4.4 Northwest Region

The NMFS Northwest Region is responsible for collecting scientific data and managing marine resources and habitats in Federal waters off the states of California, Oregon, and Washington: the area comprising the California Coastal Current LME[1] as well as coastal and inland waters utilized by species protected under the MMPA and ESA. The Pacific Fishery Management Council (PFMC), in conjunction with the NMFS, is responsible for managing fisheries in the Northwest Region.

4.4.1 Fisheries Overview

A total of 30 commercial fisheries are included in this report for the Northwest Region (Table 4.4.1). Landings from these fisheries in Oregon and Washington were valued at approximately $281 million in 2005.[2] A variety of gear types (e.g., longlines, pots/traps, trawls, and gillnets) are used to capture groundfish and salmon species. In addition, crab, anchovy, sardines, herring, mackerel, shrimp, squid, and other shellfish and mollusks provide other important fishing opportunities.

Sixty-three percent of Northwest Regional fisheries are managed at the state level (Figure 4.4.1). Of the 11 remaining fisheries, four are managed at the Federal level, one is managed by tribal authorities, and six are under shared management.

Two PFMC FMPs regulate harvest of Pacific Coast groundfish and salmon in the Northwest Region. Through the management process, the PFMC develops and recommends to NMFS harvest specifications and management measures for over 82 species of groundfish managed under the Pacific Coast Groundfish FMP. Pacific hake (*Merluccius productus*, also referred to as whiting) comprises the largest proportion of groundfish catch by volume. Management of the Pacific hake mid-water trawl fishery is shared between Federal and state governments and tribal authorities (an international treaty is currently being developed between Canada and the U.S). Groundfish bottom trawl fisheries targeting other species are primarily federally managed. The California/Oregon nearshore rockfish fisheries have shared Federal/state management.

The PFMC's Pacific Coast Salmon FMP manages species of Pacific salmon, which support important commercial, recreational, and tribal fisheries in the states of California, Idaho, Oregon, and Washington. Managed fisheries include a number of state-managed coastal and inland salmon fisheries. These "inside water" commercial fisheries primarily utilize gillnets and purse seine gear. Federally managed ocean salmon fisheries include commercial troll and recreational fisheries (recreational fisheries are not addressed in this edition of the report). Of the two salmon fisheries addressed in this report, one is federally managed (West Coast salmon troll, non-tribal ocean), and the other has shared management by the Federal government and the coastal Native American tribes (West Coast salmon troll, tribal ocean).

The regional interstate commission, the Pacific States Marine Fisheries Commission (PSMFC), does not have regulatory or management authority, but works to advance policies and actions to conserve, develop, and manage fishery resources in the states of California, Oregon, Washington, Idaho, and Alaska. The Pacific Coast Fisheries Information Network (PacFIN), run by PSMFC, is a joint Federal–state data-collection and information system used to compile and maintain data for Pacific Coast commercial fisheries.

In 2005, the Pacific halibut (*Hippoglossus stenolepis*) longline fishery was the only fishery in the Northwest that included an international management authority, the IPHC. The IPHC, established in 1923, conducts research on and manages Pacific halibut stocks within U.S. and Canadian waters.

4.4.2. Addressing Regional Bycatch Concerns

The PFMC and NMFS have implemented a variety of regulations to monitor and reduce bycatch in Federal fisheries. Note that the information in this report is based on the regulations in place at the time of writing. Sine that time, new regulations implementing trawl-rationalization for the West Coast groundfish fishery have been implemented (discussed in a later section).

Groundfish

The Pacific Coast Groundfish FMP outlines a number of conservation measures including periodic vessel landing limits (trip limits), seasonal closures, and area and gear restrictions, in addition to reduced capacity. Periodic vessel landing limits are the designated weight of a fish species or species group that can be landed during a designated time period, usually two months. Periodic vessel landing limits constrain the amount of a species or species group that can be landed; however, they do not constrain how much of a species or species group can be caught. Therefore, regulatory discard is common as vessels reach landing limits for one species before the limits for other species. Since the FMP was established, trip limits have become more restrictive, and as trip limits apply to more species, regulatory discards have increased. Discard also occurs when vessels catch species or sizes of fish which have no value to processors or other available buyers.

[1] http://www.lme.noaa.gov/.

[2] Ex-vessel landings value, Fisheries Economics of the U.S., 2006. Available online http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2006.html.

Table 4.4.1
Northwest Region fisheries included in the U.S. National Bycatch Report. Fisheries are listed alphabetically, first by management authority and then by fishery name. Rows containing fisheries for which bycatch estimates are included in this report are shaded.

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear	Federal	Pacific Coast Groundfish	Longline, Bottom; Pots and Traps, Other	Sablefish	Landing receipt (fish ticket), observer data
West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	Federal	Pacific Coast Groundfish	Longline, Bottom; Pots and Traps, Other	Sablefish, groundfish	Landing receipt (fish ticket), observer data
West Coast Limited-Entry Bottom Trawl: Groundfish Bottom Trawl	Federal	Pacific Coast Groundfish	Otter Trawl Bottom, Fish	Groundfish	Landing receipt (fish ticket), logbook, observer data
West Coast Salmon Troll, Non-Tribal Ocean	Federal	Pacific Coast Salmon	Troll Lines	Salmon	Landing receipt (fish ticket), logbook, Observer data
CA Halibut Trawl	Federal, State		Bottom Trawl, Fish	California halibut	Observer data
CA/OR Nearshore Rockfish	Federal, State	Pacific Coast Groundfish	Combined Gears	Nearshore rockfish	Landing receipt (fish ticket), observer data, state logbook
West Coast Pacific Halibut Longline, Non-Tribal	Federal, State, International	Pacific Coast Groundfish	Longline	Pacific halibut	
West Coast Mid-Water Trawl For Whiting, Shoreside Processing	Federal, State, Tribal	Pacific Coast Groundfish	Mid-water Trawl	Pacific whiting	Observer data
West Coast Mid-Water Trawl For Whiting, At-Sea Processing	Federal, Tribal	Pacific Coast Groundfish	Mid-water Trawl	Pacific whiting	Observer data
West Coast Salmon Troll, Tribal Ocean	Federal, Tribal	Pacific Coast Salmon	Troll Lines	Salmon	Landing receipt (fish ticket), logbook, observer data
OR/CA Pink Shrimp	State		Shrimp Trawls	Pink shrimp	Observer data
OR/CA Spot Prawn	State		Pots and Traps, Shrimp	Spot shrimp	Observer data
WA Beach Seine / OR Drag Seine	State		Other Seines		
WA Grays Harbor Salmon Drift Gillnet (excluding Treaty Tribal Fishing)	State		Gillnet	Salmon	

Table 4.4.1 (continued)

Fishery[a]	Management Authority	Federal Fishery Management Plan (FMP)[b]	Gear Type	Target Species (Common Name)	Data Sources[c]
WA Grays Harbor Salmon Set and Drift Gillnet	State		Gillnet	Salmon	
WA Herring Brush Weir	State		Weirs	Pacific herring	
WA/OR Gillnet	State		Gillnet	Salmon	
WA/OR Herring, Smelt, Squid Purse Seine	State		Purse Seine	Coastal pelagic species	
WA/OR Lower Columbia River Drift Gillnet	State		Gillnet	Salmon	
WA/OR Shrimp Pot and Trap	State		Pots and Traps, Shrimp	Shrimp spp.	
WA/OR Smelt, Herring Dip Net	State		Dip Nets	Coastal pelagic species	
WA/OR Lower Columbia River Salmon Drift	State		Gill Nets	Salmon	
WA/OR Misc. Invertebrate	State		By Hand, Diving Gear		
WA/OR/CA Dungeness Crab Pot	State		Pots and Traps, Other	Dungeness crab	
WA Puget Sound Region Salmon Drift Gillnet	State		Gillnet	Salmon	
WA Salmon Purse Seine	State		Purse Seine	Salmon	
WA Salmon Reef Net	State		Other Fixed Nets	Salmon	
WA Willapa Bay Drift Gillnet	State		Gillnet	Salmon	
Willapa Bay Salmon Drift	State		Gillnet	Salmon	
Makah Salmon Set Gillnet Areas 4, 4A, 4B	Tribal		Gillnet	Salmon	

[a] Aquaculture fisheries are listed for consistency with the MMPA List of Fisheries when they occur, but were not analyzed for the U.S. National Bycatch Report. Recreational fisheries are not included in this edition of the report and are not listed.
[b] Note that non-Federal FMPs were not identified through this process..
[c] Data sources were evaluated only for Federal fisheries and non-Federal fisheries with Federal data-collection programs.

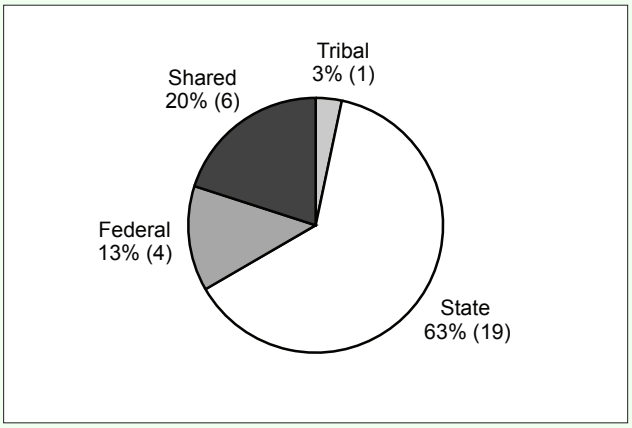


Figure 4.4.1
Management jurisdictions for Northwest Region fisheries (percentages based on numbers of fisheries, not volume or revenue); "shared" indicates that international, Federal, state, and/or tribal authorities share management jurisdiction for the fishery.

Several additional measures have been taken to shift fishing incentives away from depleted rockfish species. In 2000, the PFMC imposed a restriction on bottom trawl footrope size for landing shelf and nearshore rockfish species. Footrope configuration and the use of chafing gear were linked to various groundfish trip limits. In 2002, area- and depth-related closures were instituted to further reduce bycatch of depleted rockfish species, while also dictating where different footrope configurations could be used. By 2003, area- and depth-related closures were established in both the limited-entry and open-access sectors of the groundfish fishery for both trawl and fixed gears. In 2005, a selective flatfish trawl gear requirement was established to further reduce bycatch of depleted rockfish based on net design. This requirement was again linked to the area- and depth-related closures. Area- and depth-related closures continue to change over time in response to bycatch rates and fishery management.

In 2001, the PFMC began to institute measures to reduce capacity in the groundfish fishery. That year, permit stacking was instituted in the limited-entry sablefish-endorsed fixed gear fishery. Permit stacking allows for up to three limited-entry sablefish (*Anoplopoma fimbria*)-endorsed permits to be stacked on a single vessel. Prior to this measure, a single vessel fished each permit. In 2003, groundfish and pink shrimp (*Pandalus jordani*) fishers, in cooperation with the Federal government, reduced capacity in the limited-entry groundfish bottom trawl fleet through a permit and vessel buyback program. Ninety-two permits and vessels, representing about a third of the overall trawl effort, were removed from the fishery.

The PFMC and NMFS have developed rebuilding plans for all overfished stocks, as required under the Magnuson-Stevens Reauthorization Act of 2006 (MSRA). Because many overfished groundfish stocks co-occur with healthy stocks, harvest of healthy stocks is often constrained to ensure that rebuilding stocks are not subject to overfishing and may be rebuilt within the established time frame. To achieve a balance, NMFS and PFMC work to identify a rebuilding period for each species that is as short as possible, taking into account the status and biology of the species and the impacts of management alternatives on fishing communities.

In 2001, the NMFS implemented the West Coast Groundfish Observer Program (WCGOP) to gather data necessary to manage Federal groundfish fisheries off the coasts of Washington, Oregon, and California. The program's focus is estimation of groundfish species bycatch in West Coast fisheries. Also in 2001, the At-Sea Hake Observer Program (A-SHOP) was transferred from the AFSC to the Northwest Fisheries Science Center (NWFSC). The A-SHOP program monitors total catch and bycatch of the Pacific hake sectors that process their catch at sea (catcher–processors and motherships). Bycatch caps were instituted in this fishery in 2005 for several overfished and rebuilding stocks known to be taken. Specifically, bycatch caps were instituted for canary rockfish (*Sebastes pinniger*), widow rockfish (*Sebastes entomelas*), and darkblotched rockfish (*Sebastes crameri*).

Due to the conservation efforts of the PFMC and NMFS, populations of several groundfish stocks are increasing. Lingcod (*Ophiodon elongates*), which was declared overfished in 1999, had been rebuilt by 2005. Pacific hake was declared overfished in 2002, but was rebuilt by 2004. In addition, bocaccio and darkblotched rockfish, Pacific Ocean perch (*Sebastes alutus*), and widow rockfish (*Sebastes entomelas*) are no longer overfished and are rebuilding.

In 2010, the NMFS and the PFMC approved Amendments 20 and 21 to the Pacific Coast Groundfish FMP. The new measures move the Pacific Coast groundfish bottom trawl fishery from a limited-entry permit system to a catch-share program. The management options implemented under an individual transferable quota (ITQ) system significantly affect data collection and bycatch monitoring, as well as the methods of estimation used, and also influence bycatch levels in this fishery. This program is currently in its first year of implementation.

Salmon

In ocean salmon troll fisheries, the primary bycatch is incidental salmon species. Bycatch of non-salmonid fish species in salmon fisheries is generally very limited. Under the Pacific Coast Salmon FMP, only hook-and-line gear is allowed in oceanic salmon fisheries, and regulations allow for retention of most groundfish species and limited numbers of Pacific halibut that are caught incidentally. All ocean salmon fisheries are mixed-stock fisheries, and may either allow retention of mixed species or be limited to retention of single species. At-sea differentiation between salmon stocks is not currently feasible, except for distinguishing marked hatchery fish from unmarked fish. In single-species fisheries, captured individuals of other species must be discarded.

Conservation measures in recent years, intended to reduce the mortality of stocks of concern (e.g., mark-selective fisheries and single-species fisheries), have increased the ratio of bycatch to landed catch in the non-tribal portion of the fishery. Major regulations currently in place under the Salmon FMP include setting annual goals for the number of spawners of major salmon stocks ("spawner escapement goals") and the allocation of harvest among different groups of fishers. The NMFS and PFMC must also ensure that all salmon fisheries comply with ESA regulations, as several ESA-listed fish populations occur in the region.

Other fisheries

The remaining fisheries listed in Table 4.4.1 have limited or no bycatch information available. With the exception of the

pink shrimp and Dungeness crab fisheries, the remaining fisheries are sporadic, or effort occurs at levels much lower than in the observed fisheries.

The pink shrimp trawl fisheries in Oregon and Northern California have limited observer coverage and are known to take small quantities of groundfish and squid. To reduce groundfish bycatch in the pink shrimp fisheries, Washington, Oregon, and California instituted mandatory requirements for the use of BRD's. The Oregon pink shrimp fishery was certified by the Marine Stewardship Council in 2007 due in part to the effectiveness of the required rigid type of BRD. Bycatch of groundfish, Dungeness crab (*Cancer magister*), and other species is known to occur in the California halibut bottom trawl fishery. Limited observer data are available, as it is also a state-managed fishery.

4.4.3 Data Sources

Table 4.4.1 lists sources of bycatch data available for federally managed Northwest fisheries and for those state fisheries with relevant Federal data-collection programs. Three primary data sources are available for Northwest Regional fisheries: observer programs, logbooks, and landing receipts (also known as fish tickets). Both the NMFS and state agencies utilize PacFIN (the regional database clearinghouse maintained by PSMFC) to compile and maintain data on Pacific coast fisheries.

4.4.3.1 Observer Programs

Prior to 2002, comprehensive total catch data were not available, as only limited state or NMFS observer programs (implemented primarily under the MMPA) existed through the 1980s and 1990s. In 2001, under the Pacific Coast Groundfish FMP, NMFS established and authorized the WCGOP to collect data on at-sea discards in the West Coast non-hake groundfish fleet. The A-SHOP, which had originally focused on incidental take of marine mammals and salmon, evolved to collect data for estimating total catch by the early 1990s. Although domestic at-sea hake processors had historically carried NMFS-trained observers voluntarily, observer coverage for the Federal at-sea hake fishery became mandatory in 2004 under the Pacific Coast Groundfish FMP. In addition, an electronic monitoring (EM) video program was tested in the shore-based mid-water trawl hake fishery from 2004 to 2009. The EM system was tested to confirm that landings data accurately represented what was being caught at sea, i.e., that instances of at-sea discard were recorded.

The WCGOP and A-SHOP observers monitor and record haul-related information; determine the total catch; sample hauls for species composition; collect length, weight, age structure, and tagged fish data; and record marine mammal and seabird sightings and interactions. Data collected by the WCGOP and A-SHOP programs are compiled and maintained by NMFS. Possible biases in data collected by WCGOP observers include changes in fishing behavior by observed vessels relative to non-observed vessels, pooling of data across ports without weighting by relative strataum size (e.g., fraction of trips or landings), and deviations from the sampling plan due to implementation issues (e.g., vessel safety, size, etc.). Biases in the A-SHOP data are minimal, as the fishery is a census of vessels, and samples of catch are random and include approximately 50% of the total catch. One caveat is that catcher vessels delivering to motherships are currently unobserved and may represent a source of unaccounted-for discards.

Observer programs at developing or mature coverage levels are in place for several fisheries including the West Coast mid-water trawl fishery for hake with at-sea processing, and the limited-entry groundfish fisheries (trawl and fixed gear). Other regional fisheries are observed at baseline or pilot levels. Current observer programs are listed in Table 4.4.2. In FY 2005, over 6,184 sea days of commercial fishing were observed in the Northwest Region (approximately 36% of this was EM coverage of the mid-water trawl fishery for hake with shoreside processing).

4.4.3.2 Logbooks

Mandatory logbook programs are currently in place for some of the fisheries for which discards were estimated. Logbooks were used to estimate discards in the West Coast limited-entry groundfish bottom trawl fishery.

Logbook record-keeping for the limited-entry groundfish trawl fishery is a state-mandated requirement in Washington, Oregon, and California. A common format of logbook is used by all three states. Information in paper logbooks is recorded by vessel personnel. Data collected include vessel name, departure date, return date, departure port, return port, gear type, haul set/retrieval location (latitude/longitude), average depth, haul number, haul set/retrieval date/time, and retained catch in pounds by category (single species or species group). Discard information is not recorded in logbooks, although all commercial fishermen are required under the MMPA to submit a marine mammal take form if they incidentally take a marine mammal.

Trawl logbooks are submitted to each state agency: California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW), and recorded information is entered into state agency databases. Electronic logbook data are then uploaded on a quarterly basis to PacFIN. Often, the most complete logbook data for a calendar year are not available until April of the following year. For the Pacific Coast groundfish bottom trawl fishery, the

Table 4.4.2
Current Northwest Regional Federal observer programs and fisheries observed. Coverage level was determined by observed landings. Programs and observed fisheries are listed alphabetically. Observer programs that ended over 10 years ago are not listed in this table.

Observer Program	U.S. National Bycatch Report Fisheries	Authority to Place Observers	Program Duration	Coverage Level
At-Sea Hake Observer Program	West Coast Mid-Water Trawl For Whiting, At-Sea Processing	MSFCMA (50 CFR 660)	1975–present	2005-08: 100%
West Coast Groundfish Observer Program	CA Halibut Trawl	MSFCMA (50 CFR 660)	2001–present	2005: 1–10% 2006: <1–10% 2007: <1–10% 2008: <1–10%
	CA/OR Nearshore Rockfish			
	CA/OR Pink Shrimp			
	CA/OR Spot Prawn			
	West Coast Groundfish Bottom Trawl; West Coast Limited-Entry Bottom Trawl	MSFCMA (50 CFR 660)	2001–present	2005: 24% 2006: 22% 2007: 18.5% 2008: 17–30%
	West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear			2005: 42% 2006: 28% 2007: 25.1% 2008: 17–30%
	West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	MSFCMA (50 CFR 660)	2001–present	2005: 3% 2006: 7% 2007: 12.6% (program does not cover all portions of non-endorsed fishery) 2008: 17–30%
	West Coast Mid-Water Trawl For Hake, Shoreside Processing	MSFCMA (50 CFR 660)	2004–09	2005–08: 100% of vessels (covered with pilot EM)

completeness of logbook submission is not fully known. As with most self-reported data, the trawl logbooks are unverified, creating a potential for bias. However, the state agencies all employ similar procedures during data processing to adjust logbook weights, based on trip-level comparison of logbook trip entries and corresponding landing receipts.

The State of Oregon requires logbooks for its state-managed fisheries, such as nearshore rockfish, although currently these logbooks are not directly available to NMFS.

4.4.3.3 Landing Receipts

Landing receipts, also known as fish tickets, are required to be completed by fish buyers in each port for every shoreside delivery of fish by a vessel. Each state agency issues blank fish tickets to fish buyers to complete and return to the agency for processing. Fish tickets are available for all of the fisheries for which bycatch estimates are presented here, with the exception of the West Coast mid-water trawl for Pacific hake with at-sea processing, as only processed catch is ever landed. Potential fish ticket biases include the possibility that not all landings are recorded on submitted fish tickets and inconsistencies in the recording of species between fish buyers, ports, and states.

State laws require that all fish landed by a vessel be recorded on a landing receipt. Washington, Oregon, and California each have a slightly different format of landing receipt. Data collected include delivery date, port, processor identification, vessel identification, fisherman name, gear

type, catch category (single species or species group), and landed weight or number of fish (for salmon). These data pertain only to fish being retained and landed by the vessel; discards at sea are not recorded on the landing receipt. Landing receipts are recorded by fish buyers and then sent to the issuing state agency. The receipts are then entered into state agency databases and uploaded electronically to the PacFIN regional database. The data are uploaded to PacFIN within a week, or up to every two months, depending on the state agency.

In many observed Northwest fisheries, it is necessary to adjust retained catch weight recorded by observers to landings receipt(s) weight. Matching observed catch with landing receipts can be problematic due to differences in dates (end dates of observed trips do not always match the date of landing) or differences in the recorded species/fish category assignments between the observer program and landing receipts.

4.4.4 Northwest Region Bycatch Estimation Methods

4.4.4.1 Fish Discard Estimation Methods for the West Coast Limited-Entry Bottom Trawl, Groundfish Bottom Trawl Fishery

Fish discard estimation methods in this fishery are detailed in the report on mortality in the West Coast groundfish fishery by Hastie and Bellman (2006) and the WCGOP data report (NWFSC 2006a). For WCGOP observer data-collection methods, refer to the program's manual (NWFSC 2006b). Fleet-wide discard estimates are derived from WCGOP observer data, landing receipt data, and trawl industry logbook data. WCGOP observer data and trawl logbook data are stratified by area, season, and depth. The approach is to estimate discards as a direct function of retained catch.

Discard ratios are calculated from observer data for three sets of species: rebuilding species (species that are under rebuilding plans), fishery target species, and other incidentally caught species. Stratum discard ratios for rebuilding species and other incidental species, where the majority of species catch is often discarded, are calculated by dividing a rebuilding or other incidental species' discarded weight by the aggregate retained weight of the target species in the stratum. Stratum discard ratios for target species, where the species catch is characterized by a mix of retention and discard, are calculated by dividing each target species' discarded weight by its retained weight.

Stratum estimates of discard for individual rebuilding species and other incidental species are calculated by multiplying the aggregate logbook target species catch in each stratum by the appropriate discard ratio. Stratum estimates of discard are calculated for each target species by multiplying the logbook retained species catch by the appropriate discard ratio. The stratum discard estimates are then summed for each area and two-month period. Logbook data do not provide a complete synopsis of all trawl trips, thus discard estimates must be expanded to reflect the difference between landed catch reported on landing receipts and that reported in logbooks. The extrapolation ratio for rebuilding and other incidentally caught species is equal to the landing receipt weight of the combined target species, divided by logbook weight for the combined target species. The extrapolation ratio for target species is equal to landing receipt weight divided by logbook weight for each state and two-month period. Measures of uncertainty were not calculated for this report, but methods to do so are being developed.

4.4.4.2 Fish Discard Estimation Method for Pacific Halibut in the West Coast Limited-Entry Bottom Trawl, Groundfish Bottom Trawl Fishery

Fish discard estimation methods for Pacific halibut (*Hippoglossus stenolepis*) caught in the limited-entry groundfish bottom trawl fishery are detailed in a report by Wallace and Hastie (2006). The estimation method employed here is based upon methods developed for Pikitch et al. (1998). The analysis is limited in geographic extent to Washington and Oregon as Pacific halibut are rarely caught south of Oregon. The method calculates Pacific halibut bycatch rates, which are stratified by season, depth, latitude, and by the amount of arrowtooth flounder (*Atheresthes stomias*) landed. Arrowtooth flounder is the species most highly correlated with Pacific halibut discard from the bottom trawl fishery in this area. The Pacific halibut bycatch rates (weight per hour) are then multiplied by the amount of trawl effort (hours towed) in each stratum, as determined from trawl industry logbooks. Pacific halibut bycatch for the bottom trawl fleet is estimated by summing across strata. Measures of uncertainty were not calculated for 2005, the baseline of data used for this report. Starting in 2007, measures of uncertainty for the Pacific halibut bycatch rate are reported, and these measures will be included in future editions of this report.

4.4.4.3 Fish Discard Estimation Methods for the West Coast Limited-Entry Sablefish-Endorsed Fixed-Gear Fishery and the Non-Sablefish-Endorsed Fixed-Gear Fishery

Fish discard estimation methods in these fisheries are detailed in a data report by Hastie and Bellman (2006), but further separation of landings by the limited-entry sablefish-endorsed fishery and the non-sablefish-endorsed fixed gear fishery was necessary in calculating discard estimates for this report. The WCGOP data reports also contain ad-

ditional details (NWFSC 2006c,d). Fleet-wide discard estimates in these fisheries are derived from WCGOP and landing receipt data. The primary limited-entry sablefish-endorsed fixed gear fishery takes place from April to the end of October and operates under a tier-limit endorsement program. The non-sablefish-endorsed fixed gear fishery can occur year-round under daily trip limit management. These fisheries are stratified by area and gear type and by the area-specific depth zones dictated by fishery management. The analysis is limited in geographic extent to north of 36°N latitude.

Sablefish landings and discard estimates are calculated by gear type and area. Estimated discard of sablefish is calculated by multiplying the landed catch from fish ticket receipts by the corresponding observed discard ratio. Discard ratios for rebuilding and other groundfish species are calculated by dividing the stratum discard weight of each species by the retained catch weight of sablefish. Estimated discard of rebuilding and other groundfish species is calculated by multiplying the observed discard ratio by sablefish landing weight. A sablefish mortality rate was not applied in discard estimation for the U.S. National Bycatch Report. Measures of uncertainty were not calculated for this report, but the development of methods is underway.

4.4.4.4 Fish Discard Estimation Methods for the Oregon/California Nearshore Rockfish Fishery

Fish discard estimation methods in this fishery are detailed in a data report by Hastie and Bellman (2006), but further correction of the fishery landings data was necessary in calculating discard estimates for this report. The WCGOP data report also contains additional details (NWFSC 2007). Fleet-wide discard estimates in the nearshore (depths less than 50 fathoms) fishery are derived from WCGOP data, landing receipt data, and other parameters developed through modeling efforts by the Groundfish Management Team (GMT) of the PFMC.

The total observed catch weights of nearshore species or species groups are stratified by area and depth. The discard percentage of observed species or species group is calculated for each stratum. Landed fish ticket weights for each species or species group are expanded to produce fleet-wide total catch estimates (landed + discard), using various retention rates for all depths less than 50 fathoms. Total catch is then distributed among three depth intervals, based on GMT estimates. Within each depth stratum, discard estimates for rebuilding species are calculated by multiplying the observed discard ratios by total nearshore target species landing weight. The total nearshore target species landing weights were corrected in the southern area depth stratums when calculating discard estimates for this report. Mortality or survivorship rates were not applied when reporting discard estimates for this report. Measures of uncertainty were not calculated for this report, but the development of methods is underway.

4.4.4.5 Fish Discard Estimation Methods for the West Coast Mid-Water Trawl for Whiting, At-Sea Processing Fishery

Discard estimates in this fishery were obtained directly from observer data collected by the A-SHOP program. For observer data-collection methods, refer to the program's data manuals (AFSC 2006; NWFSC 2006e). Summaries of target and bycatch are presented in an annual report by the Northwest Regional Office (NMFS 2006a). The same data are also incorporated in the total mortality data report for the West Coast groundfish fishery (Hastie and Bellman 2006). The A-SHOP obtains data on total bycatch in the fishery, not specifically on discard. Discard estimates are based on an observer's visual approximation of the portion of bycatch that is potentially discarded. Thus, the discard estimates are largely tentative and should be viewed with caution. The discard estimates for the at-sea hake mid-water trawl fishery do not include data collected in the Makah Tribal sector of the fishery. Measures of uncertainty were not calculated.

4.4.4.6 Marine Mammal and Seabird Bycatch Estimation Methods for the West Coast Mid-Water Trawl for Whiting, At-Sea Processing; West Coast Limited-Entry Bottom Trawl–Groundfish Bottom Trawl; Limited-Entry Sablefish-Endorsed Fixed Gear; Non-Sablefish-Endorsed Fixed Gear; and Oregon–California Nearshore Rockfish Fisheries

Marine mammal and seabird bycatch estimation methods for these fisheries are detailed in a data report by the Northwest Fisheries Science Center (NWFSC 2008). Observer program data were analyzed from WCGOP and A-SHOP. Observations of WCGOP-observed fisheries and landings made by these fisheries were aggregated into general groundfish management areas based on vessel return port. In the at-sea hake trawl fishery, only tows that were monitored for marine mammals were used for marine mammal bycatch calculation. All of the sampled tows were used for calculating seabird bycatch in the at-sea hake trawl fishery, as the seabirds were mixed in with the fish catch.

For marine mammal takes in all fisheries and seabird takes in all fisheries except the at-sea hake trawl fishery, bycatch estimates and variance were calculated using a ratio estimator technique (Cochran 1977). This estimator was selected because the variance estimate does not assume that the numerator and denominator are independent. The ratio estimator was used to calculate bycatch rates from observer data, and then the rates were multiplied by the total target catch recorded on landing receipts to obtain bycatch

estimates for the fishery. The target catch is sablefish in the fixed gear fisheries, catch weight of all fish species in the at-sea hake fishery, and a subset of target groundfish species in the bottom trawl fishery. Total bycatch estimates were calculated by summing the bycatch estimates across all groundfish management areas. Calculation of the variance of the total bycatch estimate assumed that the bycatch estimates between management areas were independent, and was accomplished by summing variances across all areas.

A different method was used for seabird bycatch calculations in the at-sea hake trawl fishery. Approximately 99% of all tows in the fishery were sampled. To calculate the total number of seabirds in the catch, the number of seabirds was first extrapolated from the subsample to the tow level by dividing the number of seabirds by the percentage of the tow sampled. Total seabird takes were then calculated by dividing the sum of the number of birds, extrapolated to the tow level, by the percentage of tows sampled.

For all of the fisheries except the at-sea hake fishery, confidence intervals of 90% were calculated because the coefficients of variance were high. For the at-sea hake fishery, 95% confidence intervals were calculated because the estimates were more precise. A lognormal approximation (Burnham et al. 1987) was used to calculate confidence intervals. The advantage in using this method is that it captures the skewed nature of data distribution and avoids calculating lower bounds less than zero.

In the Oregon and California nearshore fisheries, no marine mammal or seabird takes were observed, and thus no further analysis of the fisheries was completed.

4.4.4.7 Fish Discard Estimation Methods for the West Coast Salmon Troll, Non-Tribal, and Tribal Ocean Fisheries

Pacific Coast Federal salmon fisheries focus on Chinook (*Oncorhynchus tshawytscha*) and coho (*Oncorhynchus kisutch*) salmon. Ocean salmon fisheries are divided into geographic areas and the commercial ocean tribal fishery is conducted only north of Cape Falcon, Oregon. The primary bycatch that occurs is bycatch of salmon species. Beginning in 2000, nearly all non-tribal commercial fisheries for coho salmon have allowed retention only of marked hatchery fish. Fisheries were sampled by state programs through limited onboard observation and dockside interviews.

Summary information on the estimated bycatch of Chinook and coho salmon is included in a pre-season process when recommendations are developed for management and also in post-season stock assessment and fishery evaluation (SAFE) reports (PFMC 2005, 2006). Incidental mortality is calculated as shaker mortality plus drop-off mortality. Shaker mortality includes sublegal fish and unmarked fish caught and released in mark-selective fisheries. Drop-off mortality includes fish that escape from gear and subsequently die, and fish removed from gear by marine mammals. Drop-off mortality is calculated as 5% of the total encounters (landed catch + discards). Shaker mortality is calculated as discards × HRM, where HRM is the hooking release mortality rate. The HRM is 26% for commercial salmon fisheries.

Given that incidental mortality (*IM*) and catch (*C*) are related to discards (*D*) as:

$$IM = 0.05(C + D) + D(HRM)$$

then discards were solved for as:

$$D = [(IM / 0.05) - C] \times [0.05 / (0.05 + HRM)].$$

The catch and bycatch mortality numbers used to calculate discard estimates for this report are included in Table I-7 of the Review of 2005 Ocean Salmon Fisheries (PFMC 2006). Measures of uncertainty were not calculated.

4.4.4.8 Marine Mammal and Seabird Bycatch Estimation Methods for the West Coast Salmon Troll, Non-Tribal, and Tribal Ocean Fisheries

Bycatch estimates of marine mammals and seabirds in these fisheries are not available. Pacific Coast salmon fisheries have a minimal impact on marine mammals, according to the Pacific salmon fisheries management final programmatic EIS (NMFS 2003). Northwest Region oceanic salmon fisheries are classified under the MMPA as Category III, with remote likelihood of causing, or no known cases of, serious injuries or mortalities of marine mammals. Direct impacts on seabirds are also minimal to non-existent, as determined in both the supplemental and programmatic EIS (PFMC 2000; NMFS 2003). The supplemental EIS also considered impacts to other ESA-listed species such as sea turtles and concluded that they were not significant.

4.4.5 Tier Scores for Northwest Region Fisheries

Ten Northwest fisheries with Federal or shared management were scored, based on the quality and availability of bycatch data and current estimation methods. Other data may be available for state, international, and tribal fisheries; however, these programs were beyond the scope of this initial report. The remaining twenty fisheries do not have any Federal management component, are inconsistently monitored by Federal data-collection programs, or have no relevant Federal data collection. In addition, many of these fisheries have had limited effort in recent years. For those with large amounts of effort, such as the Dungeness crab pot fishery, bycatch of finfish is very rare and the likelihood of marine mammal, sea turtle, and seabird injuries is very low.

Unique tier scores were assigned to evaluated fisheries using the tier scoring procedures outlined in Section 3 for fish, marine mammals and other protected species (Table 4.4.3). For all three bycatch types, 50% of Northwest fisheries scored in Tier 2 (Figure 4.4.2). For marine mammals and other protected species, the distribution of scores was the same: 30% in Tier 0, 10% in Tier 1, 50% in Tier 2, and 10% in Tier 3 (Figure 4.4.2 B and C). Scores for fish placed 10% of fisheries in Tier 0, 30% in Tier 1, 50% in Tier 2, and 10% in Tier 3. No Northwest fisheries scored in Tier 4 for fish, marine mammals, or other protected species.

Table 4.4.3

The 2005 fishery tier scores for the Northwest Region (listed alphabetically, first by management authority and then by fishery name). Fisheries in shaded rows were scored for this report. Only Federal data-collection programs were evaluated. Some state fisheries with a Federal bycatch data-collection component, such as the pink shrimp and spot prawn fisheries, could not be properly assigned to a tier due to limited data at the time.

Fishery	Management Authority	Fish	Marine Mammal	Other Protected Species
West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear	Federal	2	2	2
West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear	Federal	2	2	2
West Coast Limited-Entry Bottom Trawl; Groundfish Bottom Trawl	Federal	2	2	2
West Coast Salmon Troll, Non-Tribal Ocean	Federal	1	0	0
CA Halibut Trawl	Federal, State	1	1	1
CA/OR Nearshore Rockfish	Federal, State	2	2	2
West Coast Pacific Halibut Longline, Non-Tribal	Federal, State, International	0	0	0
West Coast Mid-Water Trawl for Whiting, Shoreside Processing	Federal, State, Tribal	2	2	2
West Coast Mid-Water Trawl for Whiting, At-Sea Processing	Federal, Tribal	3	3	3
West Coast Salmon Troll, Tribal Ocean	Federal, Tribal	1	0	0
OR/CA Pink Shrimp	State			
OR/CA Spot Prawn	State			
WA Beach Seine / OR Drag Seine	State			
WA Grays Harbor Salmon Drift Gillnet (excluding Treaty Tribal Fishing)	State			
WA Grays Harbor Salmon Set and Drift Gillnet	State			
WA Herring Brush Weir	State			
WA/OR Gillnet	State			
WA/OR Herring, Smelt, Squid Purse Seine	State			
WA/OR Lower Columbia River Drift Gillnet	State			
WA/OR Lower Columbia River Salmon Drift	State			
WA/OR Misc Invertebrate	State			
WA/OR Shrimp Pot and Trap	State			

Table 4.4.3 (continued)

Fishery	Management Authority	Fish	Marine Mammal	Other Protected Species
WA/OR Smelt, Herring Dip Net	State			
WA/OR/CA Dungeness Crab Pot	State			
WA Puget Sound Region Salmon Drift Gillnet	State			
WA Salmon Purse Seine	State			
WA Salmon Reef Net	State			
WA Willapa Bay Drift Gillnet	State			
Willapa Bay Salmon Drift	State			
Makah Salmon Set Gillnet Areas 4, 4A, 4B	Tribal			

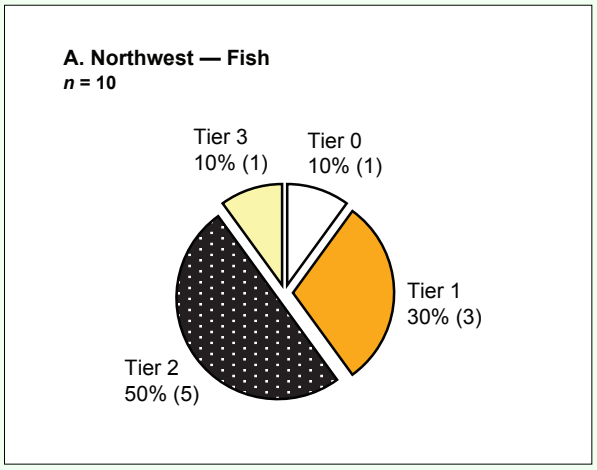
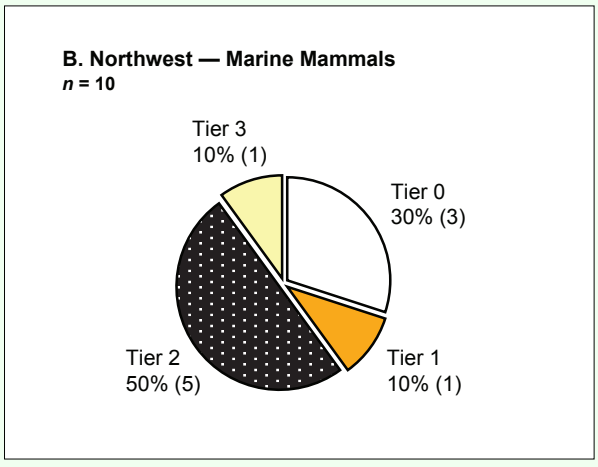
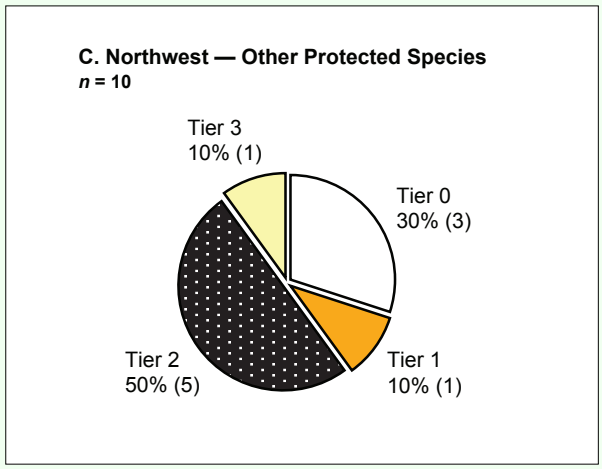


Figure 4.4.2
Tier classifications by number and percentage for Northwest Region fisheries, for fisheries with Federal or shared management or relevant Federal data-collection programs for A) fish, B) marine mammals, and C) other protected species. Tier scores are for the year 2005.





4.4.6. Northwest Region Key Stocks

Eighty-one key stocks were identified in the Northwest Region (Table 4.4.4). As in all regions, not all species listed as key stocks have available bycatch estimates. All ESA-listed populations found in the Northwest Region (47) were automatically included in the list of key stocks, regardless of whether bycatch has been recorded. In other cases, stocks were listed due to conservation concerns, data needs, and/or public interest in the stock. Seventy-three percent of key stocks identified for the Northwest Region were fish stocks, including 26 ESA-listed salmon stocks (Figure 4.4.3). A similar number of stocks listed under the FSSI (22) were identified. Four fish groups (categories), which included both FSSI and non-FSSI/non-ESA-listed stocks, were also included as key stocks. Fish groups are used by the Northwest Region as the basis for calculating and presenting discard estimates; fishery managers use them to determine if target harvest specifications for that group have been exceeded or if sorting is not required to the species level. In some cases, fish groups are used when individual fish are not identified to the stock or species level, on landing receipts in particular. For example, an observer may record species-level information on several retained skate species, but the landing receipt is recorded using "unspecified skates," which can include multiple species of skates. Species included in a particular fish group can differ between fisheries, as they are determined by the specific catch or landings during a given year. The FSSI fish stocks from each grouping are included in the FSSI section of Table 4.4.4, along with their status information. The non-FSSI/non-ESA key fish stocks have been listed separately; no status information is available for these stocks.

Table 4.4.4
Key fish and marine mammal stocks and key sea turtle and seabird populations for the Northwest Region. Overfishing and overfished status is based on 2008 Quarter 1 FSSI report. Some species are listed twice due to occurrences in multiple groups.

Key Fish Stocks Listed by FSSI[a]			
Species/stock name		Overfishing	Overfished
Common name	Scientific name		
Arrowtooth flounder	*Atheresthes stomias*	No	No
Black rockfish, North	*Sebastes melanops*	No	No
Blue rockfish	*Sebastes mystinus*	Unknown	No
Bocaccio	*Sebastes paucispinis*	No	Yes
Cabezon, South	*Scorpaenichthys marmoratus*	No	No
Canary rockfish	*Sebastes pinniger*	No	No — rebuilding
Cowcod	*Sebastes levis*	No	Yes
Darkblotched rockfish	*Sebastes crameri*	No	Yes
Dover sole	*Microstomus pacificus*	No	No
English sole	*Parophrys vetulus*	No	No
Kelp greenling, Oregon	*Hexagrammos decagrammus*	Unknown	No
Lingcod	*Ophiodon elongatus*	No	No
Longspine thornyhead	*Sebastolobus altivelis*	No	No
Pacific ocean perch	*Sebastes alutus*	No	No — rebuilding
Petrale sole	*Eopsetta jordani*	No	No
Shortspine thornyhead	*Sebastolobus alascanus*	No	No
Spiny dogfish	*Squalus acanthias*	Unknown	Unknown

Table 4.4.4 (continued)

Key Fish Stocks Listed by FSSI[a] (cont.)			
Species/stock name			
Common name	**Scientific name**	**Overfishing**	**Overfished**
Widow rockfish	*Sebastes entomelas*	No	No — rebuilding
Yelloweye rockfish	*Sebastes ruberrimus*	No	Yes
Deeper nearshore species:			
Blue rockfish	*Sebastes mystinus*	Unknown	No
Brown rockfish	*Sebastes auriculatus*	Unknown	Unknown
Other minor nearshore rockfish:			
Brown rockfish	*Sebastes auriculatus*	Unknown	Unknown
Gopher rockfish	*Sebastes carnatus*	Unknown	No
Unspecified skate:			
Longnose skate	*Raja rhina*	Unknown	No
Other nearshore rockfish:			
Gopher rockfish	*Sebastes carnatus*	Unknown	No

Key Fish Stocks Listed by ESA		
Species/stock name		
Common name	**Scientific name**	**Stock status**
Chinook salmon, California coastal	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Central Valley spring run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Lower Columbia River	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Puget Sound	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Sacramento River winter run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, Snake River fall run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Snake River spring/summer run	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon, Upper Columbia River spring run	*Oncorhynchus tshawytscha*	Endangered
Chinook salmon, Upper Willamette River	*Oncorhynchus tshawytscha*	Threatened
Chum salmon, Columbia River	*Oncorhynchus keta*	Threatened
Chum salmon, Hood Canal summer run	*Oncorhynchus keta*	Threatened
Coho salmon, Central California coast	*Oncorhynchus kisutch*	Endangered
Coho salmon, Lower Columbia River	*Oncorhynchus kisutch*	Threatened
Coho salmon, Southern Oregon and Northern California coasts	*Oncorhynchus kisutch*	Threatened
Sockeye salmon, Ozette Lake	*Oncorhynchus nerka*	Threatened
Sockeye salmon, Snake River	*Oncorhynchus nerka*	Endangered
Steelhead, California Central Valley	*Oncorhynchus mykiss*	Threatened

Table 4.4.4 (continued)

Key Fish Stocks Listed by ESA (cont.)		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Steelhead, Central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, Lower Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, Middle Columbia River	*Oncorhynchus mykiss*	Threatened
Steelhead, Northern California	*Oncorhynchus mykiss*	Threatened
Steelhead, Snake River Basin	*Oncorhynchus mykiss*	Threatened
Steelhead, South-Central California coast	*Oncorhynchus mykiss*	Threatened
Steelhead, Southern California	*Oncorhynchus mykiss*	Endangered
Steelhead, Upper Columbia River	*Oncorhynchus mykiss*	Endangered
Steelhead, Upper Willamette River	*Oncorhynchus mykiss*	Threatened
Key Fish Stocks Not Listed by FSSI or ESA[a]		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Dungeness crab	*Cancer magister*	Not applicable
Pacific halibut	*Hippoglossus stenolepis*	
Deeper nearshore species:		
Black-and-yellow rockfish	*Sebastes chrysomelas*	
Copper rockfish	*Sebastes caurinus*	
Olive rockfish	*Sebastes serranoides*	
Treefish	*Sebastes serriceps*	
Other minor nearshore rockfish:		
Black-and-yellow rockfish	*Sebastes chrysomelas*	
China rockfish	*Sebastes nebulosus*	
Copper rockfish	*Sebastes caurinus*	
Grass rockfish	*Sebastes rastrelliger*	
Quillback rockfish	*Sebastes maliger*	
Unspecified skate:		
Big skate	*Raja binoculata*	
Other nearshore rockfish:		
China rockfish	*Sebastes nebulosus*	
Grass rockfish	*Sebastes rastrelliger*	
Kelp rockfish	*Sebastes atrovirens*	
Quillback rockfish	*Sebastes maliger*	

Table 4.4.4 (continued)

Key Marine Mammal Stocks Listed by ESA		
Species/stock name		**Stock status**
Common name	**Scientific name**	
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale, Southern Resident	*Orcinus orca*	Endangered
Sea otter, California	*Enhydra lutris nereis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Steller sea lion, Eastern	*Eumetopias jubatus*	Threatened
Steller sea lion, Western	*Eumetopias jubatus*	Endangered

Key Marine Mammal Stocks Not Listed by ESA			
Species/stock name		**ZMRG**	**Stock status[b]**
Common name	**Scientific name**		
None			

Key Sea Turtle Populations		
Species/stock name		**Population Status**
Common name	**Scientific name**	
Green sea turtle	*Chelonia mydas*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened

Key Seabird Populations Listed by ESA		
Species/stock name		**Population status**
Common name	**Scientific name**	
Brown pelican	*Pelecanus occidentalis*	Endangered
California least tern	*Sterna antillarum browni*	Endangered
Hawaiian dark-rumped petral	*Pterodroma phaeopygia sandwichensis*	Endangered
Least tern, Interior population	*Sterna antillarum*	Endangered
Marbled murrelet, CA, OR, WA	*Brachyramphus marmoratus marmoratus*	Threatened
Newell's Townsend's shearwater	*Puffinus auricularis newelli*	Threatened
Short-tailed albatross	*Phoebastria albatrus*	Endangered

Key Seabird Populations Not Listed by ESA			
Species/stock name		**Bycatch concern**	**Population status**
Common name	**Scientific name**		
Black-footed albatross	*Phoebastria nigripes*	Yes	Stable/Increasing/ Decreasing[c]

[a] Several species are listed multiple times, as they are members of multiple fish groups. However, each species is counted only once as a key stock.
[b] Stock status based on NMFS marine mammal stock assessments (Caretta, Forney, Lowry, et al. 2007).
[c] Different colonies of black-footed albatross have different population trends (see Naughton et al. 2008a).

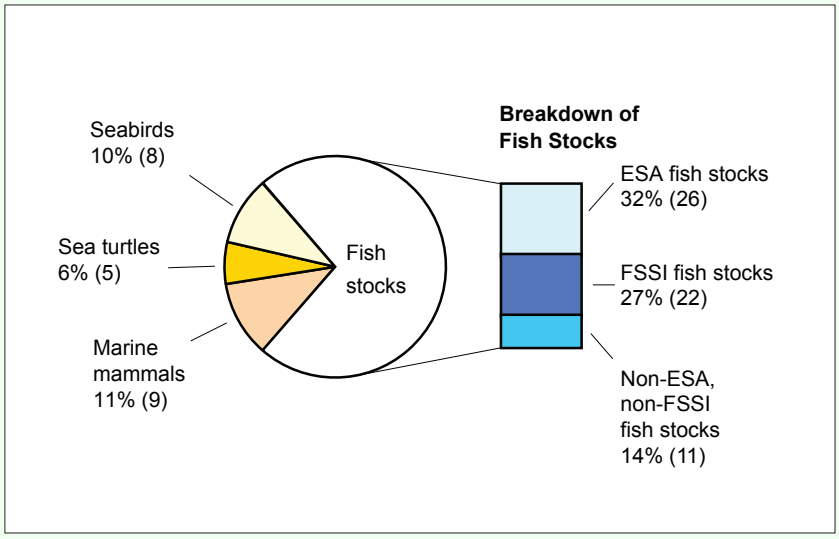


Figure 4.4.3
Key stocks in the Northwest Region, by resource type (*n* = 81).

The majority of key fish stocks were added through the quantitative analysis process, as described in Section 3. Several fish stocks were also added through the qualitative process. A number of FSSI groundfish stocks—arrowtooth flounder (*Atheresthes stomias*), black rockfish (*Sebastes melanops*), cabezon (*Scorpaenicthys marmoratus*), Dover sole (*Microstomus pacificas*), English sole (*Parophrys vetulus*), lingcod (*Ophiodon elongates*), longspine thornyhead (*Sebastolobus altivelis*), Pacific ocean perch (*Sebastes alutus*), petrale sole (*Eopsetta jordanii*), shortspine thornyhead (*Sebastolobus alascanus*), and unspecified skate—were added through the qualitative process, due to their importance as either catch or bycatch. The need to monitor discard of Pacific halibut and Dungeness crab, which are targets of important state fisheries, led the Northwest Region to add both species to the list of key stocks.

The remaining 22 stocks are composed of 8 seabird populations (7 ESA-listed), 9 ESA-listed marine mammal populations, and 5 sea turtle populations (all sea turtles are ESA-listed; Figure 4.4.3). Note that the brown pelican (*Pelecanus occidentalis*) was delisted in 2009 due to its recovery; however, it is listed in this report as an ESA species for consistency with the timeframe of the data and management regulations discussed herein. Of the nine ESA-listed marine mammal key stocks, six are cetaceans, two are pinnipeds (Steller sea lion, eastern and western U.S. populations, which are listed separately under the ESA as distinct population segments), and one is a mustalid (California sea otter). Both populations of Steller sea lions may be taken in Northwest Regional fisheries, but the two cannot be differentiated without genetic sampling. One non-ESA-listed population of seabird, the black-footed albatross (*Phoebastria nigripes*), was added through the qualitative process. The black-footed albatross is also on the USFWS list of Birds of Conservation Concern.

4.4.7. Northwest Region Bycatch Estimates

Bycatch estimates were provided for 3 marine mammal stocks, all sea turtle populations, 6 seabird populations, and 53 fish stocks found in the Northwest Region.

In Appendix 4.4, Tables A and B list fish bycatch estimates by fishery and species. Fish discard estimates were provided for seven of the nine fisheries in the Northwest Region with Federal or shared management or relevant Federal data-collection programs. Fish discard estimates were not available for the remaining fisheries with Federal or shared management: California halibut trawl, West Coast non-tribal Pacific halibut longline, and West Coast mid-water trawl for hake with shoreside processing.

As discussed in Section 4.4.4, fish groups (e.g., deeper nearshore species) were used, as well as individual species. Members of species groups are listed in Appendix I of this report. Bycatch of two salmon species were provided in numbers of individuals, in accordance with current reporting requirements and the salmon fishery management structure. Individual number-to-weight conversions were not available.

Appendix 4.4, Tables C, D, and E list bycatch estimates by fishery for marine mammals, sea turtles, and seabirds. All fisheries with Federal observer data that have no recorded takes of marine mammals, sea turtles, or seabirds have estimates of zero for those bycatch types. Bycatch estimates of marine mammals and seabirds in Pacific Coast ocean salmon fisheries were not available; however, these fisheries have minimal impact on marine mammals (PFMC 2000; NMFS 2003) and are listed as Category III fisheries under the MMPA.

It should be noted that discard estimates provided in the U.S. National Bycatch Report appear higher than those used in regional total mortality reporting. This is in part due to the fact that regional total mortality reports apply discard mortality rates (DMRs) to some species or species groups, unlike the discard estimates provided in this report, which do not.

4.4.8 Bycatch Estimate Improvement Plans for Northwest Region Fisheries

Bycatch data collection and estimation improvement plans were developed for the seven Northwest fisheries with Federal management or relevant Federal data-collection programs, for which bycatch is currently estimated:

- West Coast groundfish non-trawl gear: limited-entry sablefish-endorsed fixed gear
- West Coast groundfish non-trawl gear: non-endorsed fixed gear
- West Coast groundfish limited-entry bottom trawl: groundfish bottom trawl
- West Coast mid-water trawl for whiting, at-sea processing
- California/Oregon nearshore rockfish
- West Coast salmon troll, non-tribal ocean
- West Coast salmon troll, tribal ocean

These fisheries were identified through the quantitative process as having bycatch of key species and/or high overall bycatch levels.

4.4.8.1 Bycatch Estimation Improvement Plans for Northwest Fisheries of Focus

General Recommendations

In addition to maintaining current coverage levels for all fisheries monitored by WCGOP and A-SHOP, the Northwest Regional team recommends funding to allow for dedicated staff analyst time to complete the following tasks for all WCGOP observed fisheries:

- Improve estimation methods by incorporating improvements for linking and tracking permits with landing receipts.
- Improve estimation methods by including measures of uncertainty for finfish bycatch.
- Explore alternative methods of improving analyses of marine mammal and seabird bycatch data.

These are feasible recommendations and can be implemented through providing additional time for a data analyst to explore and develop potential new methods.

4.4.8.2 Fishery-Specific Improvements

California/Oregon Nearshore Rockfish

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- Increased coverage of this fishery by the WCGOP is desired for improved characterization of fleet-wide discard and bycatch.
- The potential observer effect on observed vessels compared to non-observed vessels has yet to be resolved.
- Fishery landings data are still difficult to identify and define for this fishery overall.
- Appropriate depth stratification of fishing effort in this fishery is also challenging.
- A method is currently lacking for calculating a coefficient of variance or other measure of uncertainty.

Recommendations:

- The Northwest Regional team has recommended increasing observer coverage of this fishery: this is a feasible recommendation since the WCGOP already provides some fishery coverage and has, therefore, already implemented the infrastructure to collect bycatch data.
- It was recommended that additional sources of fishery data for improving estimation methods be explored: this is a feasible recommendation and can be implemented through providing additional time for data analysts to develop collaborations with state agencies and develop new methods based on incorporation of information found in state nearshore logbook data, or on a tracking system for state landings data.
- Improving the estimation methods to include measures of uncertainty was also recommended.

Ed Bowlby, NOAA

A rockfish swims among deep-sea coral off the Washington State coast.

West Coast Groundfish Limited-Entry Bottom Trawl: Groundfish Bottom Trawl

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- A method is currently lacking for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest team has recommended improving the estimation method to include measures of uncertainty for estimates of finfish discard.
- It was recommended to explore alternative methods of improving analyses of marine mammal and seabird bycatch data.

West Coast Groundfish Non-Trawl Gear: Limited-Entry Sablefish-Endorsed Fixed Gear

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- The fishery has not previously tracked the limited-entry permit number on landing receipts to assist in determination of landings specific to this fishery and to assist in the determination of vessel participation in this fishery. Recent regulations (2007) now require the permit number to be listed on landing receipts to assist in tracking catch and landings for each permit associated with this fishery.
- Estimation methods will need to be further adapted to incorporate the improved tracking of landings and vessel participation.
- This fishery lacks a method for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest team recommends adapting the estimation method to incorporate the use of landing receipts to link and track permits.
- It was recommended that the estimation method be improved to include measures of uncertainty for estimates of finfish discard.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Groundfish Non-Trawl Gear: Non-Endorsed Fixed Gear

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- Increased coverage of this fishery by the WCGOP is desired for improved characterization of fleet-wide discard and bycatch.

- A method is currently lacking for calculating a CV or other measure of uncertainty.

Recommendations:

- The Northwest Regional team has recommended increasing observer coverage of this fishery: this is a feasible recommendation since the WCGOP already provides some fishery coverage and has, therefore, already implemented the infrastructure to collect bycatch data. However, depending on recent coverage (during 2007), current rates may be high enough and no further increase would be needed.

- It was recommended that the estimation method be improved to include measures of uncertainty for estimates of finfish discard.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Mid-Water Trawl for Whiting, At-Sea Processing

Tier Scores: Fish = 2; Marine Mammals = 2; Other Protected Species = 2

Bycatch and data-collection concerns:

- At-sea monitoring to collect potential discard information is not currently in place for catcher vessels delivering to mother ships.

Recommendations:

- The Northwest Regional team has recommended testing and deployment of EM systems aboard all at-sea catcher vessels.

- Exploring alternative methods to improve analyses of marine mammal and seabird bycatch data was also recommended.

West Coast Salmon Troll, Non-Tribal Ocean

Tier Scores: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Formerly limited state and tribal observer programs covering the ocean salmon fisheries have been discontinued due to lack of funding. This eliminates the ability to estimate discard with any scientific basis or accuracy.

- A genetic stock identification (GSI) program is feasible for Chinook salmon and would provide estimates of the stock composition of discards, though there is not a perfect match between stocks that can be discriminated with GSI and those of fishery management and ESA concern.

Recommendations:

- The Northwest Regional team has recommended restoring and expanding observer programs, including non-lethal tissue collection for GSI, from discards. A minimal program could be implemented for approximately 750 observer DAS, not including resources required for processing genetic samples. Obtaining adequate sample sizes may be an issue, given recent catch rates and current salmon abundance.

West Coast Salmon Troll, Tribal Ocean

Tier Scores: Fish = 1; Marine Mammals = 0; Other Protected Species = 0

Bycatch and data-collection concerns:

- Formerly limited state and tribal observer programs covering the ocean salmon fisheries have been discontinued due to lack of funding. This eliminates the ability to estimate discard with any scientific basis or accuracy.

- A GSI program is feasible for Chinook salmon and would provide estimates of the stock composition of discards, though there is not a perfect match between stocks that can be discriminated with GSI and those of fishery management and ESA concern.

Recommendations:

- The Northwest Regional team has recommended restoring state and tribal monitoring observer programs. Based on the requirements of the previous program, the tribal portion of the observer program could be implemented

with 83 DAS per year. This would be a minimal program, and obtaining adequate sample sizes may be an issue, given the catch rates associated with current salmon abundance.

4.4.8.3 Summary of Northwest Region Recommendations

Table 4.4.5 outlines bycatch data collection and estimation improvements recommended by the Northwest Region. In addition to maintaining current coverage levels for observed fisheries, a total of seven recommendations are made. All recommendations are specific to a particular fishery, with the exception of the team's recommendation to fund additional data analyst time to improve estimation methods for WCGOP-observed fisheries. This recommendation has several components and applies to multiple fisheries. The cost of maintaining current coverage levels for Northwest observer programs was $5.941M (including $ 0.390M in industry funding) in FY 2008. The total known requirements to meet regional recommendations are one full-time staff member and 1,855 DAS per year. The feasibility of implementing these recommendations, as evaluated by the Northwest Regional team, is included in Table 4.4.5.

Table 4.4.5
Summary of the Northwest Region's recommendations and estimated needs for implementation in terms of full-time staff and observer DAS.[a] All requirements are annual unless otherwise indicated; ** denotes no additional resource requirements. For further discussion of recommendations, see Section 5.8.

Recommendation[a]	Additional DAS[b]	Feasibility
Maintain observer coverage levels on all currently observed fisheries.	**	High
Fund additional data analyst time to improve estimation methods for WCGOP.	NA	High
Increase observer coverage for the West Coast groundfish non-trawl gear, non-endorsed fixed gear fishery.	167	High
Explore additional sources of data for improving estimation methods in the CA/OR nearshore rockfish fishery.	NA	High
Increase observer coverage of the CA/OR nearshore rockfish fishery.	625	High
Test and deploy EM systems aboard all West Coast mid-water trawls for whiting, at-sea catcher vessels.	225	High
Restore and expand observer programs for the West Coast non-tribal ocean salmon troll fishery.	750	Moderate
Restore and expand state and tribal observer programs for the West Coast tribal ocean troll fishery.	83	Moderate
Number of new full-time staff needed to implement all data-quality and estimation method improvements recommended by the Northwest Region:	1	
Total DAS requirement for all recommendations*:	1,850	

* This amount is in addition to the annual requirements of Northwest Regional observer programs.
[a] Some recommendations may require additional resource expenditures, such as equipment, which are not itemized.
[b] One observer DAS includes the cost for the observer deployment as well as costs for associated equipment and program administrative functions (staffing).

Appendix 4.4 Northwest Region Bycatch Estimates

Table 4.4.A
Subtables showing annual fish bycatch estimates and coefficient of variation (CV), where available, for Northwest fisheries. Bycatch estimates are in pounds or number of individuals. Key stocks are shaded. * following the name of a stock group (members of which are described in Appendix I) indicates a fishery for which bycatch estimates were available only for the generalized stock group. Fishery bycatch ratios = bycatch / (bycatch + landings).

Subtable 4.4.A.1		CA/OR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black rockfish	*Sebastes melanops*	2005	12,125.41	Pounds	
Blue rockfish	*Sebastes mystinus*	2005	7,716.17	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	132.28	Pounds	
Cabezon	*Scorpaenichthys marmoratus*	2005	71,429.69	Pounds	
California sheephead	*Semicossyphus pulcher*	2005	40,565.01	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	8,465.74	Pounds	
Deeper nearshore species*		2005	27,557.78	Pounds	
Kelp greenling	*Hexagrammos decagrammus*	2005	21,825.74	Pounds	
Lingcod	*Ophiodon elongatus*	2005	119,732.91	Pounds	
Other minor nearshore rockfish, north*	Sebastidae	2005	1,543.23	Pounds	
Shallow nearshore species*		2005	20,943.89	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	198.42	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	3,813.99	Pounds	
TOTAL FISHERY BYCATCH			336,050.23	Pounds	
TOTAL FISHERY LANDINGS			894,561.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			1,230,611.23	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/TOTAL CATCH)			0.27		

Table 4.4.A (continued)

Subtable 4.4.A.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	115,963.01	Pounds	
Big skate	*Raja binoculata*	2005	63,933.98	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	220.46	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	0.00	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	0.00	Pounds	
Cowcod	*Sebastes levis*	2005	0.00	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	661.39	Pounds	
Dover sole	*Microstomus pacificus*	2005	4,409.25	Pounds	
Dungeness crab	*Cancer magister*	2005	1,543.24	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	14,991.42	Pounds	
Longnose skate	*Raja rhina*	2005	69,665.99	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 3*	Pleuronectiformes	2005	0.00	Pounds	
Other groundfish 3*		2005	11,464.02	Pounds	
Other shelf rockfish 3*	Sebastidae	2005	20,062.04	Pounds	
Other slope rockfish 3*	Sebastidae	2005	24,912.21	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	3,306.93	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	440.92	Pounds	
Pacific whiting	*Merluccius productus*	2005	881.85	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	537,927.28	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	1,543.23	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	197,974.88	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	0.00	Pounds	
Tanner crab	*Chionoecetes* spp.	2005	9,920.79	Pounds	
Unspecified skate 1*	Rajidae	2005	26,675.90	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	1,102.31	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	1,102.31	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	661.39	Pounds	
TOTAL FISHERY BYCATCH			1,109,364.78	Pounds	
TOTAL FISHERY LANDINGS			4,925,940.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			6,035,304.78	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.18		

Table 4.4.A (continued)

Subtable 4.4.A.3		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	48,942.56	Pounds	
Big skate	*Raja binoculata*	2005	26,675.90	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	661.39	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	0.00	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	0.00	Pounds	
Cowcod	*Sebastes levis*	2005	0.00	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	440.92	Pounds	
Dover sole	*Microstomus pacificus*	2005	3,086.47	Pounds	
Dungeness crab	*Cancer magister*	2005	881.85	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	6,172.94	Pounds	
Longnose skate	*Raja rhina*	2005	40,785.47	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 3*		2005	0.00	Pounds	
Other groundfish 3*		2005	6,393.40	Pounds	
Other shelf rockfish 3*	Sebastidae	2005	8,377.56	Pounds	
Other slope rockfish 3*	Sebastidae	2005	10,361.71	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	1,322.77	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	220.46	Pounds	
Pacific whiting	*Merluccius productus*	2005	440.92	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	315,260.66	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	661.39	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	104,719.45	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	0.00	Pounds	
Tanner crab	Chionoecetes	2005	7,716.17	Pounds	
Unspecified skate 1*	Rajidae	2005	11,243.56	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	440.92	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	440.92	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	220.46	Pounds	
TOTAL FISHERY BYCATCH			595,467.85	Pounds	
TOTAL FISHERY LANDINGS			3,498,089.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			4,093,556.85	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.15		

Table 4.4.A (continued)

Subtable 4.4.A.4		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	3,079,854.14	Pounds	
Big skate	*Raja binoculata*	2005	244,712.82	Pounds	
Black rockfish	*Sebastes melanops*	2005	2,204.62	Pounds	
Blackgill rockfish	*Sebastes melanostomus*	2005	4,409.24	Pounds	
Bocaccio	*Sebastes paucispinis*	2005	61,067.97	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	47,619.79	Pounds	
Chilipepper rockfish	*Sebastes goodei*	2005	114,640.24	Pounds	
Cowcod	*Sebastes levis*	2005	3,086.47	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	52,249.49	Pounds	
Dover sole	*Microstomus pacificus*	2005	1,446,232.44	Pounds	
Dungeness crab	*Cancer magister*	2005	559,974.15	Pounds	
English sole	*Parophrys vetulus*	2005	665,795.24	Pounds	
Lingcod	*Ophiodon elongatus*	2005	844,369.46	Pounds	
Longnose skate	*Raja rhina*	2005	1,404,342.94	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	202,825.04	Pounds	
Other flatfish 1*	Pleuronectiformes	2005	1,611,577.22	Pounds	
Other groundfish 1*		2005	3,359,840.88	Pounds	
Other nearshore rockfish	Sebastidae	2005	0.00	Pounds	
Other shelf rockfish 1*	Sebastidae	2005	178,574.22	Pounds	
Other slope rockfish 1*	Sebastidae	2005	59,524.74	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	8,818.48	Pounds	
Pacific halibut	*Hippoglossus stenolepis*	2005	954,172.76	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	23,809.90	Pounds	
Pacific whiting	*Merluccius productus*	2005	1,812,197.64	Pounds	
Petrale sole	*Eopsetta jordani*	2005	121,254.10	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	1,155,220.88	Pounds	
Shortbelly rockfish	*Sebastes jordani*	2005	2,204.62	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	293,214.46	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	2,352,329.54	Pounds	
Splitnose rockfish	*Sebastes diploproa*	2005	317,465.28	Pounds	
Tanner crab	Chionoecetes	2005	555,564.24	Pounds	
Unspecified skate 1*	Rajidae	2005	304,237.56	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	7,275.25	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	1,322.77	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	63,933.98	Pounds	
TOTAL FISHERY BYCATCH			21,915,920.18	Pounds	
TOTAL FISHERY LANDINGS			42,728,085.00	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			64,644,005.18	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.34		

Table 4.4.A (continued)

Subtable 4.4.A.5		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Arrowtooth flounder	*Atheresthes stomias*	2005	0.00	Pounds	
Canary rockfish	*Sebastes pinniger*	2005	881.85	Pounds	
Darkblotched rockfish	*Sebastes crameri*	2005	8,818.48	Pounds	
Dover sole	*Microstomus pacificus*	2005	0.00	Pounds	
Dungeness crab	*Cancer magister*	2005	0.00	Pounds	
English sole	*Parophrys vetulus*	2005	0.00	Pounds	
Lingcod	*Ophiodon elongatus*	2005	3,306.93	Pounds	
Longspine thornyhead	*Sebastolobus altivelis*	2005	0.00	Pounds	
Other flatfish 2*	Pleuronectiformes	2005	2,204.62	Pounds	
Other groundfish 2*		2005	0.00	Pounds	
Other shelf rockfish 2*	Sebastidae	2005	2,204.62	Pounds	
Other slope rockfish 2*	Sebastidae	2005	17,636.96	Pounds	
Pacific cod	*Gadus macrocephalus*	2005	0.00	Pounds	
Pacific ocean perch	*Sebastes alutus*	2005	440.92	Pounds	
Pacific whiting	*Merluccius productus*	2005	1,223,564.10	Pounds	
Petrale sole	*Eopsetta jordani*	2005	0.00	Pounds	
Sablefish	*Anoplopoma fimbria*	2005	11,023.10	Pounds	
Shortspine thornyhead	*Sebastolobus alascanus*	2005	0.00	Pounds	
Spiny dogfish	*Squalus acanthias*	2005	110,231.00	Pounds	
Tanner crab	Chionoecetes	2005	0.00	Pounds	
Unspecified skate 2*	Rajidae	2005	2,204.62	Pounds	
Widow rockfish	*Sebastes entomelas*	2005	118,388.09	Pounds	
Yelloweye rockfish	*Sebastes ruberrimus*	2005	0.00	Pounds	
Yellowtail rockfish	*Sebastes flavidus*	2005	105,821.76	Pounds	
TOTAL FISHERY BYCATCH			1,606,727.05	Pounds	
TOTAL FISHERY LANDINGS			279,653,842.38	Pounds	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			281,260,569.43	Pounds	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.01		

Table 4.4.A (continued)

Subtable 4.4.A.5		WEST COAST SALMON TROLL, NON-TRIBAL OCEAN			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Chinook salmon	*Oncorhynchus tshawytscha*	2005	157,200.00	Individuals	
Coho salmon	*Oncorhynchus kisutch*	2005	27,400.00	Individuals	
TOTAL FISHERY BYCATCH			184,600.00	Individuals	
TOTAL FISHERY LANDINGS			629,600.00	Individuals	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			814,200.00	Individuals	
FISHERY BYCATCH RATIO (BYCATCH/TOTAL CATCH)			0.23		

Subtable 4.4.A.6		WEST COAST SALMON TROLL, TRIBAL OCEAN			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Chinook salmon	*Oncorhynchus tshawytscha*	2005	13,200.00	Individuals	
Coho salmon	*Oncorhynchus kisutch*	2005	2,600.00	Individuals	
TOTAL FISHERY BYCATCH			15,800.00	Individuals	
TOTAL FISHERY LANDINGS			65,800.00	Individuals	
TOTAL FISHERY CATCH (BYCATCH + LANDINGS)			81,600.00	Individuals	
FISHERY BYCATCH RATIO (BYCATCH/ TOTAL CATCH)			0.19		

Table 4.4.B

Summary of Northwest Region fish bycatch by stocks and species. Key stocks are shaded. Where data were available, species bycatch ratios were calculated using the following formula: species bycatch ratio = bycatch of all substocks/(bycatch of all substocks + species landings). * Landings are not available for species groups, as it was not possible to determine the exact composition of the bycatch group and the proportion of bycatch and landings to allocate to each species. **Bycatch ratios could not be developed when bycatch estimates were provided either as numbers of individuals or as both individuals and pounds, or where landings were not available.

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Arrowtooth flounder	*Atheresthes stomias*	All Northwest Region bycatch estimates are provided at the species level.		3,244,759.71	Pounds	4,921,775.00	Pounds	0.40
Big skate[a]	*Raja binoculata*			335,322.70	Pounds	–	–	**
Black rockfish	*Sebastes melanops*			14,330.03	Pounds	390,830.00	Pounds	0.04
Blackgill rockfish	*Sebastes melanostomus*			5,291.09	Pounds	119,722.00	Pounds	0.04
Blue rockfish	*Sebastes mystinus*			7,716.17	Pounds	42,134.00	Pounds	0.15
Bocaccio	*Sebastes paucispinis*			61,200.25	Pounds	15,797.00	Pounds	0.79
Cabezon	*Scorpaenichthys marmoratus*			71,429.69	Pounds	131,988.00	Pounds	0.35
California sheephead	*Semicossyphus pulcher*			40,565.01	Pounds	88,287.00	Pounds	0.31
Canary rockfish	*Sebastes pinniger*			56,967.38	Pounds	26,671.00	Pounds	0.68
Chilipepper rockfish	*Sebastes goodei*			114,640.24	Pounds	146,380.00		0.44
Chinook salmon	*Oncorhynchus tshawytscha*			170,400.00	Individuals	12,992,711.00	Pounds	**
Coho salmon	*Oncorhynchus kisutch*			30,000.00	Individuals	5,005,112.00	Pounds	**
Cowcod	*Sebastes levis*			3,086.47	Pounds	85.00	Pounds	0.97
Darkblotched rockfish	*Sebastes crameri*			62,170.28	Pounds	188,740.00	Pounds	0.25
Deeper nearshore species*				27,557.75	Pounds	–	–	**
Dover sole	*Microstomus pacificus*			1,453,726.43	Pounds	15,204,016.00	Pounds	0.09
Dungeness crab	*Cancer magister*			562,398.56	Pounds	60,674,411.00	Pounds	0.01
English sole	*Parophrys vetulus*			665,795.24	Pounds	2,426,006.00	Pounds	0.22
Kelp greenling	*Hexagrammos decagrammus*			21,825.74	Pounds	49,991.00	Pounds	0.30
Lingcod	*Ophiodon elongatus*			988,573.66	Pounds	448,785.00	Pounds	0.69
Longnose skate[a]	*Raja rhina*			1,514,794.40	Pounds	–	–	**
Longspine thornyhead	*Sebastolobus altivelis*			202,825.04	Pounds	1,463,267.00	Pounds	0.12
Other flatfish 1*	Pleuronectiformes			1,611,577.22	Pounds	–	–	**
Other flatfish 2*	Pleuronectiformes			2,204.62	Pounds	–	–	**

Table 4.4.B (continued)

		TOTAL STOCK BYCATCH		TOTAL SPECIES BYCATCH		SPECIES LANDINGS		SPECIES BYCATCH RATIO
COMMON NAME	SCIENTIFIC NAME	AMOUNT	UNIT	AMOUNT	UNIT	2005 LANDINGS	UNIT	RATIO
Other flatfish 3*	Pleuronectiformes	All Northwest Region bycatch estimates are provided at the species level.		0.00	Pounds	–	–	**
Other groundfish 1*				3,359,840.88	Pounds	–	–	**
Other groundfish 2*				0.00	Pounds	–	–	**
Other groundfish 3*				17,857.42	Pounds	–	–	**
Other minor nearshore rockfish - north*	Sebastidae			1,543.23	Pounds	–	–	**
Other nearshore rockfish	Sebastidae			0.00	Pounds	–	–	**
Other shelf rockfish 1*	Sebastidae			178,574.22	Pounds	–	–	**
Other shelf rockfish 2*	Sebastidae			2,204.62	Pounds	–	–	**
Other shelf rockfish 3*	Sebastidae			28,439.60	Pounds	–	–	**
Other slope rockfish 1*	Sebastidae			59,524.74	Pounds	–	–	**
Other slope rockfish 2*	Sebastidae			17,636.96	Pounds	–	–	**
Other slope rockfish 3*	Sebastidae			35,273.92	Pounds	–	–	**
Pacific cod	*Gadus macrocephalus*			13,448.18	Pounds	1,997,855.00	Pounds	0.01
Pacific halibut	*Hippoglossus stenolepis*			954,172.76	Pounds	2,305,632.00	Pounds	0.29
Pacific ocean perch	*Sebastes alutus*			24,912.20	Pounds	112,561.00	Pounds	0.18
Pacific whiting	*Merluccius productus*			3,037,084.51	Pounds	237,592,889.00	Pounds	0.01
Petrale sole	*Eopsetta jordani*			121,254.10	Pounds	6,026,883.00	Pounds	0.02
Sablefish	*Anoplopoma fimbria*			2,019,431.92	Pounds	13,717,108.00	Pounds	0.13
Shallow nearshore species*				20,943.89	Pounds	–	–	**
Shortbelly rockfish[b]	*Sebastes jordani*			2,204.62	Pounds	–	–	**
Shortspine thornyhead	*Sebastolobus alascanus*			295,419.08	Pounds	1,375,932.00	Pounds	0.18
Spiny dogfish	*Squalus acanthias*			2,765,254.87	Pounds	1,207,583.00	Pounds	0.70
Splitnose rockfish[a]	*Sebastes diploproa*			317,465.28	Pounds	–	Pounds	**
Tanner crab[b]	Chionoecetes			573,201.20	Pounds	–	–	
Unspecified skate 1*	Rajidae			342,157.02	Pounds	–	–	**
Unspecified skate 2*	Rajidae			2,204.62	Pounds	–	–	**
Widow rockfish	*Sebastes entomelas*			127,404.99	Pounds	236,018.00	Pounds	0.35
Yelloweye rockfish	*Sebastes ruberrimus*			6,679.99	Pounds	–	–	**
Yellowtail rockfish	*Sebastes flavidus*			170,637.59	Pounds	1,685,646.00	Pounds	0.09

[a] It was not possible to allocate landings to species.
[b] Species is not targeted and is not landed or rarely landed.

Table 4.4.C

Subtables showing marine mammal bycatch estimates for Northwest Region fisheries. All bycatch estimates and coefficients of variation (CVs) are in number of individuals. Bycatch estimates are from the year 2005 exclusively and reflect incidental mortality and serious injury. Key stocks and populations are shaded.

Subtable 4.4.C.1		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
California sea lion	*Zalophus californianus*	2005	14.0	Individuals	0.41
TOTAL FISHERY BYCATCH			14.0	Individuals	

Subtable 4.4.C.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All marine mammal species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.C.3		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
California sea lion	*Zalophus californianus*	2005	19.7	Individuals	0.45
TOTAL FISHERY BYCATCH			19.7	Individuals	

Subtable 4.4.C.4		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
Steller sea lion	*Eumetopias jubatus*	2005	2.4	Individuals	0.30
Harbor seal	*Phoca vitulina*	2005	1.2	Individuals	0.42
TOTAL FISHERY BYCATCH			3.6	Individuals	

Subtable 4.4.C.5		CA/OR FOR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All marine mammal species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.C.6 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
California sea lion	*Zalophus californianus*	33.7	Individuals
Harbor seal	*Phoca vitulina*	1.2	Individuals
Steller sea lion	*Eumetopias jubatus*	2.4	Individuals
TOTAL FISHERY BYCATCH		37.3	Individuals

Table 4.4.D
Subtables showing sea turtle bycatch estimates (mortalities + individuals released alive) for Northwest Region fisheries. Shading indicates key species. All bycatch estimates are in number of individuals. Bycatch estimates are from the year 2005 exclusively.

Subtable 4.4.D.1		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.3		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.4		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.5		CA/OR FOR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**NUMBER**	**UNIT**	**CV**
All sea turtle species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Subtable 4.4.D.6 (SUMMARY)		TOTAL SPECIES BYCATCH	
COMMON NAME	**SCIENTIFIC NAME**	**NUMBER**	**UNIT**
All sea turtle species		0	Individuals

Table 4.4.E

Subtables showing seabird bycatch estimates for Northwest fisheries. All bycatch estimates and coefficients of variation (CVs) are in number of individuals. Bycatch estimates are from the year 2005 exclusively. Key stocks/populations are shaded.

Subtable 4.4.E.1		WEST COAST GROUNDFISH NON-TRAWL GEAR: LIMITED-ENTRY SABLEFISH-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black-footed albatross	*Phoebastria nigripes*	2005	56.8	Individuals	0.40
TOTAL FISHERY BYCATCH			56.8	Individuals	

Subtable 4.4.E.2		WEST COAST GROUNDFISH NON-TRAWL GEAR: NON-ENDORSED FIXED GEAR			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Brown pelican	*Pelecanus occidentalis*	2005	35.6	Individuals	1.00
TOTAL FISHERY BYCATCH			35.6	Individuals	

Subtable 4.4.E.3		WEST COAST LIMITED-ENTRY BOTTOM TRAWL; GROUNDFISH BOTTOM TRAWL			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Unidentified gull	Laridae	2005	3.8	Individuals	0.86
TOTAL FISHERY BYCATCH			3.8	Individuals	

Subtable 4.4.E.4		WEST COAST MID-WATER TRAWL FOR WHITING, AT-SEA PROCESSING			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
Black-footed albatross	*Phoebastria nigripes*	2005	2.0	Individuals	
Common murre	*Uria aalge*	2005	2.0	Individuals	
Northern fulmar	*Fulmarus glacialis*	2005	2.0	Individuals	
Sooty shearwater	*Puffinus griseus*	2005	2.0	Individuals	
Unidentified sea bird	Laridae	2005	2.0	Individuals	
TOTAL FISHERY BYCATCH			10.0	Individuals	

Subtable 4.4.E.6		CA/OR FOR NEARSHORE ROCKFISH			
COMMON NAME	**SCIENTIFIC NAME**	**DATA SOURCE**	**AMOUNT**	**UNIT**	**CV**
All seabird species		2005	0	Individuals	
TOTAL FISHERY BYCATCH			0	Individuals	

Table 4.4.E (continued)

Subtable 4.4.E.7 (SUMMARY)		**TOTAL SPECIES BYCATCH**	
COMMON NAME	**SCIENTIFIC NAME**	**AMOUNT**	**UNIT**
Black-footed albatross	*Phoebastria nigripes*	58.8	Individuals
Brown pelican	*Pelecanus occidentalis*	35.6	Individuals
Common murre	*Uria aalge*	2.0	Individuals
Northern fulmar	*Fulmarus glacialis*	2.0	Individuals
Sooty shearwater	*Puffinus griseus*	2.0	Individuals
Unidentified gull	Laridae	3.8	Individuals
Unidentified seabird		2.0	Individuals
TOTAL FISHERY BYCATCH		106.2	Individuals