011.

Gill net fishery landings data (100% coverage) are collected by state agencies in California and Oregon (only minor amounts of tuna and tuna-like fishes are landed in Oregon). Logbook data for gill net fisheries are collected from 100% of the fleet by the CDFG. CDFG also collected length data for swordfish landings until 1999 from less than 1% of the landings. NOAA Fisheries observers on gill net vessels have also collected length data since about 1990 and observer coverage is about 20% of effort.

G. Harpoon

The harpoon fishery operates in areas within the EEZ in California waters between 32°N and 34°N latitude. The number of vessels participating in the fishery generally decreased from 114 in 1986 to 23 in 2001 (Table 1). Seventeen vessels fished in 2011. Swordfish is targeted and trends in catches have fluctuated from a high of 305 t in 1985 to 20 t in 1991 (Table 2). Thirty-seven tons were landed in 2010 and 24 t in 2011. Figure 11 shows the spatial distribution of the U.S. harpoon fishery in 2011.

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

H. Sport

The sport fishery operates along the West Coast between about 28°N and 50°N latitude. The number of vessels participating in the fishery has fluctuated between 81 and 220 since 1985. In 2011, there were 165 vessels participating (Table 1). The catch was dominated by albacore and Pacific bluefin tuna with 424 t and 456 t caught, respectively in 2011. Figure 12 shows the spatial distribution of reported logbook fishing effort by the U.S. West Coast sport fleet in 2011.

III. Research

NMFS 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 NMFS. These studies are carried out largely in cooperation with stakeholders and in collaboration with colleagues both in the U.S. and abroad. Asterisks (*) indicate that more information can be found at http://swfsc.noaa.gov/HMSAnnualReport/. For further SWFSC research information please visit: http://swfsc.noaa.gov/HMSAnnualReport/.

Otolith collections to support stock assessments*

Given the uncertainty surrounding current growth models and stock structure of north Pacific albacore, NMFS scientists are expanding biological sampling along the U.S. West Coast and have also acquired samples from both the central and western Pacific. This and other ongoing studies support the ISC's recent proposal for a North Pacific-wide sampling program to address the uncertainties with current growth models and stock structure for albacore in the eastern Pacific Ocean (EPO). Two objectives of the sampling program that relate most directly to stock assessments are age and growth, and population structure using otolith-based methods.

Age and growth – NMFS scientists assessed age and growth of north Pacific albacore by examining annual growth increments in sagittal otoliths from 486 fish collected throughout the North Pacific Ocean, dorsal fin spines, length frequency analysis to generate estimates of size-at –age. Overall, ages ranged from 1 to 15 years with the majority of fish between 2 to 4 years of age. Fin spine ages generally matched otolith-derived ages (85% of samples), though samples were only available and analyzed for young fish. Results suggest north Pacific albacore are a relatively long-lived tuna species and provide updated biological parameters useful for future stock assessment models incorporating age-specific life history information.

Population structure – NMFS scientists examined stable isotopes of carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) in addition to several trace elements in whole otoliths of albacore collected in the northern region (offshore Oregon and Washington, > 40° N) and southern region (offshore southern California and northern Baja California, Mexico, < 40° N) of the Eastern Pacific Ocean. Significant differences existed in otolith chemistry from fish collected between the two regions ($P < 0.05$) and overall cross-validated classification success was 100% with age-specific comparisons exceeding 90% success. Otolith $\delta^{18}O$ was significantly enriched in the southern region relative to the northern region, similar to reported seawater $\delta^{18}O$ differences. In addition, significantly higher concentrations of sodium and magnesium combined with lower phosphorus in otoliths from fish collected in the southern region are consistent with regional physicochemical conditions (i.e. salinity, temperature, phosphate). Our findings support previous studies that have shown limited regional mixing of albacore in the EPO and provide life history information useful for management of north Pacific albacore.

Swordfish Research and SLUTH*

Since 2006, NMFS has been studying swordfish in the SCB to examine migratory patterns, foraging ecology, and local stock structure. In 2008, NMFS initiated the Swordfish and Leatherback Use of Temperate Habitat (SLUTH) study. The overarching objective of SLUTH is to integrate studies of swordfish and leatherback sea turtles to inform management and conservation efforts.

Characterizing Target Catch and Non-target Species Catch and the Behavior of Fishermen – Part of the SLUTH initiative is to explore creative methods to reduce the bycatch of non-target species in the CADGN. One approach is to use the fisheries data to better understand the environmental factors that affect the distribution of leatherbacks, swordfish, and the fishers themselves. NMFS is using novel statistical approaches including boosted regression trees and random forests to model the relationships between the distribution and abundance of the focal species, fishing effort and a range of factors. The first approach has been to characterize the impact of environment on catch rates. A second approach is to use the fisheries data to better understand the factors that affect the distribution of fishing effort. Results suggest that it is possible to accurately predict fishing effort using a modest set of readily-available predictor variables. Thus, along with information on bycatch species distributions, forecasts of where the probability of bycatch is expected to be high could be provided in order to make in season adjustments to times and areas fished. A manuscript describing the predictive modeling of fishery effort has been submitted to *Ecological Applications*.

*Improving Location Estimates from Electronic Tags** – While the traditional pop-up satellite tags provide valuable information on vertical behavior, obtaining an accurate assessment of geographic location based on light is complicated by the diel vertical migrations of swordfish. Therefore, NMFS is currently working with a researcher at CSIRO in Australia on software to improve light-based geolocation estimates.

NMFS's shark research program focuses on pelagic sharks that occur along the U.S. Pacific coast, including shortfin mako (*Isurus oxyrinchus)*, blue sharks (*Prionace glauca*), basking sharks (*Cetorhinus maximus)*, and three species of thresher sharks: common thresher (*Alopias vulpinus),* bigeye thresher (*A. superciliosus),* and pelagic thresher (*A. pelagicus)*. Center scientists are studying the sharks' biology, distribution, movements, stock structure, population status, and potential vulnerability to fishing pressure. This information is provided to international, national, and regional fisheries conservation and management bodies having stewardship for sharks. Some of the recently completed and ongoing shark research activities being carried out at NMFS are discussed below.

Electronic Tagging Studies*

Since 1999, NMFS has used satellite technology to study the movements and behaviors of blue, shortfin mako and common thresher sharks and to link these data to physical and biological oceanography. Other species are tagged opportunistically. In recent years, shark tag deployments have been carried out in collaboration with Mexican colleagues at CICESE (Centro de Investigación Científica y de Educación Superior de Ensenada), and Canadian colleagues at the DFO Pacific Biological Station in Nanaimo, British Columbia and the TOPP program (www.topp.org). Movements vary among species with thresher sharks remaining in more coastal waters within 100-200 miles of shore while blue and mako sharks range farther. Individual mako and blue sharks tracked for up to two years each have demonstrated seasonal movements away from southern California with sharks returning the subsequent summer, demonstrating homing to the productive waters off southern California.

Age Validation Studies*

NMFS is estimating age and growth of mako, common thresher, and blue sharks from band formation in vertebrae as well as validating aging methods for these three species based on band deposition periodicity determined using oxytetracycline (OTC). Annual research surveys provide an opportunity to tag animals with OTC. When the shark is recaptured and the vertebrae recovered, the number of bands laid down since the known date of OTC injection can be used to determine band deposition periodicity.

Oxytetracycline age validation of juvenile shortfin makos – The purpose of this study was to validate vertebral band counts for ageing juvenile shortfin mako sharks and to resolve the discrepancy between the fast observed growth rates and the much slower growth predicted by age-at-length models that assume one band pair is deposited per year. OTC labeled vertebrae of 29 juvenile shortfin mako were obtained from tag-recapture activities. Time at liberty for the 29 sharks ranged from 4 months to 4.4 years (mean=1.3 years). Growth information was also obtained from length frequency modal analyses (MULTIFAN and MIXDIST) using a 29-year dataset of commercial and research catch data, in addition to tag-recapture growth models (GROTAG) using lengths and time-at-liberty. For samples used for age validation, shark size at time of release ranged from 79 to 142 cm FL and from 98 to 200 cm FL at recapture. Results from band counts of vertebrae distal to OTC marks indicate two band pairs (2 translucent and 2 opaque) are formed per year for shortfin mako of the size range examined (Figure AA). In addition, total band pair counts at length compared well with results of a similar study in this region, suggesting vertebral readings were similar, and only assumptions about deposition rate differed. Growth rates calculated from length frequency modal analyses estimate 26.5 to 35.5 cm per year for the first age class mode (85 cm FL), and 22.4 to 28.6 cm per year for the second age class mode (130 cm FL). In addition, the GROTAG model also resulted in a rapid growth rate during time at liberty for tagged fish of the two youngest age classes with estimates of 28.7 and 19.6 cm FL per year at 85 and 130 cm FL, respectively. Collectively, these methods suggest rapid growth of juvenile shortfin mako in the Southern California Bight and suggest biannual deposition in vertebrae. An analysis of juvenile mako shark band deposition patterns is now complete and a manuscript has been drafted.

Thresher Sharks Released from the Recreational Fishery*

NMFS and Pfleger Institute of Environmental Research are conducting a study to assess the post-release survival of thresher sharks caught by recreational anglers. A major component of this project is education and outreach to the recreational fishing community in order to promote fishing practices that enhance thresher shark catch and release survival, such as mouth hooking. A brochure (http://www.pier.org/flyers/BREP_thresher_brochure.pdf) and video have been produced for recreational anglers that highlight the best fishing practices.

Shortfin Mako Shark Genetics*

A study completed in collaboration with NMFS and a University of San Diego graduate student provides evidence of regional stock structure of makos sharks within the Pacific Ocean. Using mtDNA sequencing, makos in the North Pacific were shown to be genetically distinct from those in the South Pacific and Atlantic Ocean. In a follow-up study, a suite of nuclear microsatellite markers is being developed to further refine the spatial and temporal resolution of shortfin mako stocks within the Pacific. These markers will also be used to develop estimates of effective population size within the California Current region.

Central and Western Pacific Fisheries Monitoring
WPacFIN collects and manages data from most of the U.S. central and western Pacific fisheries (Hawaii, American Samoa, Guam, Commonwealth of the Northern Mariana Islands). This includes longline, skipjack pole-and-line, tropical troll, and tropical handline fisheries. In 2011, WPacFIN completed and published the 26th edition of Fishery Statistics of the Western Pacific (Hamm et al., 2011). Annual reports 2011 for the Hawaii-based longline fishery and the American Samoa longiine fishery were also published (PIFSC, 2012; PIFSC, 2012).

NOAA Fisheries also produced standardized CPUE time series for whitetip shark (*Carcharhinus longimanus*) and silky shark (*C. falciformis*) in the Hawaii longline fishery using the Pacific Islands Regional Observer Program data (1995–2010). This work is important because these species are taken in large but unknown numbers, primarily as bycatch, in many Pacific Ocean fisheries. This work can be used as input for stock assessment for these shark species (Wash and Clarke, 2011).

Hawaii Longline Fishery Economics
Since 2004, NOAA Fisheries observers have collected data on fishing costs and other economic information from more than 1,900 longline trips in order to assess changes in important economic indicators of the Hawaii-based longline fisheries (Pan, 2010). Over 2004-2011, the average trip cost in the longline fishery for tuna-targeting trips increased by about 60%, from $13,720 per trip in 2004 to $28,910 per trip in 2011. In 2004, fuel cost made up about 45% of the total trip cost (non-labor items). However, in 2011, fuel cost made up about 62% of the total trip cost. The economics data collection program is continuing with the Hawaii longline fishery and has extended to other fisheries and areas in Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

Hawaii Small Boat Economics
NOAA Fisheries conducted a survey to assess economic and social characteristics of the Hawaii small boat pelagic fishery. A total of 343 surveys were completed in 2007-2008, revealing high levels of heterogeneity within the fishery, and diverse motivations for fishing (economic, social, and cultural). The results of the study provide an important baseline that will allow fishery managers to better understand how new fishery regulations and changing macroeconomic conditions may affect the financial performance and behavior of fishers (Hospital et al., 2011). Similar cost-earnings surveys were also conducted in Guam and CNMI, and for the Hawaii charter fishing (Hospital et al., in press).

Hawaii Seafood Retail Monitoring Project
NOAA Fisheries conducted a five-year retail monitoring project between 2007 and 2011 to develop a time-series of consumer-level prices for the Hawaii seafood retail market. These data allow researchers to better understand the economic contribution of fisheries and the market impacts of regulations by exploring how price changes travel through the fish ‘value chain’ from the fisherman to the consumer. This will be the first published source of consumer-level prices for Hawaii seafood (Hospital and Beavers, in press).

Hawaii ‘Ahi Pricing Analysis Study

This NOAA Fisheries project investigated the pricing dynamics between ‘ahi (tuna) prices received by fishermen and the prices paid by consumers in Hawaii. A greater understanding of retailer pricing behavior and how price changes at the ex-vessel level are passed on to consumers will allow fishery managers to better determine the consumer effects of fishery regulations and identify potential market power issues (Houbcharaun and Hospital, 2011).

Spillover Effects of Hawaii Longline Regulation for Turtles

This NOAA Fisheries study provides a quantified estimate of the possible spillover effects resulting from the environmental regulations for sea turtle protection imposed on the Hawaii shallow-set longline fishery for swordfish based on 2 perspectives. First, this study estimates the spillover effect resulting from market replacement as U.S. swordfish consumption shifts from domestic production to foreign imports as a result of the domestic fishery closure. Because U.S. swordfish imports are harvested in different oceans by different countries, the spillover effects are estimated on a global scale (the sum across all oceans). Subsequently, this study estimates the spillover effects resulting from the displacement of production by the competitors in the specific ocean area where the Hawaii shallow-set longline fishery for swordfish operates. From the data that are available and the analysis, the study suggests strong spillover (market transfer effects) from regulation of the Hawaii shallow-set longline fishery for swordfish (Chan and Pan, 2012).

Projected climate impacts on the pelagic ecosystem size structure and catches in the North Pacific over the 21st century

NOAA Fisheries paired output from an earth system model with a size-based food web model to investigate the effects of climate change on the abundance of large fish over the 21st century. The earth system model combines a coupled climate model with a biogeochemical model including major nutrients, three phytoplankton functional groups, and zooplankton grazing. The size-based food web model includes linkages between two overlapping size-structured pelagic communities: primary producers and consumers. This study focused on seven sites in the North Pacific, each highlighted a specific aspect of forecasted climate change, and included ecosystem exploitation through fishing. Climate-induced phytoplankton changes had a larger effect on the abundance of large fish than did physical warming changes. Projected changes in large phytoplankton density are estimated to result in declines of large fish abundance ranging from 0 - 78% in the central North Pacific and increases of up to 43% in the California Current region. Overall, the model projects changes in the abundance of large fish being of the same order of magnitude as changes in the abundance of large phytoplankton (Woodworth et al., 2012).

Gear Modification to Reduce Turtle Bycatch

Since 2006 NOAA Fisheries has provided funds and technical expertise to support research experiments world wide to identify means to reduce sea turtle bycatch in both longline and gillnet fisheries. During 2011, gear modification trials were underway in Brazil, Peru, Mexico, Italy, and Costa Rica. Research from the past few years indicates that relatively large circle hooks effectively reduce the bycatch of both loggerhead and leatherback sea turtles in longline fishing gear (Domingo et al. in press; Piovano et al., 2012; Serafy et al., in press; Swimmer et al., 2011). These hooks also show acceptable catch rates of tuna species, but slightly reduced catch rates of targeted swordfish.

Post-release Survival of Turtles in Longline Fisheries
Another NOAA Fisheries objective is to improve estimates of sea turtles' post-release survival after their release from fishing gear, specifically regarding shallow longline gear. Current methods involve use of pop-up satellite archival tags (PSATs) and platform terminal transmitters (PTTs) in the North Pacific and South Atlantic Oceans, as well as the Mediterranean Sea. Preliminary results of tracking studies indicate no differences in duration of transmissions as a function of the turtle's 'severity' of injury, specifically deep or shallow hookings, and that most sea turtles were tracked for the duration of the tag's battery life.

A sea turtle post-release mortality workshop was convened in 2011 to ensure that the current estimates continue to be based on the best available science (Swimmer and Gilman, in press). Additional work has been conducted on the role of safe handling to ensure maximal chance of survival after release (Hall et al., 2012). Simultaneous studies are ongoing on the movement patterns of loggerhead sea turtles in the South Atlantic Ocean (Barcelo et al., in press), and on data interpretation for the various tag types deployed on turtles (Musyl et al., 2011A and B; Jones et al., 2012).

Longline Hook Effects on Catch
NOAA Fisheries conducted a study that tested the effects of using large (16/0) circle hooks on catch rates in three pelagic longline fisheries in the South Pacific Ocean. Large (16/0) circle hooks were tested against a variety of smaller hooks already in use by longline vessels in American Samoa, Cook Islands, and New Caledonia. A total of 4,912 fishes of 33 species were observed on 145,982 hooks from 67 sets. In the Cook Islands fishery, there was no significant difference in catch by hook type for two main target species, but there was an increase in catchability for swordfish. In the New Caledonia fishery, there was no significant difference in catch by hook size for any species. In the American Samoa fishery, 16/0 circle hooks did not significantly affect the catch of albacore, but did significantly reduce the catch of skipjack tuna, dolphinfish, and wahoo. For all locations, catch rates on 16/0 circle hooks were nominally lower, but not always significant for smaller pelagic species (Curran and Beverly, in press).

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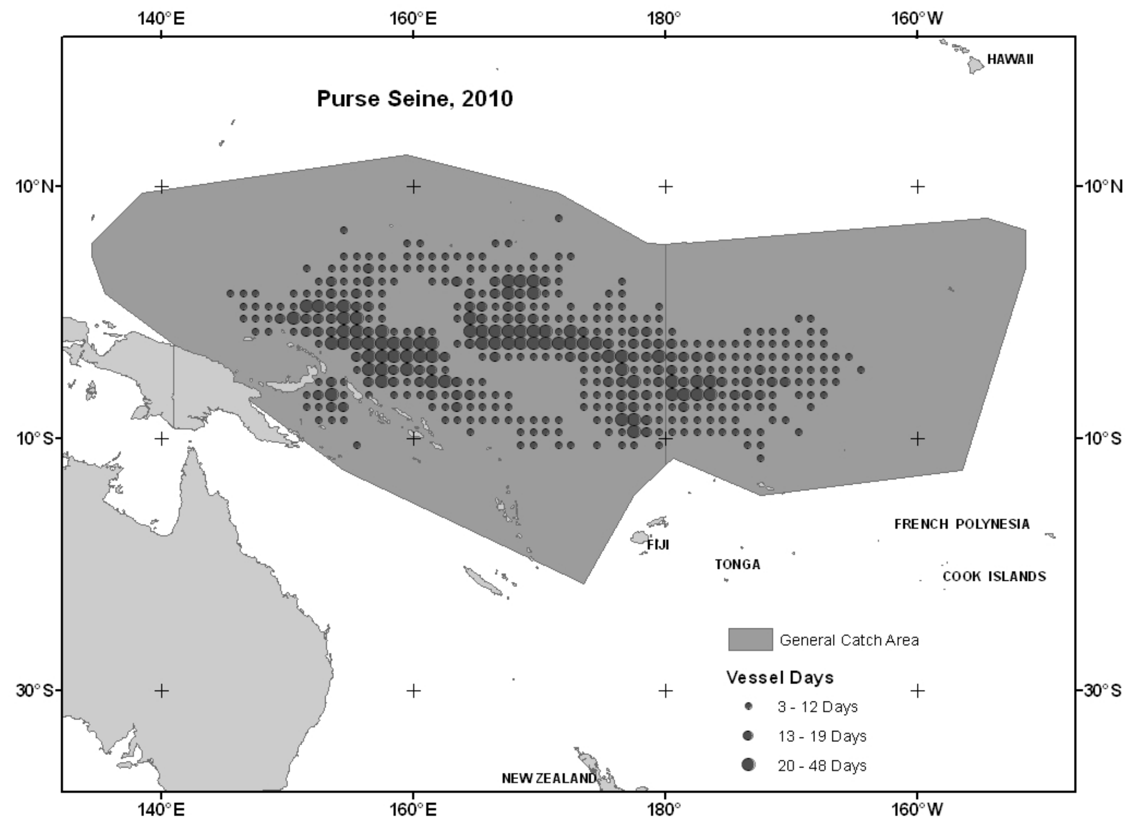

Figure 1. Spatial distribution of reported logbook fishing effort by the U.S. western Pacific purse seine fishery in vessel-days, in 2010 (provisional data). Area of circles is proportional to effort. Effort in some areas is not shown in order to preserve data confidentiality.

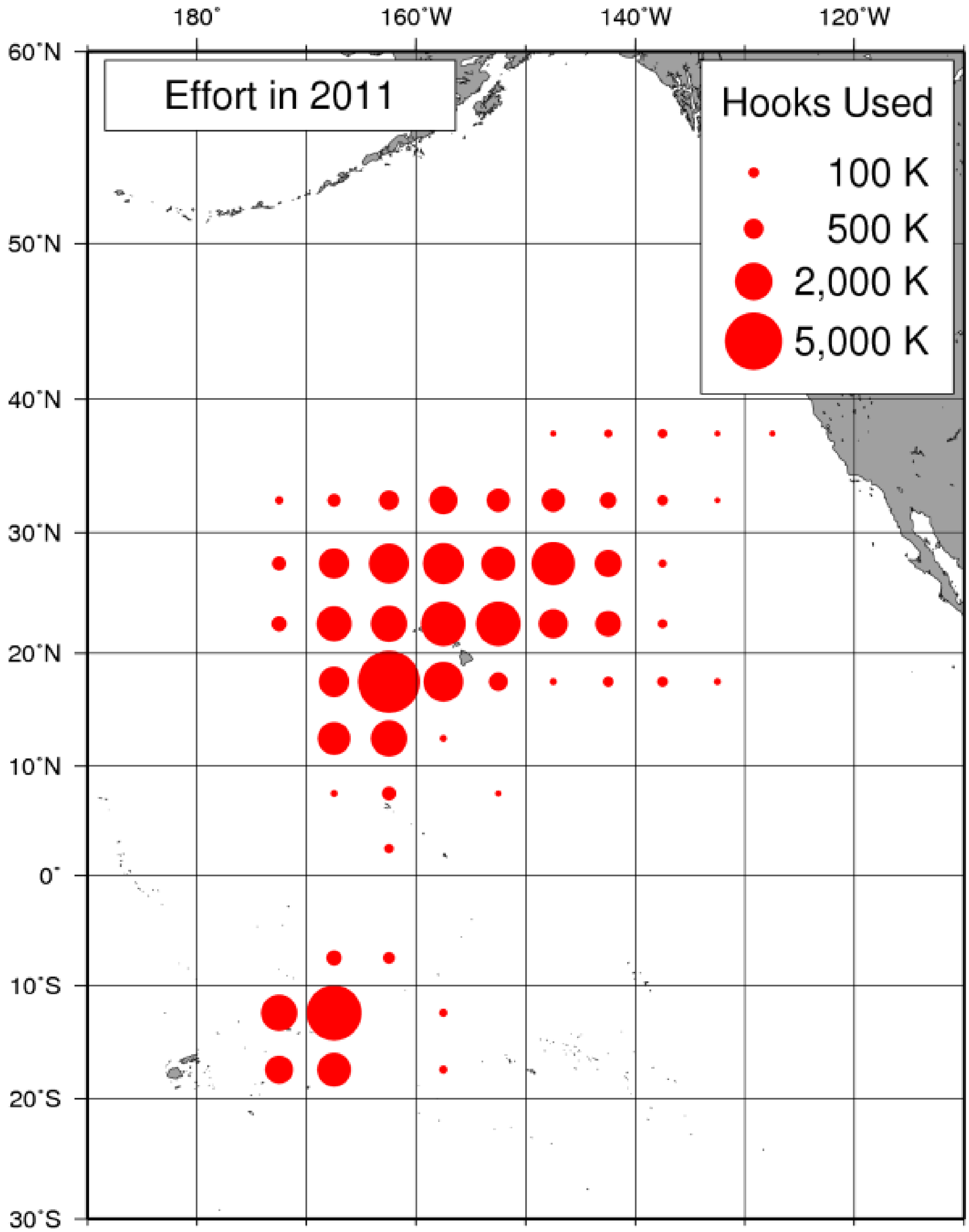

Figure 2. Spatial distribution of reported logbook fishing effort by the U.S. longline fishery in 1,000s of hooks, in 2011 (provisional data). Area of circles is proportional to effort. Effort in some areas is not shown in order to preserve data confidentiality.

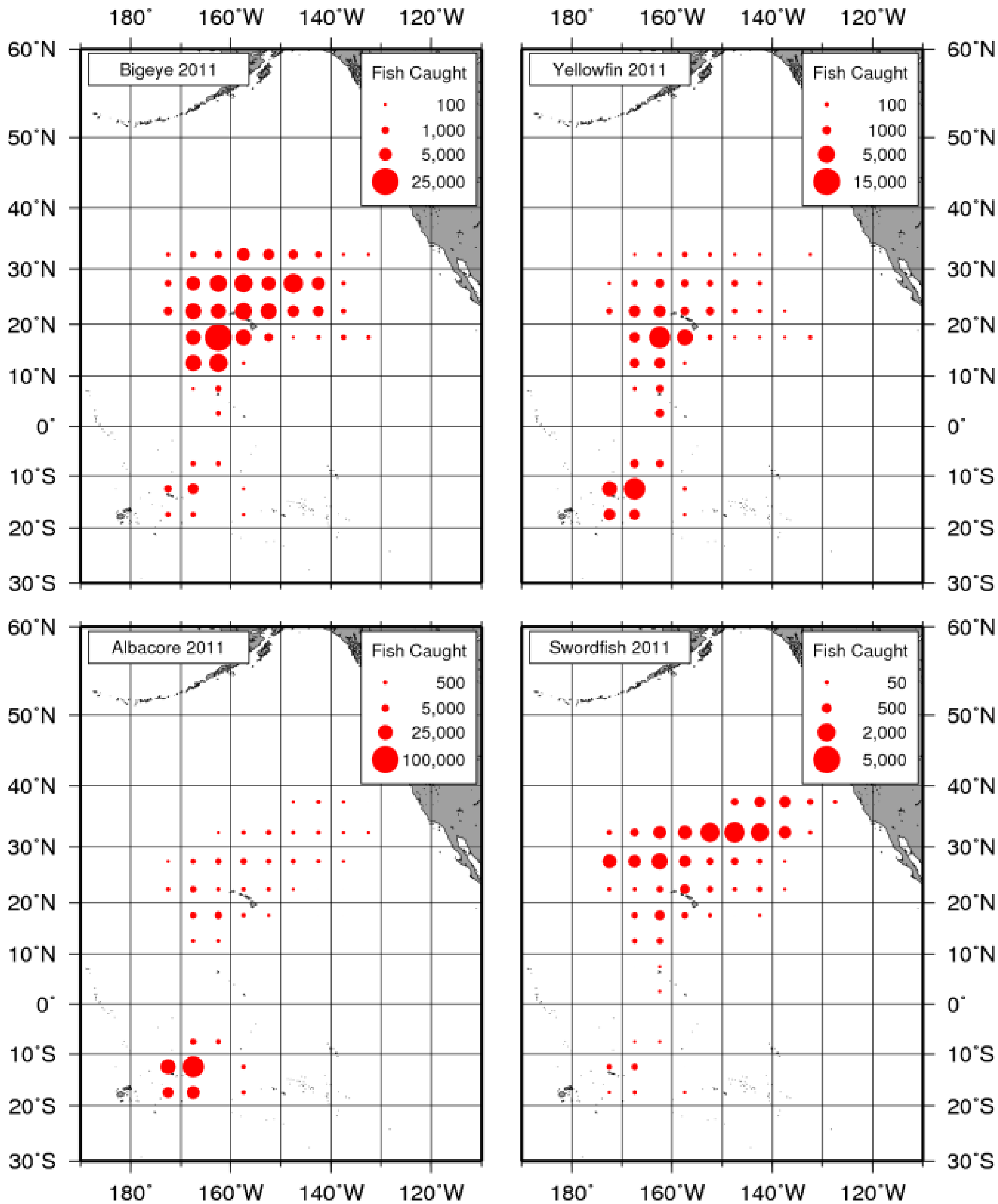

Figure 3. Spatial distribution of reported logbook fishing catch by the U.S. longline fishery in numbers of fish, in 2011 (provisional data). Area of circles is proportional to catch. Catch in some areas is not shown in order to preserve data confidentiality.

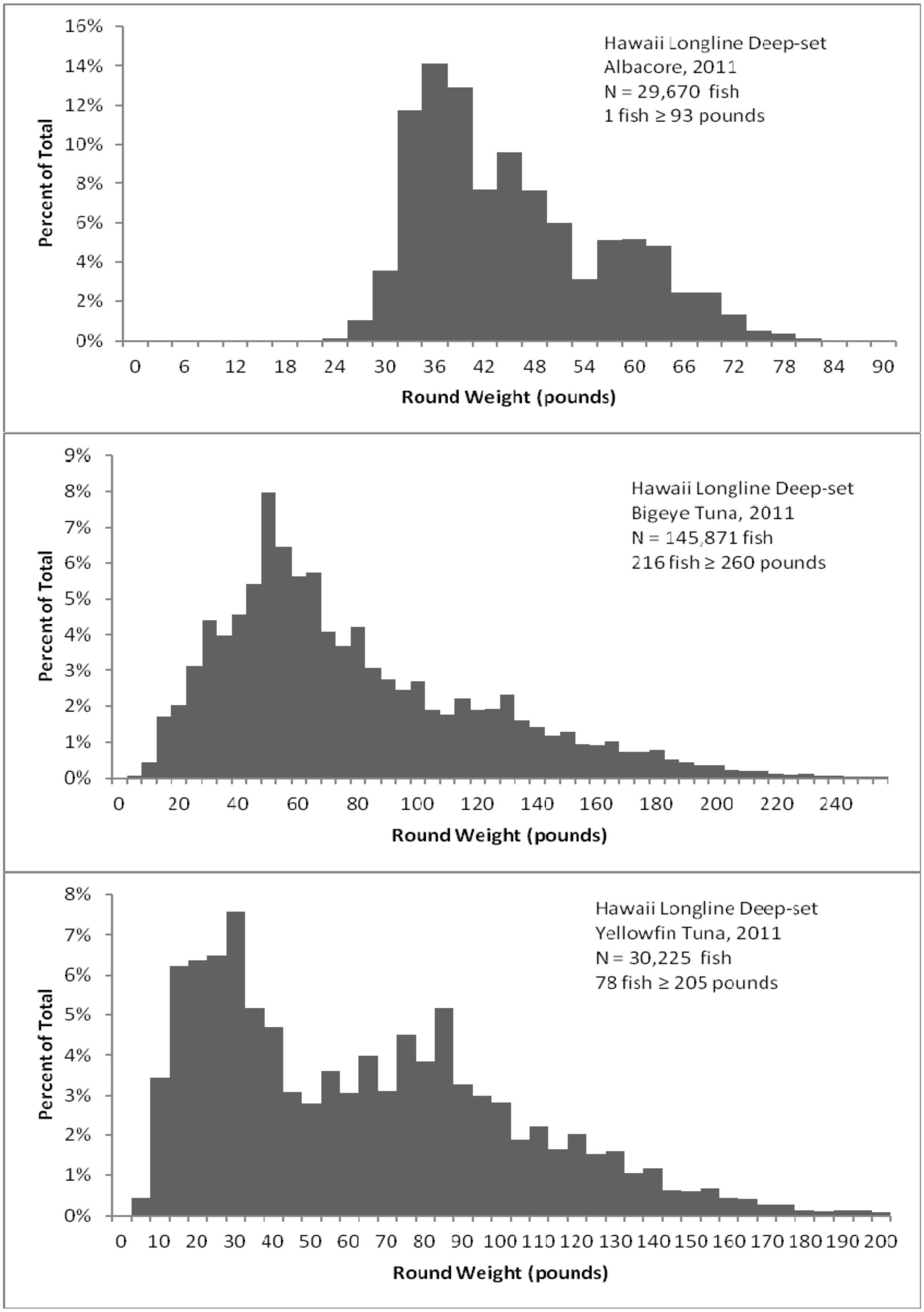

Figure 4. Size distribution of (A) albacore (*Thunnus alalunga*), (B) bigeye tuna (*Thunnus obesus*), and (C) yellowfin tuna (*Thunnus albacares*) caught by the Hawaii-based deep-set longline fishery in the North Pacific Ocean, 2011.

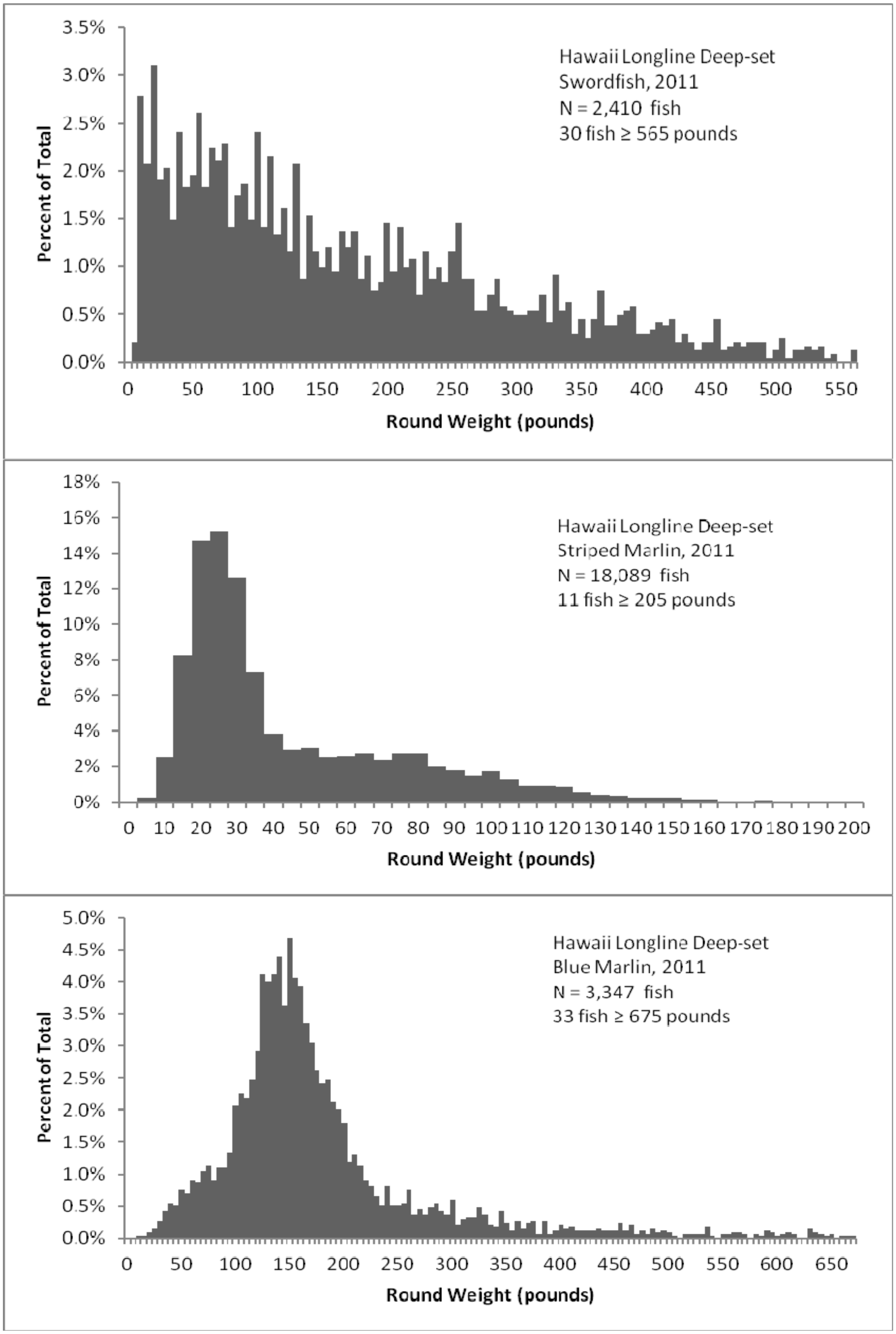

Figure 5. Size distribution of (A) swordfish (*Xiphias gladius*), (B) striped marlin (*Tetrapturus audax*), and (C) blue marlin (*Makaira mazara*) catch by the Hawaii-based deep-set longline fishery in the North Pacific Ocean, 2011.

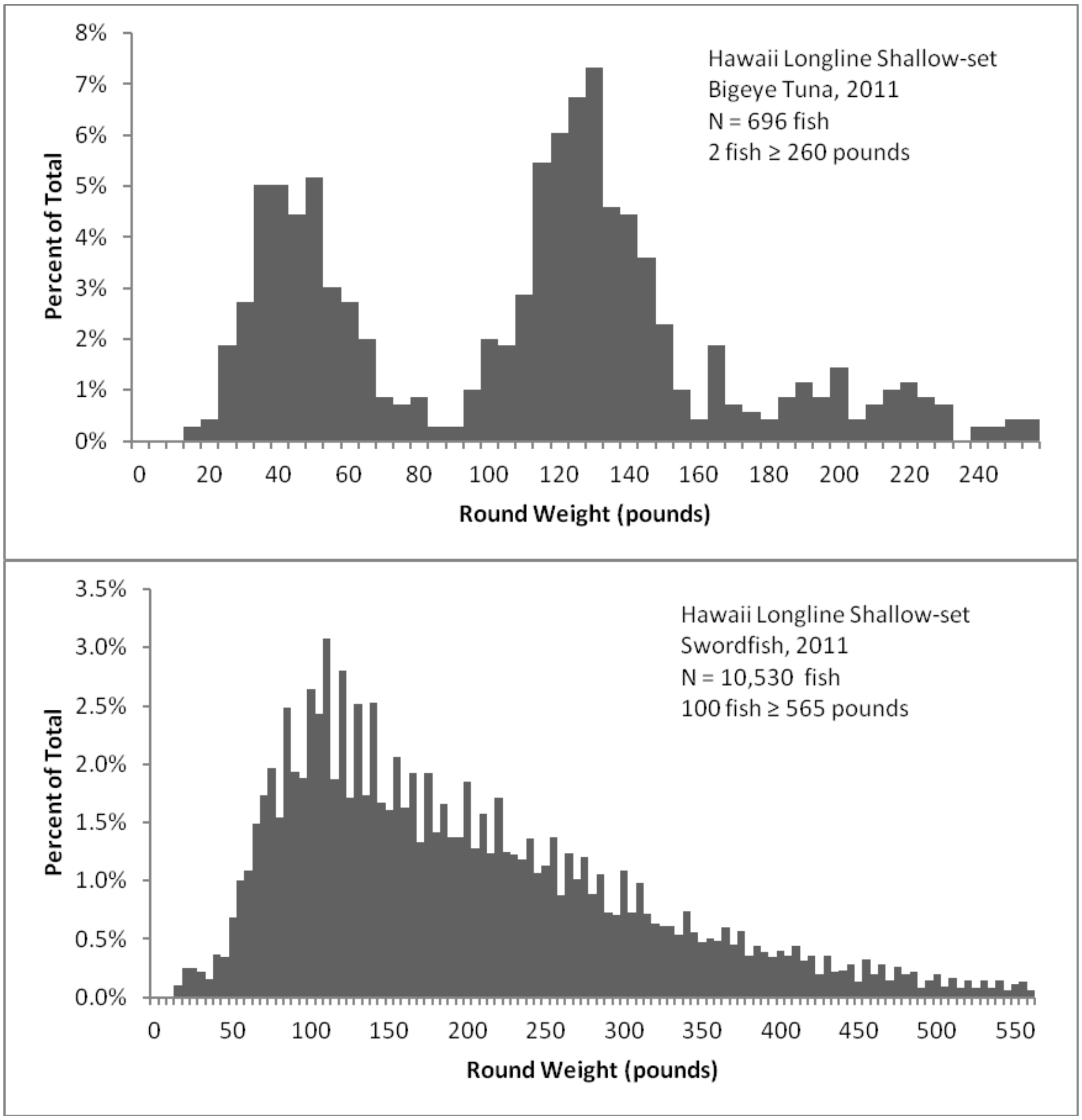

Figure 6. Size distribution of (A) bigeye tuna (*Thunnus obesus*), and (B) swordfish (*Xiphias gladius*) caught by the Hawaii-based shallow-set longline fishery in the North Pacific Ocean, 2011.

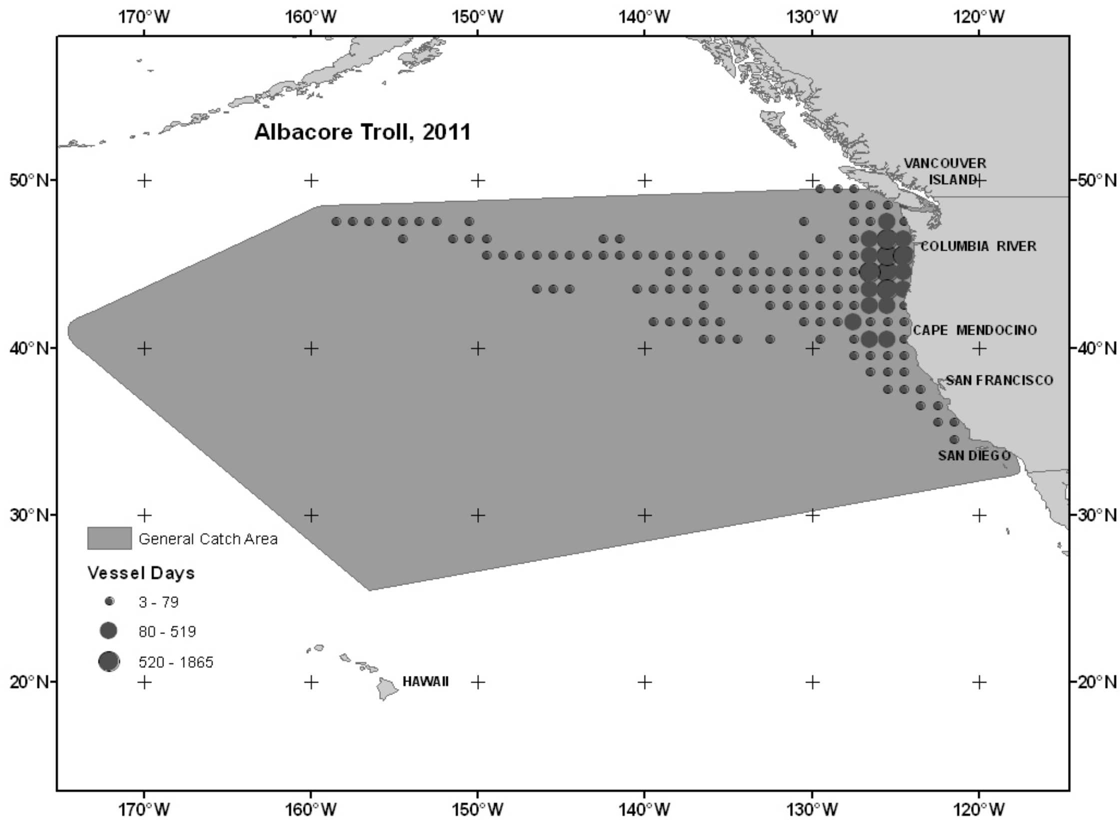

Figure 7. Spatial distribution of reported logbook fishing effort by the U.S. albacore (*Thunnus alalunga*) troll fishery in vessel days in 2011 (provisional data). Area of circles is proportional to effort. Effort in some areas is not shown in order to preserve data confidentiality.

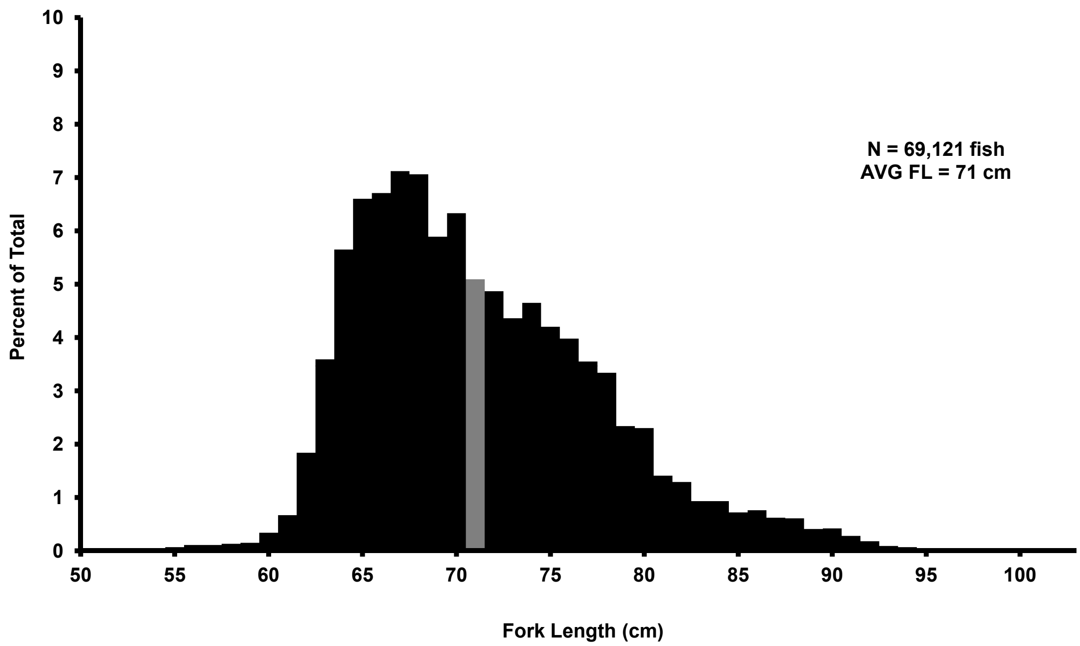

Figure 8. Size distribution of albacore catch by the U.S. albacore (*Thunnus alalunga*) troll and pole-and-line fishery in 2011.

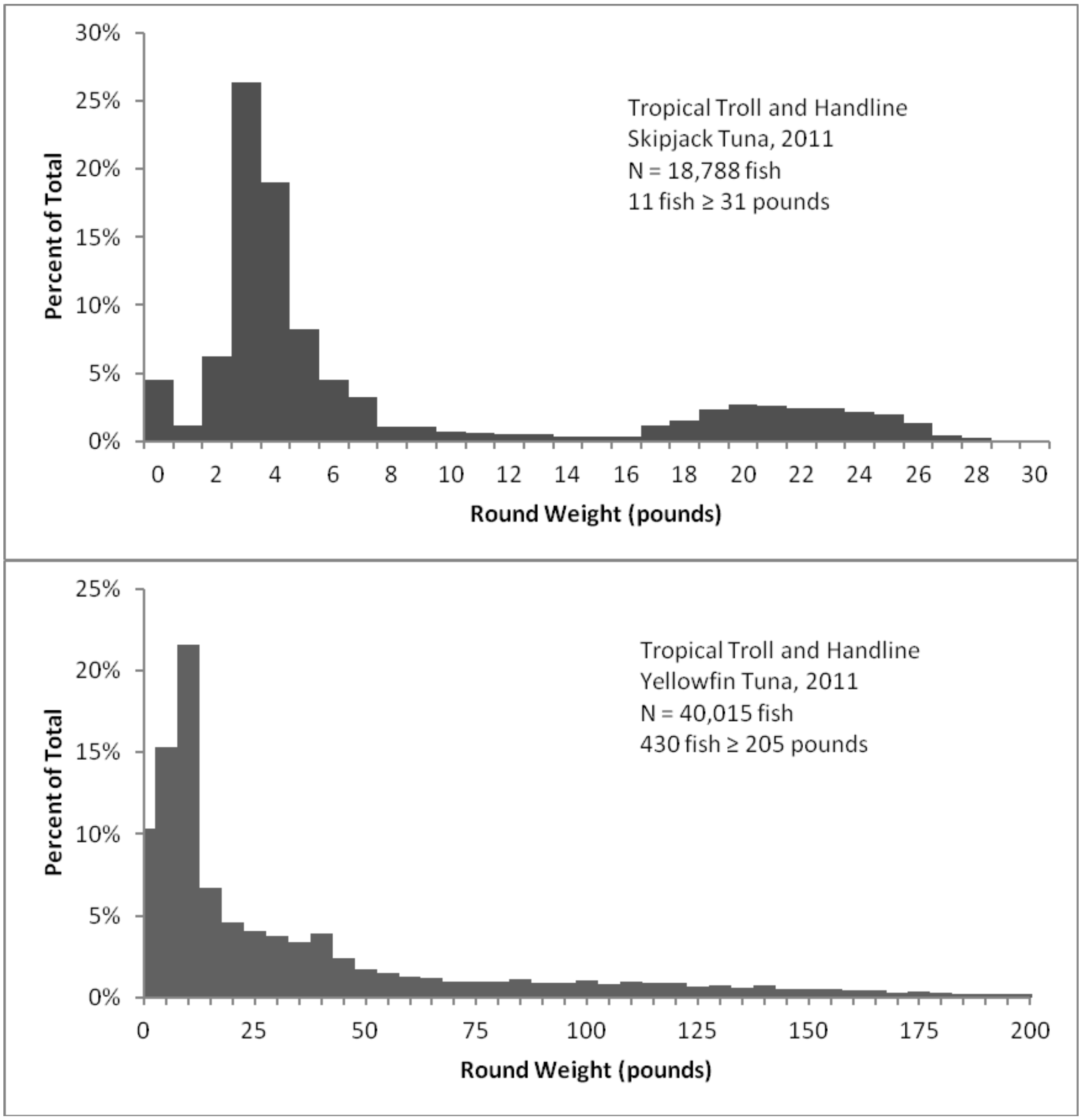

Figure 9. Size distribution of (A) skipjack tuna (*Katsuwonus pelamis*) and (B) yellowfin tuna (*Thunnus albacares*) catch by the Hawaii troll and handline fishery, 2011.

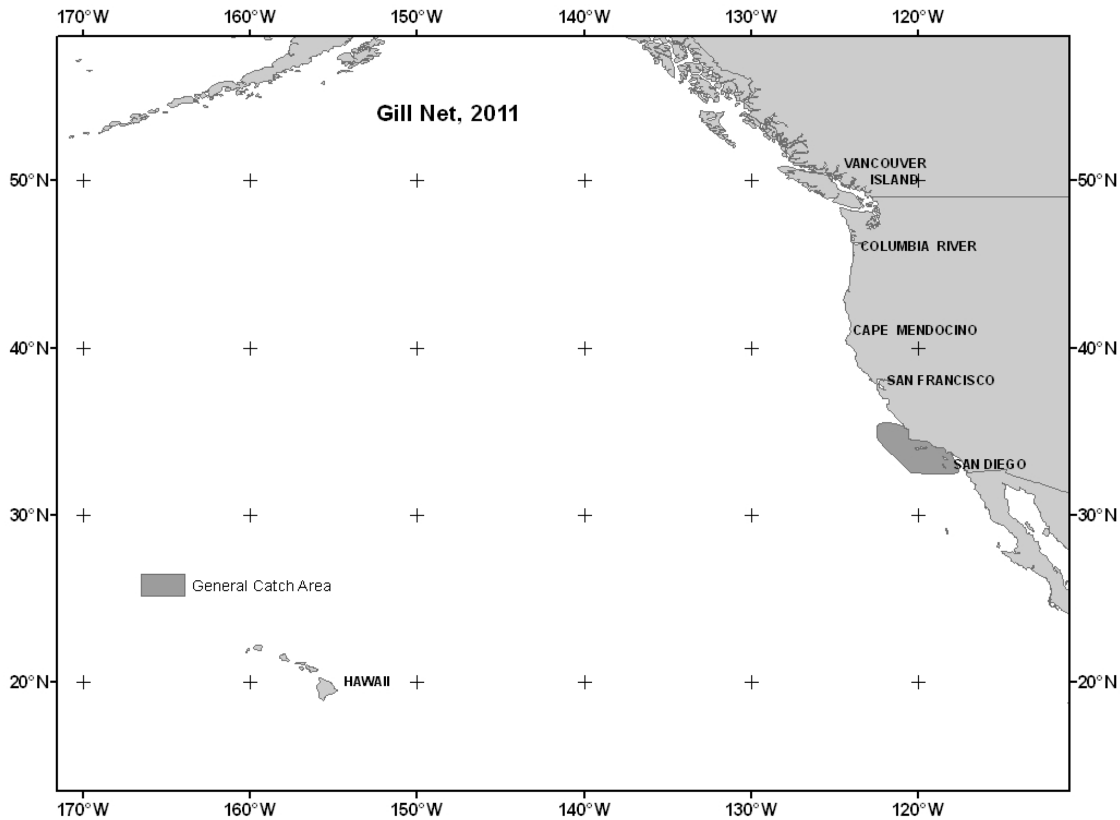

Figure 10. Spatial extent of reported logbook fishing effort by the U.S. pelagic drift gill net fishery in the North Pacific Ocean in 2011 (provisional data).

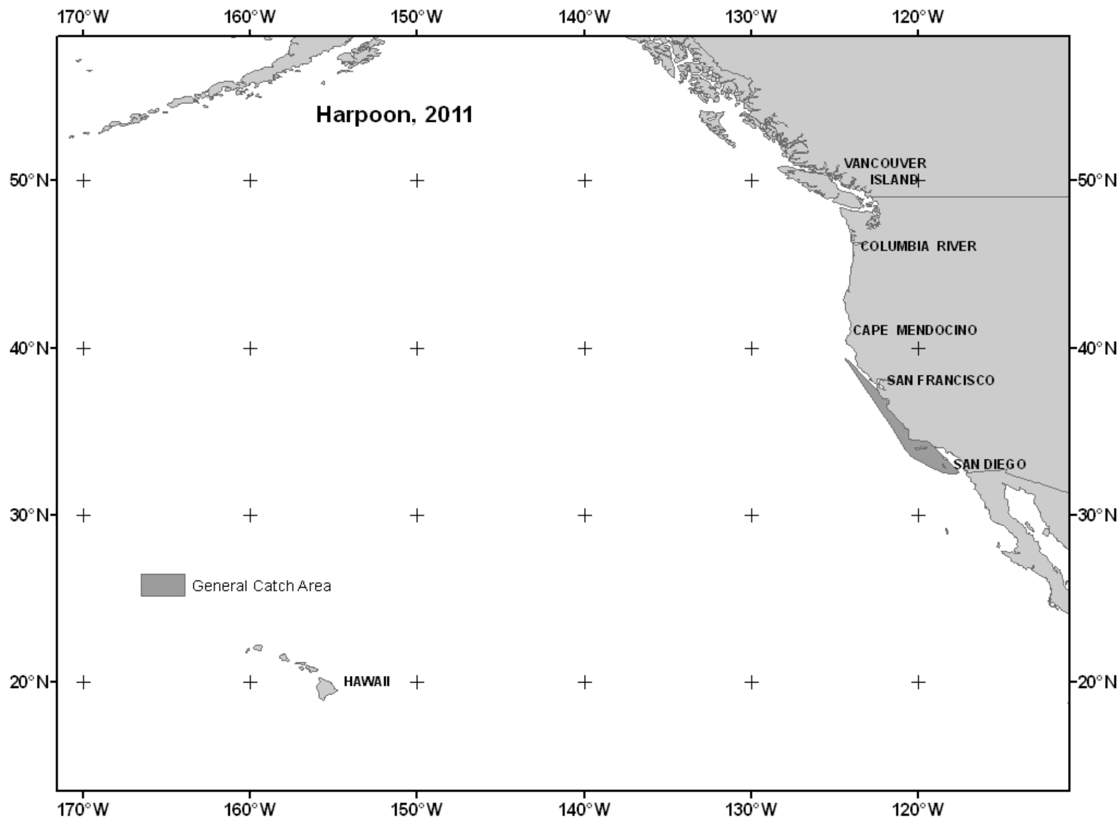

Figure 11. Spatial extent of reported logbook fishing effort by the U.S. harpoon fishery in the North Pacific Ocean in 2011 (provisional data).

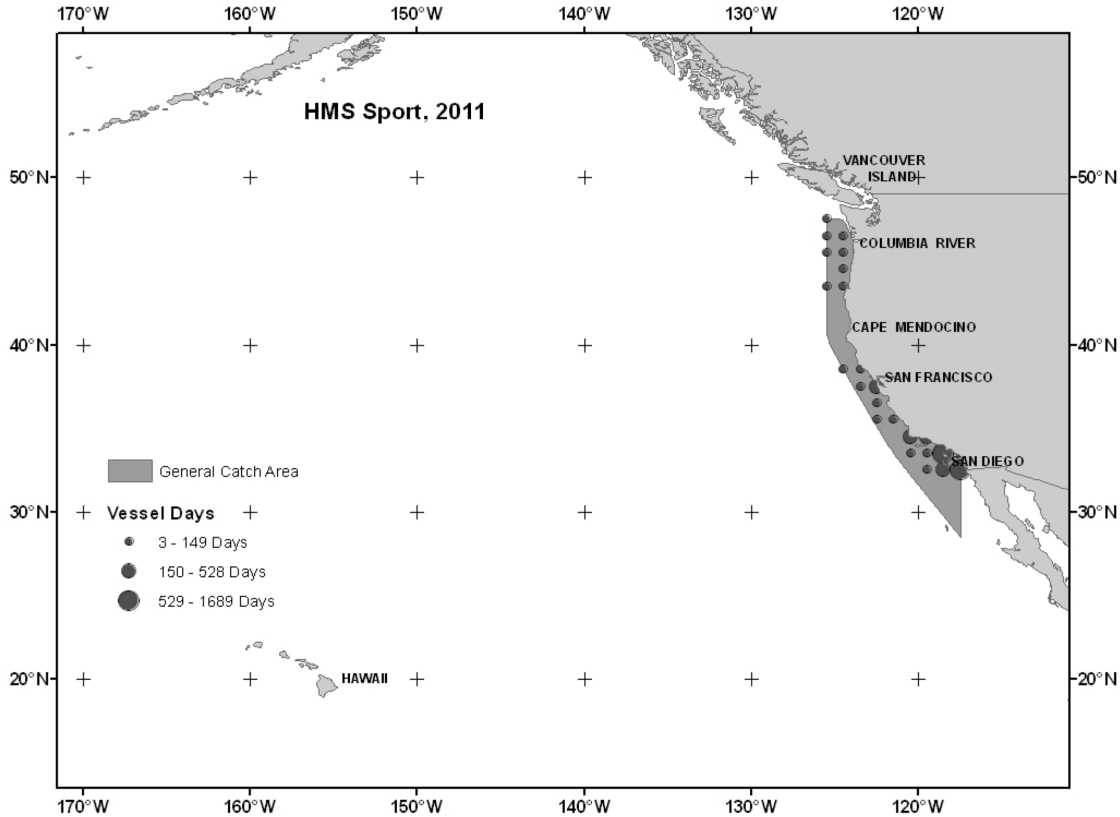

Figure 12. Spatial distribution of reported logbook fishing effort by the U.S. West Coast sport fleet, in vessel days, in 2011 (provisional data). Area of circles is proportional to effort. Effort in some areas is not shown in order to preserve data confidentiality.

Table 1. Number of vessels fishing in the North Pacific Ocean in various U.S. fisheries.
Data for 2011 are preliminary. [1]

Year	Purse Seine [2]	Longline	Albacore Troll and Pole-and-Line	Tropical Pole and Line	Tropical Troll [3]	Tropical Handline	Gillnet	Harpoon	Sport	Other
1985	53	36	792	27			210	99	127	331
1986	51	39	419	19			220	113	101	296
1987	47	37	486	18	1,899		210	98	96	265
1988	74	50	531	17	1,878		192	83	81	239
1989	73	88	338	18	2,002		158	44	106	174
1990	71	138	368	12	2,042		146	49	117	200
1991	59	141	172	12	2,117		123	32	86	163
1992	72	124	602	11	2,160		113	48	126	172
1993	68	122	608	13	2,132		105	44	103	190
1994	72	127	721	11	2,210		112	49	88	139
1995	65	116	471	11	2,387		127	39	136	129
1996	61	114	676	9	2,411		100	30	132	112
1997	68	117	1,172	9	2,400		104	31	206	178
1998	68	122	841	9	2,370		87	26	202	185
1999	42	140	776	9	2,502		78	30	200	154
2000	40	130	645	7	2,229		77	26	206	164
2001	43	125	860	9	2,208		64	23	220	140
2002	31	123	644	13	2,045		45	29	175	94
2003	29	128	729	14	1,960		37	34	214	120
2004	28	126	695	11	2,012		33	29	184	90
2005	23	126	541	10	1,917		37	24	186	76
2006	11	128	601	11	1,916		45	24	200	91
2007	22	130	676	3	1,869	424	49	28	197	78
2008	35	130	525	3	1,978	475	51	32	169	70
2009	41	128	686	6	2,083	552	61	28	200	82
2010	35	125	657	2	2,033	480	53	26	145	77
2011	22	129	687	2	2,078	505	49	17	165	86

[1] The estimations of west coast vessels targeting ISC species is currently under revision.

[2] The number of Purse Seine vessels has been revised and represents counts of unique vessels from EPO and WCPO fisheries that caught tunas.

[3] The number of tropical troll vessels for 1987-2006 includes tropical handline vessels.

Table 2. U.S. retained catches (metric tons, whole weight) of tunas and tuna-like species (FAO codes) by fishery in the North Pacific Ocean, north of the equator. Data for 2011 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, THR = unidentified thresher shark, SMA = shortfin mako shark, BSH = blue shark, SKH = other sharks . Blanks indicate no effort, zero indicates less than 0.5 mt, a dash indicates data are not available or were combined with another category due to confidentiality issues.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	SWO	BUM	MLS	BIL	TUN	ALV [1]	PTH	BTH	THR	SMA	BSH	SKH	TOTAL
Purse Seine [2]																		
1985	26	92,623	47,634	1,751	3,320													145,354
1986	47	102,736	52,817	264	4,851													160,715
1987	1	123,044	48,667	222	861													172,795
1988	17	88,302	78,250	1,120	923													168,612
1989	1	77,744	35,671	516	1,046													114,978
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	39	3,694	14,378	512	410													19,033
2010	--	7,136	41,523	1,557														50,216
2011	41	5,108	35,662	1,080	99													41,990
Longline																		
1985						2												2
1986						2												2
1987	150	261	1	815		24	51	272	45									1,619
1988	307	594	4	1,239		24	102	504	68									2,842
1989	248	986	10	1,442		218	356	612	132									4,004
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	3,807	362	326	99	5								7,663
1995	882	984	101	2,099	29	2,981	570	543	182									8,371
1996	1,185	634	41	1,846	25	2,848	467	418	115	2								7,581
1997	1,653	1,143	106	2,526	26	3,393	487	352	143	2								9,831
1998	1,120	724	76	3,274	54	3,681	395	378	172	9								9,883
1999	1,542	477	99	2,820	54	4,329	357	364	242	10								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	1,185	283	376	200	9								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	1,735	262	276	160	0				44	128	8	7	9,629
2008	353	869	121	5,959	0	1,980	348	426	239	0				42	131	7	4	10,479
2009	201	524	136	4,560	1	1,813	357	256	123	0				29	119	9	6	8,134
2010	405	544	146	5,243	0	1,668	293	158	126	0				17	91	7	3	8,701
2011	687	910	199	5,580	0	1,620	366	356	246	0				19	67	14	3	10,067

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	SWO	BUM	MLS	BIL	TUN	ALV [1]	PTH	BTH	THR	SMA	BSH	SKH	TOTAL
Albacore Troll and Pole-and-Line																		
1985	6,415	5																6,420
1986	4,708	1																4,709
1987	2,766	76																2,842
1988	4,212	7																4,219
1989	1,860	1																1,861
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	12,938																	12,938
2010	12,634																	12,634
2011	11,172																	11,172
Tropical Pole-and-Line																		
1985		472	1,328															1,800
1986		554	1,367							1								1,922
1987		1,861	2,087															3,948
1988		1,140	3,450	5														4,595
1989		1,318	2,456							3								3,777
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		--	--							-								-

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	SWO	BUM	MLS	BIL	TUN	ALV [1]	PTH	BTH	THR	SMA	BSH	SKH	TOTAL
Tropical Troll [3]																		
1985	7	967	101	8			145	18	12	2								1,260
1986	5	1,493	120	5			220	19	14	4								1,880
1987	6	1,616	137	8			261	29	20	11								2,088
1988	9	941	172	17			266	54	20	11								1,490
1989	36	828	153	14			326	24	23	11								1,415
1990	15	891	138	25			295	27	17	11								1,419
1991	72	802	237	25			346	41	25	9								1,557
1992	54	602	167	13			260	37	17	10								1,160
1993	71	861	157	3			311	67	20	6								1,496
1994	90	870	138	7			298	35	22	8								1,468
1995	177	978	152	20			315	52	29	7								1,730
1996	188	934	224	7			409	53	18	5								1,838
1997	133	770	196	26			378	37	17	4								1,561
1998	88	766	143	9			242	26	19	6								1,299
1999	331	1,019	181	24			293	27	33	4								1,912
2000	120	1,080	415	207			235	15	20	15								2,107
2001	194	878	523	226			291	44	32	13								2,201
2002	235	632	355	586			225	30	13	6								2,082
2003	85	735	268	213			210	29	18	25								1,583
2004	157	746	251	381			188	31	23	45								1,822
2005	175	679	259	295			187	20	15	14								1,644
2006	95	508	296	303			160	21	14	12								1,409
2007	3	501	266	63		1	127	13	12	8								994
2008	1	444	368	74			180	14	14	7								1,102
2009	3	469	398	59		0	15	10	8	12								974
2010	2	427	397	118			148	19	12	25							1	1,149
2011	4	485	430	110			193	16	15	18							1	1,272
Tropical Handline																		
1985						4												4
1986						4												4
1987						4		1										5
1988						6												6
1989						7		0										7
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		5	1			1								686
2008	28	227	9	148		6	1			1								420
2009	97	317	11	136		5	1			3								570
2010	53	265	7	340		3	2			4	1				1			676
2011	84	353	9	297		5	2			5					1			756

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	SWO	BUM	MLS	BIL	TUN	ALV [1]	PTH	BTH	THR	SMA	BSH	SKH	TOTAL
Gillnet																		
1985	2	12		2	8	2,990					856	0	90		129	0		4,089
1986	3	14		3	16	2,069				4	455	0	34		250	1		2,849
1987	5	3		6	2	1,529				5	354	2	18		208	1		2,133
1988	15	7		5	4	1,376				2	352	1	7		106	0		1,875
1989	4	1	5		3	1,243				3	430	0	16		117			1,822
1990	29	1	1	1	11	1,131				2	266	1	30		229	0		1,702
1991	17	1	3	3	4	944				3	542		31		125	0		1,673
1992		4	1	1	9	1,356				6	256	0	18		118	1		1,770
1993		7	2		32	1,412				9	243	1	41		87	0		1,834
1994	38				28	792				2	292	0	32		80	0		1,264
1995	52	2	70	1	20	771				1	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	931				2	332	2	11		85	0		1,492
1999	149			2	22	606				1	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	443				1	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		4	251					81		7		25	1		374
2010	5				1	61					69		1		17	0		154
2011	8		0		16	108					58	0	1		13			204
Harpoon																		
1985						305					0				1			306
1986						291							0		1			292
1987						235							0		3			238
1988						198					0				3			201
1989						62									1			63
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					1	24					0				0			25

Table 2. Continued.

FISHERY/YEAR	ALB	YFT	SKJ	BET	PBF	SWO	BUM	MLS	BIL	TUN	ALV [1]	PTH	BTH	THR	SMA	BSH	SKH	TOTAL
Sport																		
1985	1,176				89			42										1,307
1986	196				12			19										227
1987	74				34			28										136
1988	64				6			30										100
1989	160				112			52										324
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	677				176													853
2010	704				122													826
2011	424				456													880
Other [4]																		
1985	118	58	5	1	20	104				468	332		5		19	1		1,131
1986	66	227		6	41	109				6	93		14		59	1		622
1987	139	2,159	633	1	18	31				67	116		1		188	1		3,354
1988	76	936	372	1	46	64				2	67		2		214	3		1,783
1989	10	849	103		18	56					65		1		137	6		1,245
1990	20	508	147		81	43				1	90		0		141	20		1,051
1991	20	235	137		0	44					42		0		91	1		570
1992	40	1,119	1,014		14	47				2	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	19				1	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	3	1			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	0	7	1		1	0					26	0			3	0		38
2010	19	0	0		0	18					26	0			3	0		66
2011	37	1	0	1	1	90					12				2	0		144

[1] Shark species were not previously reported so estimates from 1985 - 2011 are provided.
[2] Purse Seine catches include EPO and WCPO fisheries.
[3] Tropical troll 1985-2006 includes tropical handline catches.
[4] Other catches may include commercial and sport catches.