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## Observed and Estimated Total Bycatch of Green Sturgeon and Eulachon in the 2002-2009 US West Coast Fisheries

NOAA



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## Introduction

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The primary objective of this report is to provide bycatch estimates of non-salmonid fish species listed under the Endangered Species Act (ESA) in U.S. West Coast groundfish fisheries from 2002-2009. We present observer discard ratios and estimated catch amounts (in number of individual fish) for two species: green sturgeon (*Acipenser medirostris*) and eulachon (*Thaleichthys pacificus*). The southern distinct population segment of North American green sturgeon was listed as threatened under the ESA in 2006 (71 FR 17757) and critical habitat was designated in 2009 (74 FR 52300). The North American green sturgeon southern distinct population segment (DPS) is defined as coastal and Central Valley populations, south of the Eel River in California. The southern distinct population segment of eulachon was listed as threatened under the ESA in 2010 (75 FR 13012). The eulachon southern DPS is defined from the Mad River in northern California (inclusive), north to the Skeena River in British Columbia (inclusive). This report includes estimates for all fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP) that were recorded to have caught these species from 2002-2009. These include:

- Commercial limited entry (LE) bottom trawl (green sturgeon and eulachon)
- Commercial LE bottom trawl – targeting California halibut (green sturgeon)
- Commercial open access (OA) bottom trawl – targeting California halibut (green sturgeon)
- Commercial shrimp trawl (Oregon and California) (eulachon)
- At-sea Pacific hake/whiting mothership (green sturgeon and eulachon)
- At-sea Pacific hake/whiting tribal mothership (green sturgeon and eulachon)
- At-sea Pacific hake/whiting catcher-processor (eulachon)

Fisheries observed by the WCGOP and A-SHOP which did not have any observed bycatch of green sturgeon or eulachon during this period included:

- Commercial LE fixed gear sablefish primary (tier endorsed)
- Commercial LE fixed gear non-primary sablefish (non-endorsed)
- Commercial OA fixed gear
- Commercial fixed gear state-permitted nearshore (Oregon and California)

## Data sources

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Data sources for this analysis include onboard observer data (from the WCGOP and A-SHOP), trawl logbook data, and landing receipt data (referred to as fish tickets). Discard estimation analyses focused on commercial fishery sectors in which the Northwest Fishery Science Center (NWFSC) Fishery Resource Analysis and Monitoring Division (FRAM) has conducted scientific at-sea observation of discards.

The WCGOP and the A-SHOP observe distinct sectors of the groundfish fishery. The WCGOP observes a number of different sectors of the groundfish fishery, including the limited entry (LE) groundfish bottom trawl, limited entry and open access (OA) fixed gear, state-permitted nearshore fixed gear sectors. The WCGOP also observes several fisheries that incidentally catch groundfish, including the California halibut trawl and pink shrimp trawl fisheries. Observations by the A-SHOP are from the federally permitted sector

targeting Pacific hake using mid-water trawl gear which processes catch at-sea. More information on each of these sectors is available in annual reports produced by the A-SHOP and WCGOP ([www.nwfsc.noaa.gov/research/divisions/fram/observer/](http://www.nwfsc.noaa.gov/research/divisions/fram/observer/)). Furthermore, for a list of groundfish sectors that are not covered by either program, see the description of observer coverage provided by Bellman et al. (2010) in the annual report on estimated total mortality of groundfish species.

Observers were first deployed in the at-sea hake sector in the late 1970s under the management of the North Pacific Groundfish Observer Program at NOAA's Alaska Fishery Science Center. The A-SHOP, now at NOAA's Northwest Fisheries Science Center, places fishery observers on all vessels that process Pacific hake at-sea. The at-sea hake sector consists of ten to fifteen catcher-processor vessels and motherships that begin fishing in mid-May of each year and continue until the hake quota is reached or until bycatch caps are met. All at-sea hake vessels (catcher-processors and motherships) over 125 feet are required to carry two observers, while vessels under 125 feet carry only one. At-sea hake observers monitor and record catch data in accordance with protocols detailed in the A-SHOP manual (NWFSC 2009a).

The WCGOP was established in 2001 by NOAA Fisheries (National Marine Fisheries Service, NMFS) (66 FR 20609). All commercial vessels that land groundfish caught in the United States Exclusive Economic Zone (EEZ) from 3-200 miles offshore are required to carry an observer when notified to do so by NMFS or its designated agent. Subsequent state rule-making also requires vessels that fish for groundfish within 3 miles of shore or participate in other state-managed fisheries to carry WCGOP observers when notified. The WCGOP's goal is to improve total catch estimates by collecting information on the discarded catch (fish returned overboard at-sea) of west coast groundfish species. The WCGOP coverage plan details program goals, vessel selection, observer coverage, and basic data collection (NWFSC 2006). A list of fisheries in order of coverage priority and detailed information on data collection methods employed in each observed fishery can be found in the WCGOP manual (NWFSC 2009b).

The sampling protocol employed by the WCGOP is primarily focused on the discarded portion of catch. To ensure that the recorded weights for the retained portion of the observed catch are accurate, haul-level retained catch amounts recorded by WCGOP observers are reconciled with trip-level fish ticket records. The WCGOP data are linked to fish tickets by fish ticket number(s) obtained by the observer and are adjusted so that the total trip pounds of retained fish equals the total trip pounds on the fish ticket. This is done because the fish ticket weight is more accurate and fish tickets are legally binding documents. These steps are described in further detail in annual reports produced by the WCGOP ([www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/index.cfm](http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/index.cfm)) and were conducted prior to the analyses presented in this report. All additional data processing steps that were applied to the WCGOP data during the discard estimation process are described in the methods section below.

When green sturgeon are encountered on an observed vessel by the WCGOP, observers document length and general condition, take photographs, scan for scute markings and tags, and take a tissue sample. If the specimen is dead, the observer will also take a fin ray sample and determine sex. However, all green sturgeon observed by the WCGOP have been live fish. Biological data for green sturgeon have previously been summarized in WCGOP data reports for each fishery, which are available at: <http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/index.cfm>.

When green sturgeon are encountered in a species composition sample on an observed vessel by the A-SHOP, observers document length/weight, determine sex if possible, take photographs, visually scan for tags, and take a pectoral-fin ray sample. All green sturgeon observed by the ASHOP have been dead, due to the nature of the fishery and fishing vessel operations. At-sea hake observers follow protocols detailed in the A-SHOP manual and additional materials provided by the ASHOP program related to sturgeon sampling (NWFSC 2009a).

Logbook record-keeping is a state-mandated requirement for the LE groundfish trawl sector in Washington, Oregon, and California. A common-format logbook is used by all three states and completed logbook information is entered into state agency databases. The electronic logbook data are then submitted by state agencies to the Pacific Coast Fisheries Information Network (PacFIN) regional database, which is maintained by the Pacific States Marine Fisheries Commission (PSMFC).

Annual trawl logbook data were retrieved from the PacFIN database and subsequently divided into various sectors of the groundfish fishery as indicated in Figure 1. All additional data processing steps that were applied during the discard estimation process are described in the methods section below. Logbook data from the open access groundfish trawl sector were not included in our analyses. The only portion of the open access groundfish trawl sector which caught green sturgeon was targeting California halibut. Estimation methods only utilize seasonal strata for this state fishery, which operates in a very narrow, shallow depth range.

Records of fleet-wide landings are the cornerstone of retained catch information for all sectors of the commercial groundfish fishery on the west coast. Landing receipts, known as fish tickets, are completed by fish-buyers in each port for each delivery of fish by a vessel. Fish tickets are trip-aggregated sales receipts for market categories that may represent single or multiple species. They are issued to fish-buyers by a state agency and must be returned to the agency for processing. Fish tickets are designed by the individual states, and Washington, Oregon, and California each have a slightly different format of receipt. In addition, each state conducts species-composition sampling for numerous market categories that are reported on fish tickets. Fish ticket and species-composition data are submitted by state agencies to the PacFIN regional database. Percentages for the species composition within market categories were applied to the fish ticket data used in our analyses. As such, landed weights from sampled market categories were distributed to individual species to the greatest extent possible.

Annual fish ticket landings data were retrieved from the PacFIN database and subsequently divided into various sectors of the groundfish fishery as indicated in Figure 1. All additional data processing steps that were applied during the discard estimation process are described in the methods section below.

## **Methods**

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### **At-Sea Hake Observer Program**

All vessels fishing in the at-sea hake fishery must carry at least one A-SHOP observer, and thus further estimation to expand bycatch to the fleet-wide level was not necessary. Data was provided directly from the A-SHOP program and incorporated into Table 5 for green sturgeon bycatch and Table 10 for eulachon bycatch. Number of individual fish were reported by each at-sea hake fishery sector; tribal and non-tribal

mothership and catcher-processor. This is consistent with other reporting of prohibited species in the at-sea hake fishery.

### **West Coast Groundfish Observer Program**

A deterministic approach was used to estimate green sturgeon and eulachon bycatch for fisheries for which WCGOP observer data were available. Through this approach, observed bycatch rates for green sturgeon and eulachon were directly expanded to the fleet-wide level. First, bycatch ratios were computed from observer data as the catch (in numbers) of green sturgeon or eulachon divided by the retained weight of either all groundfish (except Pacific hake) or California halibut, depending on fishery. Denominators differed for each fishery based on targeting behavior of that fishery. Bycatch ratios were then multiplied by the total fleet-wide landed weight of groundfish, California halibut, or pink shrimp (depending on the denominator used to compute observed bycatch ratios). This provided an expanded estimate of fleet-wide green sturgeon or eulachon bycatch (in numbers). Because of differences in data availability and management structure among the various fisheries, this approach was applied with slight modifications for each sector. A more detailed discussion of the methodology used to estimate bycatch within each fishery is presented below.

### **Limited Entry Bottom Trawl Fishery**

Fleet-wide green sturgeon and eulachon bycatch estimates for the LE bottom (non-midwater) trawl fishery were derived from WCGOP observer data, fish ticket landings data, and trawl logbook data. Fish ticket and logbook data were isolated for this sector based on processing steps outlined in Figure 1. A summary of observer data for the 2009 LE bottom (non-midwater) trawl sector is presented in a WCGOP data report published in October 2010 (NWFSC 2010a).

LE bottom trawl vessels that hold a California halibut bottom trawl permit may participate in the state-permitted California halibut fishery. California halibut tows can occur on the same trip as tows targeting groundfish and were identified in logbook and observer data based on the following criteria: 1) the reported tow target was California halibut or 2) the tow target was nearshore mix, sand sole, or other flatfish, and the tow took place in less than 30 fathoms and south of 40°10' N. latitude. All tows in the observer and logbook data that met at least one of the above requirements were removed from the LE bottom trawl data sets and included as data for the California halibut fishery (see below). Whether in observer or logbook data, tow target was typically determined by the vessel captain.

Several additional filtering steps were then applied to the data in order to ensure that we had distinguished the data set for the LE bottom trawl sector appropriately. First, we investigated fish ticket data for landings of more than 2 mt of Pacific hake on a given day, in order to remove them and thus exclude effort that was targeted exclusively towards this species. A similar check was performed on the observer and logbook data, such that tows with more than 2 mt of retained Pacific hake were flagged for removal. On the basis of the Pacific hake catch criterion, five observed tows and one logbook tow met the criterion and all were removed from the 2009 data before analyses.

Next, trawl logbook and observer data were filtered to ensure that all spatial and temporal information was complete. Any tows lacking a recorded depth or latitude were removed. None of the tows in the 2009 observer data met these criteria. However, 13 tows were removed from the 2009 logbook data set due to a lack of depth information.

Observer data and trawl logbook data were then stratified by state of vessel landing and season. Catch of green sturgeon and eulachon typically occurs in a shallow and limited depth range, and additional stratification by fishing depth was therefore unnecessary (Figure 2 and 3). Once both data sets had been stratified, bycatch ratios were computed from the observer data and multiplied by logbook catch weights in each stratum. This was done according to the following equation:

$$D_{asb} = \frac{\sum_t d_{ast}}{\sum_t r_{ast}} \times \sum_t R_{asbt}$$

where:

- a*: state of landing (Washington, Oregon or California)
- s*: season (winter: Nov - Apr / summer: May - Oct)
- b*: bimonthly period (Jan-Feb, Mar-Apr, ... , Nov-Dec)
- t*: tows in observer or logbook data
- d*: observed number of green sturgeon or eulachon caught
- r*: observed retained weight of all FMP groundfish except Pacific hake
- R*: weight of retained FMP groundfish (except Pacific hake) recorded in logbooks
- D*: initial bycatch estimate for state *a*, season *s*, and bimonthly period *b*

Note that the denominator of observed bycatch ratios and the logbook expansion factor included weight from all FMP groundfish retained weight except Pacific hake. Pacific hake was excluded when using the retained FMP groundfish denominator because vessels that target or land large amounts of this species are considered to be part of Pacific hake sectors, which are distinct from the groundfish bottom trawl sector. A complete listing of groundfish species included in the Pacific Coast Groundfish Fishery Management Plan and used to compute and expand bycatch ratios is provided in Appendix A. Observed numbers and bycatch ratios by state of landing and season in the LE bottom trawl fishery are presented for green sturgeon in Table 1 and for eulachon in Table 6.

In all cases where FMP groundfish were used to compute bycatch ratios, any retained weights that were recorded by the observer but that did not appear on fish tickets were excluded from the denominator. This was necessary to prevent double-counting associated with differences in the species codes used by observers and processors. For instance, while observers may record rockfish catch at the species level, various species of rockfish are often grouped, weighed, and recorded together on the fish ticket by the processor under a grouped species code such as NUSP - northern unspecified slope rockfish. In some cases, this difference in species coding prevents observer and fish ticket weights from being matched and adjusted properly. Species coding on fish tickets varies considerably between processors and over time, and it is not possible to make assumptions regarding which individual observer-recorded species likely coincide with species grouping codes on fish tickets. Instead, by using only the retained groundfish weight from fish tickets in bycatch ratio denominators, we prevent double-counting of retained weights. This is not a factor when using a single species in the denominator, such as California halibut in the California halibut bottom trawl fishery (see below), as any retained weights in observer and fish ticket data that share the same species code will match and adjust properly.

Although retained logbook weights of FMP groundfish (excluding Pacific hake) were initially used to expand observed bycatch ratios to the fleet-wide level in this fishery, logbooks are not submitted for 100% of trawl

trips and therefore do not capture all groundfish bottom trawl fishing effort. As a result, it was necessary to adjust initial fleet-level bycatch estimates to reflect the level of effort indicated by fish ticket landings. To do this, both the fish ticket and logbook data were aggregated by state and bimonthly period, to be consistent with cumulative trip limit periods. An adjustment ratio was then computed for each state and bimonthly period as the weight of FMP groundfish (except Pacific hake) recorded on fish tickets divided by that recorded in logbooks. Each adjustment ratio was multiplied by coinciding bycatch estimates and then summed across bimonthly periods and states to produce coast-wide adjusted bycatch estimates for each species:

$$adj(\hat{D}_{sa}) = \sum_b \hat{D}_{sab} \times \frac{F_{ab}}{R_{ab}}$$

where:

$F$ : weight of retained FMP groundfish (except Pacific hake) recorded on fish tickets

$adj(D_{sa})$ : adjusted bycatch estimate in season  $s$  and state  $a$

Adjustment ratios were computed separately for each state and bimonthly period to account for differences between individual states' logbook submission rates and fish ticket recording methods. An adjustment ratio value less than 1 indicated that more FMP groundfish weight was recorded in logbooks than on fish tickets. Conversely, adjustment ratios greater than 1 occurred when fish ticket FMP groundfish weights were larger than logbook weights. In 2009, the value of the adjustment ratios computed for the LE bottom trawl sector ranged between 0.959 and 1.331, with a mean of 1.062.

Estimated bycatch amounts for green sturgeon in the limited entry bottom trawl fishery during 2002-2009 are reported in Table 2, and for eulachon in Table 7.

### California Halibut Bottom Trawl Fishery

Fleet-wide green sturgeon bycatch estimates in the California halibut bottom trawl fishery were derived from WCGOP observer data and fish ticket landings data. Although all California halibut vessels are permitted by the state of California, we considered this fishery to consist of both a limited entry and an "open access" component (vessels that do not have federal limited entry groundfish permits). The WCGOP provides observer coverage for both of these components. Observer data for the LE component of the California halibut fishery were collected as part of the LE groundfish bottom trawl sector. Observer data for the California halibut fishery were then subsequently isolated based on the following criteria: 1) the tow target was California halibut or 2) the tow target was nearshore mix, sand sole or other flatfish, and the tow took place in less than 30 fathoms, south of 40°10' N. latitude. All tows in the observer data set that met at least one of the above requirements were included in the LE California halibut bottom trawl dataset. The WCGOP randomly samples the OA California halibut sector separately. This is described further in a WCGOP data report published in October 2010 (NWFSC 2010b). These two components of the California halibut trawl fishery remained separate in this analysis.

Bycatch ratios were computed for this fishery using the retained weight of California halibut in the denominator. The total landed weight of California halibut was then used as a multiplier to expand observed green sturgeon bycatch ratios to the fleet-wide level. To isolate fish tickets from trips on which California halibut was targeted, landings were only compiled from fish tickets that had greater than 150 lbs of California halibut during the period 2002-2006.

Starting in 2007, the state of California required that vessels participating in the LE and OA trawl fisheries have a California halibut bottom trawl permit in order to land more than 150 lbs of this target species. Therefore, for 2007, landed California halibut weight in the OA sector was compiled from “non-midwater” OA trawl fish tickets (see Figure 1) for those vessels that had a state-issued California halibut bottom trawl permit only. For the LE sector in 2007, landed California halibut weight was still compiled from non-midwater LE trawl fish tickets (see Figure 1) with more than 150 lbs of California halibut recorded. This was done because a small number of LE vessels that were not included on the California halibut permit list provided to the WCGOP landed large amounts of California halibut in 2007.

By 2008, state California halibut bottom trawl permits for both the LE and OA trawl sectors effectively represented all vessels targeting California halibut. Thus, landed California halibut weight for both the LE and OA sectors was compiled from non-midwater trawl fish tickets for those vessels that had a state-issued California halibut bottom trawl permit in 2008 and 2009.

Table 3 presents the total LE and OA landed weights of California halibut that were used as multipliers to expand observer bycatch ratios to the fleet-wide level. Bycatch ratios were computed by dividing the observed bycatch (in numbers) of green sturgeon by the observed retained weight (mt) of California halibut. Bycatch estimates were computed for each sector based on the following equation:

$$\hat{D}_s = \frac{\sum_t d_{st}}{\sum_t r_t} \times F_s$$

where:

$s$ : season

$t$ : observed tows

$d$ : observed bycatch (number) of green sturgeon

$r$ : observed retained weight (mt) of California halibut

$F$ : weight (mt) of retained California halibut recorded on fish tickets in season  $s$

$D$ : bycatch estimate for season  $s$

The product of bycatch ratios and the total fish ticket landed weight of California halibut produced expanded fleet-level bycatch estimates of green sturgeon for each fishery component (LE and OA). These estimates are presented in Table 4.

Although FMP groundfish and California halibut weights from the same fish tickets were used to adjust initial LE groundfish bottom trawl estimates and to expand bycatch ratios for the LE California halibut fleet, this is not anticipated to be a major source of bias in our analysis, as the primary species retained on observed California halibut tows were non-groundfish (NWFSC 2010b). However, since some flatfish species were retained on these tows, it is possible that estimates for the shallowest strata in California for the LE groundfish bottom trawl sector could have been positively biased due to slightly larger adjustment ratios (caused by the inclusion of landed flatfish weight that was in fact caught on California halibut tows). Examination of the species composition on fish tickets in the areas where California halibut is typically landed suggests that the impact of this is minor.

## **Pink Shrimp Trawl Fishery**

Fleet-wide eulachon bycatch estimates in the Oregon and California pink shrimp trawl fisheries were derived from WCGOP observer data and fish ticket landings data. Fish ticket data were assigned to these fisheries using the classification system outlined in Figure 1. A summary of the observer data for the 2009 Oregon and California pink shrimp trawl fisheries and other fishery-relevant information can be found in a WCGOP data report published in October 2010 (NWFSC 2010c). Annual pink shrimp fisheries occur from April to October. The WCGOP began coverage of Washington pink shrimp licenses in 2010, with the same criteria used for Oregon and California state pink shrimp coverage. For analysis purposes, only trips by shrimp vessels landing in/returning to a particular state are considered part of that state's pink shrimp fishery. This definition is consistent with state management.

Bycatch ratios for these fisheries were calculated by dividing the observed bycatch of eulachon (in numbers) by the observed retained weight (mt) of pink shrimp (Table 8). The total landed weight of pink shrimp was then used as a multiplier to expand observed eulachon bycatch ratios for this fishery to the fleet-wide level. The equation for the expansion of bycatch ratios in the pink shrimp fishery is identical to that presented for the California halibut fishery, but where  $r$  represents the retained weight of pink shrimp and  $F$  represents the weight of retained pink shrimp recorded on fish tickets, with no seasonal stratification.

The product of bycatch ratios and the total fish ticket landed weight of pink shrimp produced expanded fleet-level bycatch estimates of eulachon for each state fishery. These estimates are presented in Table 9.

## **Results**

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### **Green Sturgeon**

A summary of green sturgeon bycatch in all U.S. West Coast groundfish fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP) from 2002-2009 is provided in Table 5. Green sturgeon bycatch was estimated for all fisheries monitored by the WCGOP in which green sturgeon were observed. Estimates were not provided for the OA sector of the California halibut fishery in 2002 or 2006 because this sector was not observed during these years.

The largest amounts of green sturgeon bycatch were estimated in the limited entry sector of the California halibut fishery. Fishing in this sector primarily takes place in depths of less than 30 fathoms in fishing grounds adjacent to San Francisco Bay, California. LE vessels participating in this fishery hold a federal limited entry groundfish permit, and may target groundfish or California halibut on different tows within the same fishing trip. The largest estimate of green sturgeon bycatch in the LE sector of the California halibut fishery occurred in 2006, when 786 individuals were estimated to have been caught (Table 4). In that year, the largest number of green sturgeon (108 individuals) were observed on LE vessels during California halibut tows during the winter season (Table 3). Total green sturgeon bycatch in 2002 and 2006 (Table 5) should be interpreted as the lowest possible estimate of bycatch for that year because WCGOP did not observe the OA CA Halibut fishery in those years.

Overall, estimated green sturgeon bycatch from 2003 through 2006 was higher, in contrast with more recent bycatch estimates from 2007 through 2009 (Table 5). A dramatic reduction in total California halibut landings in the LE sector of the fishery occurred in 2007 relative to prior years. LE California halibut landings remained at a low level with only a slight increase in 2009 relative to 2007 (48.3 mt in 2009; 39.2 in

2007 and 2008) (Table 3). OA sector landings were also lower in 2007 than in the two years prior, but have increased since then. The highest OA sector landings during this time series were reported in 2009 (85.4 mt) (Table 3). A larger portion of LE California halibut landings are observed during the winter, while the larger portion of OA California halibut landings are observed during the summer season.

Green sturgeon bycatch in the at-sea hake fishery is very low, as the At-sea Hake Observer Program has only recorded a total of 3 green sturgeon from 2002-2009 (Table 5).

While we provide estimates for the total number of green sturgeon caught in groundfish fisheries on the U.S. West coast, we have not applied rates of discard survivorship to these estimates. Research indicates that green sturgeon may be susceptible to some level of discard mortality, particularly when encounters with fishing gear occur in higher temperature environments and last for longer periods of time (D. Erickson, University of Miami, personal communication). Handling mortality of sturgeon has been evaluated with various harvest methods in the Columbia and Rogue rivers (ODFW 2005, NMFS 2005). These studies indicate that discard mortality may be between 1 and 6%. However, it would be inappropriate to apply these mortality rates in the present analysis due to differences in gear type and the marine habitat of green sturgeon in coastal groundfish fisheries (O. P. Langness, Washington Department of Fish and Wildlife, personal communication). Information on the mortality of green sturgeon caught as bycatch in trawl fisheries on the West Coast is not currently available, and it is unclear what proportion of captured individuals survive.

The depth distribution of all tows encountering green sturgeon bycatch (2002-2009, all fisheries combined) indicates that this species is most likely to be encountered in tows from 5 to 45 fathoms, but have been observed in tows as deep as 65 fathoms (maximum average-depth value) (Figure 2). However, the largest number of individual fish have been caught between 5 to 30 fathoms, with the majority of fish observed between 5 to 10 fathoms. Therefore, tows from 30 to 65 fathoms are still likely to encounter green sturgeon, but in much smaller numbers. Green sturgeon critical habitat is designated from 0 to 60 fathoms (74 FR 52300). Only one tow was observed to encounter green sturgeon bycatch with an average depth of >60 fm.

Since 2007, the WCGOP has collected lengths, general condition, photographs, and tissue samples from all green sturgeon observed, as well as sexes and fin ray samples from all dead individuals. All green sturgeon observed by the WCGOP have been live fish. Information regarding biosampling procedures for green sturgeon is available in the WCGOP observer training manual (NWFSC 2009b). The length frequency distribution of green sturgeon bycatch in the LE and OA sectors of the California halibut fishery from 2007 through April 2010 is presented in Figure 4. Based on age-length relationships presented by Beamesderfer et al. (2007), individuals observed as bycatch appear to be less than 15 years of age. Green sturgeon age at maturity is cited from several sources to range from approximately 8-18 years for males and 13-27 years for females (Beamesderfer et al. 2007).

## **Eulachon**

A summary of eulachon bycatch in all U.S. West Coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP) from 2002-2009 is provided in Table 10. Eulachon bycatch was estimated for all fisheries observed by the WCGOP in which eulachon were reported. Estimates were not provided for the pink shrimp trawl fisheries in 2002, 2003, and 2006 because these fisheries were not observed during these years.

This is the first report of eulachon bycatch in the at-sea hake groundfish fishery, as it has not traditionally been reported with other protected species. Eulachon appears to be encountered as bycatch in the catcher-processor sector of the fishery more than other sectors (Table 10). The highest eulachon bycatch in this mid-water trawl fishery was in 2006 with 145 individuals. In contrast, no eulachon were observed as bycatch in the bottom trawl fishery during 2006. The estimates of eulachon bycatch in 2002, 2003, and 2006 (Table 10) should be interpreted as the lowest possible estimates because pink shrimp fisheries were not observed in those years and they traditionally contribute the largest proportion to eulachon bycatch estimates.

The depth distribution of all tows encountering eulachon bycatch (2002-2009, all WCGOP fisheries combined) indicates that this species is most likely to be encountered in tows from 50 to 100 fathoms (Figure 3). However, the largest number of individual fish have been caught between 60 to 85 fathoms. Therefore, tows from 85 to 100 fathoms or 20 to 50 fathoms are still likely to encounter eulachon, but in much smaller numbers.

The largest amounts of eulachon bycatch were estimated in the Oregon pink shrimp trawl fishery. The largest estimate of eulachon bycatch occurred in 2009, when 861, 888 individuals were estimated to have been caught (Table 9). In 2009, the largest number of eulachon (63,174 individuals) were observed in the fishery, though fleet-wide landings were down slightly from the prior year (Table 8). The lowest number of eulachon observed was in 2004 (11,290 individuals).

A mapped representation of the spatial distribution of eulachon bycatch encounters in the Oregon pink shrimp fishery is provided in Figure 6. All observations in the fishery were mapped as points using coordinates for an average latitude and average longitude calculated from the start and end location of tows. The observations were overlaid with a 10 x 10 km grid of cells, with the number of vessels summarized in each cell. Observer data within grid cells with less than 3 vessels were removed from the analysis to ensure confidentiality. The remaining data were then the basis for a density calculation (parameters: radius 4 sq km, output cell size 300 m x 300 m) to provide a summary area of observations. Tows which encountered eulachon bycatch were also removed from those cells with less than 3 vessels to ensure confidentiality and the remaining tows were the basis for a density calculation to provide a representation of where eulachon encounters are most frequent. The density results were classified into 4 categories (zero values excluded) basically representing a scale from low, moderate, to high bycatch encounters of eulachon.

Fleet-wide pink shrimp landings in the California pink shrimp fishery are much lower than in the Oregon fishery (Table 8) and eulachon bycatch is also lower. The range of eulachon bycatch in California extends from the highest number of eulachon individuals observed in 2008 (5,907 individuals), down to zero eulachon observed in 2005 and 2009.

Point estimates fluctuate due to a number of non-biological factors, including annual variation in observer coverage rates, fishing behavior, and various physical characteristics. In addition, several sources of uncertainty that were not accounted for in this analysis may influence green sturgeon and eulachon bycatch estimates. These include uncertainty in logbook data, fish ticket landings, as well as others. Currently, it is not possible to quantify uncertainty for bycatch estimates presented in this report, as measures of the variability associated with various data sources are not available. As with all point estimates, green sturgeon and eulachon bycatch values presented here should be considered with caution.

## Acknowledgements

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The authors gratefully acknowledge the hard work and dedication of observers from the West Coast Groundfish Observer Program and the At-Sea Hake Observer Program, as well as contributions from observer program staff and Jonathan Cusick. We would like to thank Dan Erickson, Olaf Langness, and Susan Wang for their guidance on sturgeon discard survivorship rates and related research.

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chlbtwl\_report\_2009\_final.pdf

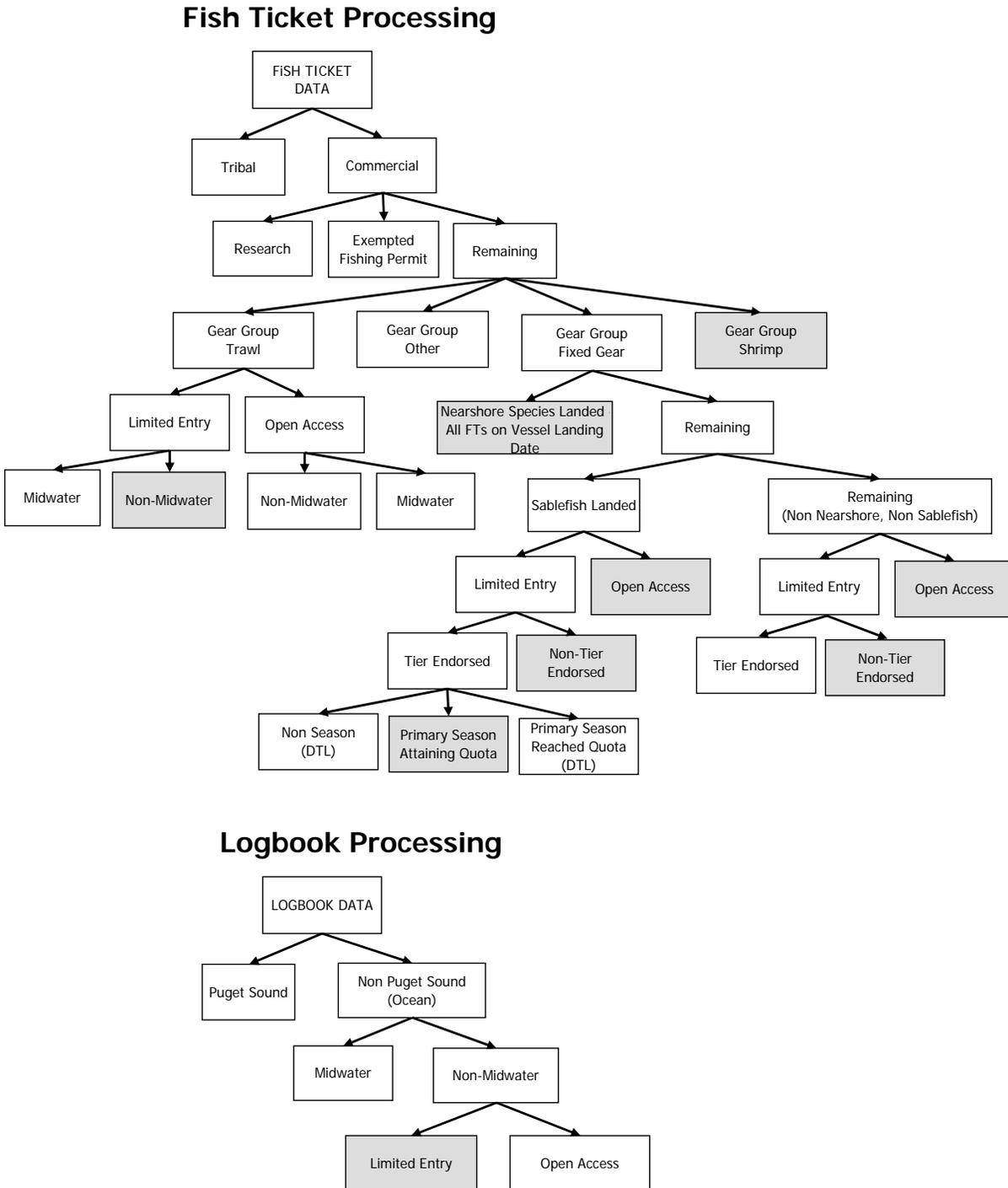
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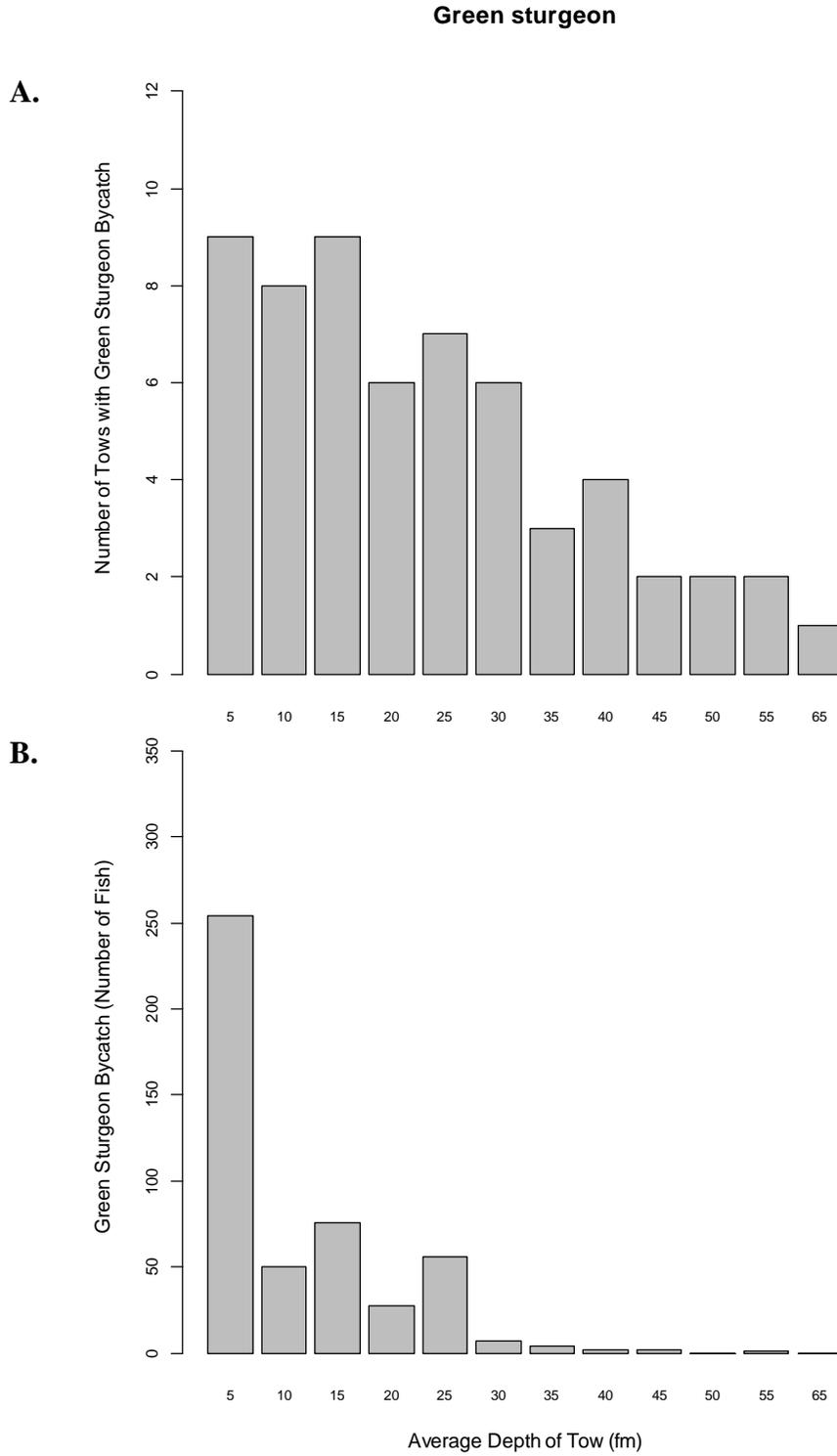
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## Figures

**Figure 1.** Fish ticket and logbook data processing for division into groundfish fishery sectors after retrieval of a full calendar year data set from the Pacific Coast Fisheries Information Network (PacFIN) database. Grey highlight indicates sectors for which federal observer data is available.



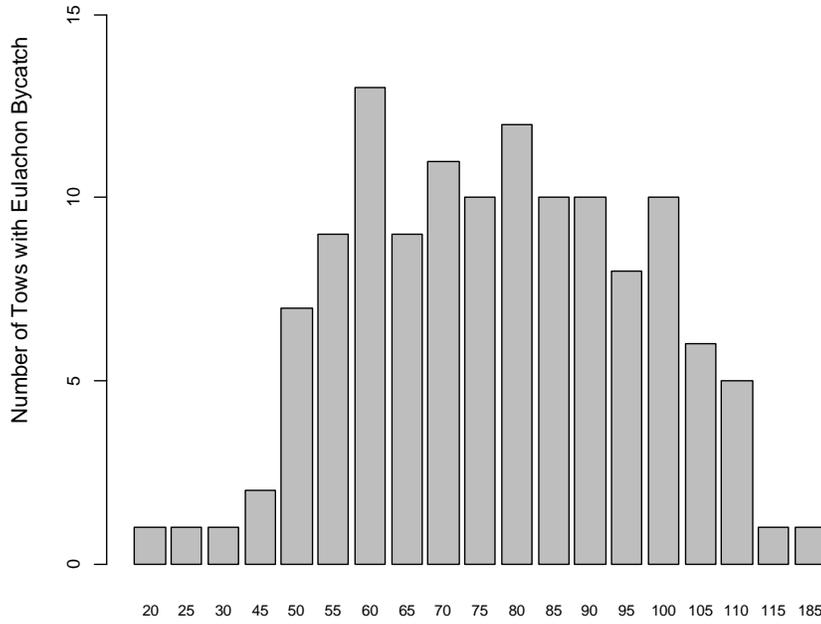
**Figure 2.** Depth distribution of A.) tows encountering green sturgeon bycatch and B.) the number of individual green sturgeon observed by the West Coast Groundfish Observer Program from 2002 through 2009.



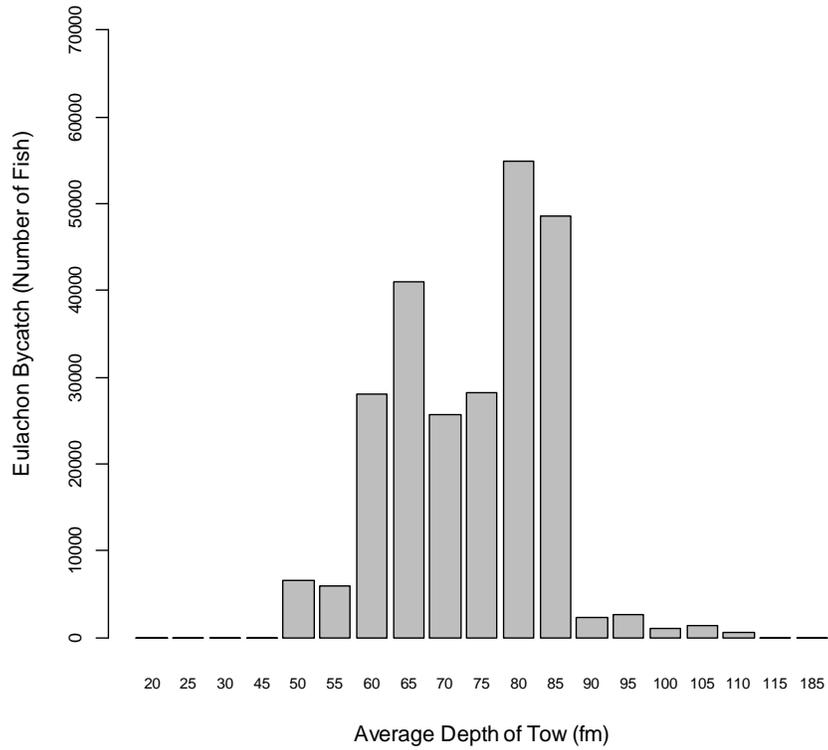
**Figure 3.** Depth distribution of A.) tows encountering eulachon bycatch and B.) the number of individual eulachon observed by the West Coast Groundfish Observer Program from 2002 through 2009.

**Eulachon**

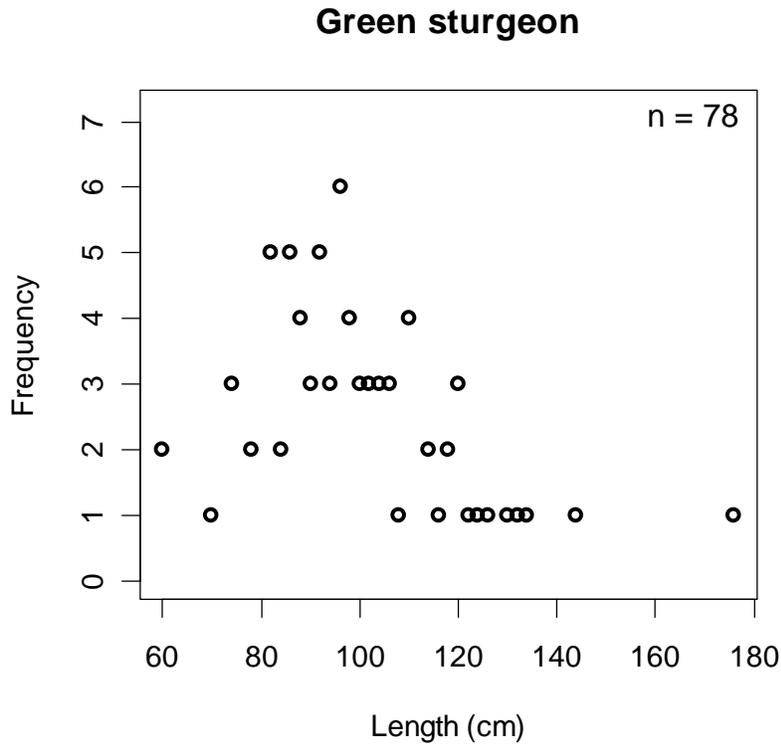
**A.**



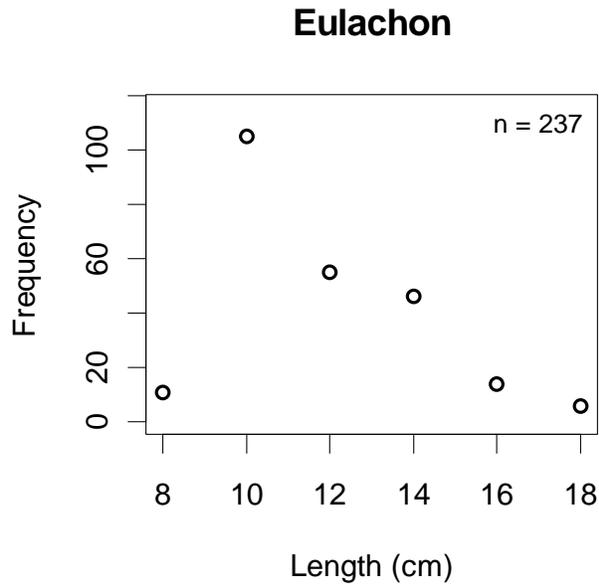
**B.**



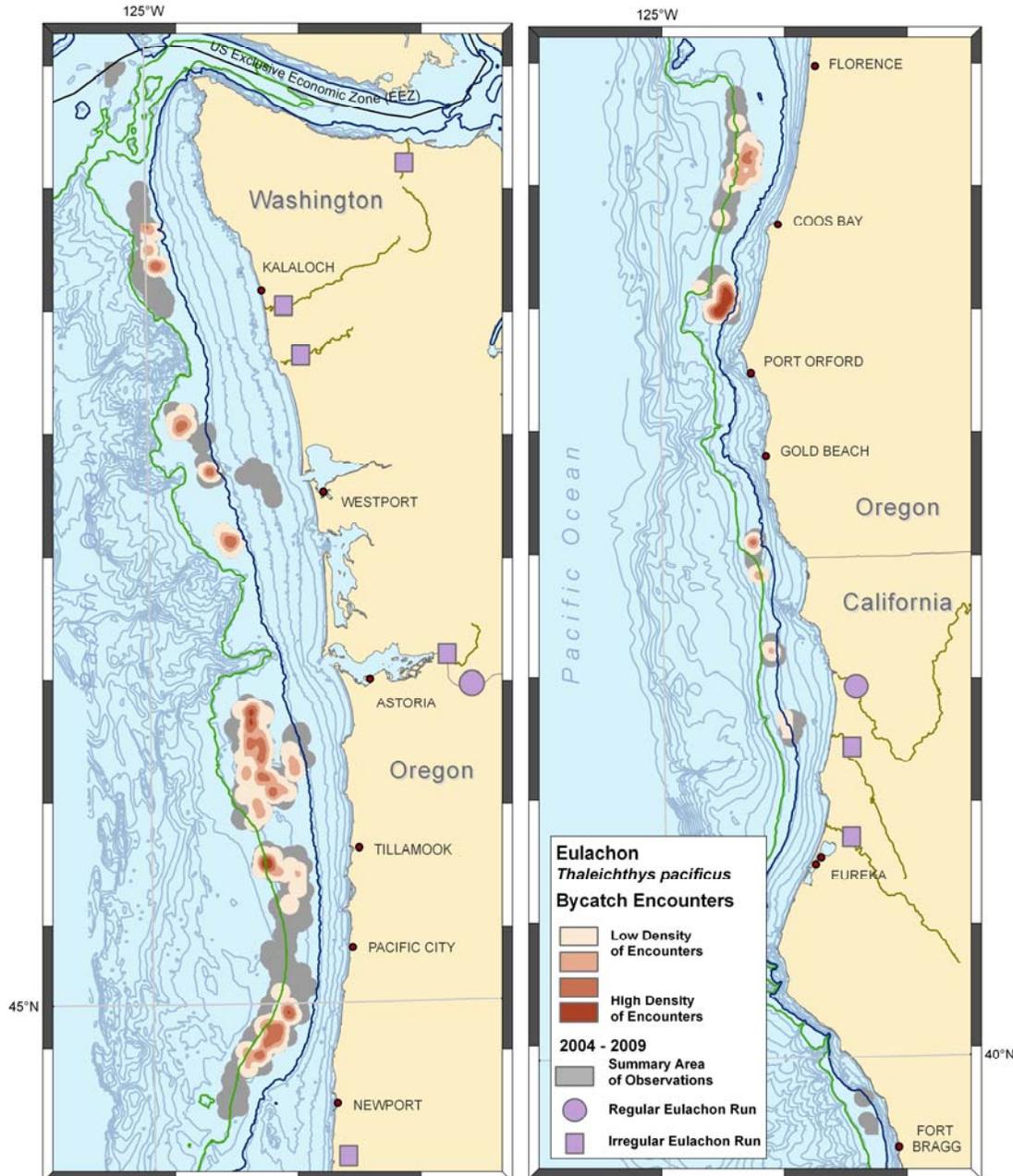
**Figure 4.** Length frequency distribution of discarded green sturgeon observed in the limited entry and open access sectors of the California halibut fishery from 2007 through April 2010.



**Figure 5.** Length frequency distribution of discarded eulachon observed in the Oregon and California pink shrimp trawl fisheries from 2009 through April 2010.



**Figure 6.** Spatial distribution of eulachon bycatch encounters in the Oregon pink shrimp fishery from 2002-2009. All observations in the fishery were mapped as points using coordinates for an average latitude and average longitude calculated from the start and end location of tows. The observations were overlaid with a 10 x 10 km grid of cells, and the data within grid cells with less than 3 vessels were removed from the analysis to ensure confidentiality. The remaining data were then the basis for a density calculation (parameters: radius 4 sq km, output cell size 300 m x 300 m). The density results were classified into 4 categories (zero values excluded) basically representing a scale from low, moderate, to high bycatch encounters of eulachon.



**West Coast Groundfish Observer Program  
Oregon Pink Shrimp Fishery**

M. Bellman  
12/20/2010



0 20 40 Kilometers  
Albers Projection NAD 83



## Tables

**Table 1.** WCGOP coverage rates, numbers of green sturgeon observed, and green sturgeon bycatch ratios from limited entry bottom trawl vessels landing in Washington, Oregon, and California from 2002-2009. Coverage rates were computed as the proportion of FMP groundfish landings that were observed (see NWFSC 2010a for more details). Bycatch ratios were calculated for each state of landing and season as the observed catch of green sturgeon (in numbers) divided by the observed weight (mt) of retained groundfish (except Pacific hake). Winter season is January-April and November-December; summer is May-October.

Year	Season	Washington			Oregon			California		
		Coverage rate	Number observed	Bycatch ratio	Coverage rate	Number observed	Bycatch ratio	Coverage rate	Number observed	Bycatch ratio
2002	winter	23%	0	0.0000	14%	1	0.0016	12%	0	0.0000
	summer	5%	1	0.0064	15%	1	0.0019	13%	0	0.0000
2003	winter	10%	0	0.0000	19%	0	0.0000	11%	0	0.0000
	summer	9%	0	0.0000	12%	0	0.0000	14%	0	0.0000
2004	winter	39%	0	0.0000	27%	0	0.0000	33%	0	0.0000
	summer	20%	0	0.0000	19%	2	0.0019	21%	1	0.0013
2005	winter	17%	0	0.0000	26%	0	0.0000	20%	0	0.0000
	summer	21%	1	0.0023	22%	1	0.0008	19%	0	0.0000
2006	winter	18%	0	0.0000	20%	1	0.0012	19%	0	0.0000
	summer	23%	0	0.0000	18%	0	0.0000	20%	0	0.0000
2007	winter	24%	0	0.0000	14%	0	0.0000	18%	0	0.0000
	summer	7%	0	0.0000	18%	1	0.0008	19%	0	0.0000
2008	winter	2%	0	0.0000	18%	0	0.0000	18%	0	0.0000
	summer	35%	0	0.0000	24%	0	0.0000	19%	0	0.0000
2009	winter	26%	0	0.0000	24%	3	0.0014	19%	0	0.0000
	summer	31%	0	0.0000	24%	6	0.0032	18%	1	0.0016

**Table 2.** Total estimated bycatch of green sturgeon in the limited entry bottom trawl fishery from 2002-2009, by state and season. Winter season is January-April and November-December and summer season is May-October.

Year	Season	Estimated green sturgeon bycatch (number of individual fish)			
		WA	OR	CA	Coastwide
2002	winter	0	7	0	7
	summer	19	6	0	25
2003	winter	0	0	0	0
	summer	0	0	0	0
2004	winter	0	0	0	0
	summer	0	10	4	14
2005	winter	0	0	0	0
	summer	4	4	0	8
2006	winter	0	5	0	5
	summer	0	0	0	0
2007	winter	0	0	0	0
	summer	0	5	0	5
2008	winter	0	0	0	0
	summer	0	0	0	0
2009	winter	0	12	0	12
	summer	0	25	5	30

**Table 3.** Number of green sturgeon observed, observed California halibut landings (mt), green sturgeon bycatch ratios, and total California halibut landings (mt) in the limited entry and open access sectors of the California halibut fishery, observed by the WCGOP from 2002 - 2009. Bycatch rates were calculated as the observed number of green sturgeon divided by the retained weight (mt) of California halibut. Winter season is January-April and November-December and summer season is May-October.

SECTOR	Number of green sturgeon observed		Observed California halibut landings (mt)		Green Sturgeon Bycatch ratio		Total California halibut landings (mt)	
	winter	summer	winter	summer	winter	summer	winter	summer
<b>Limited Entry</b>								
2002	1	0	3.6	0.0	0.2788	0.0000	68.8	36.4
2003	2	48	12.9	6.2	0.1553	7.7123	61.9	43.6
2004	0	58	14.7	16.8	0.0000	3.4526	79.9	56.5
2005	18	98	10.7	19.8	1.6771	4.9540	131.4	57.4
2006	108	0	11.1	3.2	9.7532	0.0000	80.6	38.9
2007	6	10	3.0	2.4	1.9981	4.1384	27.4	11.8
2008	43	1	9.5	0.1	4.5763	7.6021	35.8	3.4
2009	--	18	--	2.9	--	6.2121	40.8	7.6
<b>Open Access</b>								
2002 *	--	--	--	--	--	--	21.6	14.2
2003	0	4	0.1	1.8	0.0000	2.1648	18.5	7.3
2004	2	0	0.9	4.2	2.2035	0.0000	29.6	41.3
2005	6	27	2.0	5.4	2.9403	4.9552	24.1	40.4
2006 *	--	--	--	--	--	--	18.4	35.4
2007	0	0	0.8	1.9	0.0000	0.0000	8.2	30.9
2008	0	0	0.9	1.8	0.0000	0.0000	20.1	30.2
2009	0	0	0.1	0.6	0.0000	0.0000	39.3	46.1

\* A value is (--) when the fishery/strata was not observed as a whole.

The open access California halibut bottom trawl sector was not observed in 2002 or 2006.

There were no observations of the limited-entry trawl fishery targeting California halibut in the winter season of 2009.

**Table 4.** Total estimated bycatch of green sturgeon in the limited entry and open access sectors of the California halibut fishery from 2002-2009, by sector and season. Winter season is January-April and November-December and summer season is May-October.

Year	Season	Estimated green sturgeon bycatch (number of individual fish)		
		Limited Entry	Open Access	Total
2002*	winter	19	--	19
	summer	0	--	0
2003	winter	9	0	9
	summer	336	15	351
2004	winter	0	65	65
	summer	194	0	194
2005	winter	220	70	290
	summer	284	200	484
2006*	winter	786	--	786
	summer	0	--	0
2007	winter	54	0	54
	summer	48	0	48
2008	winter	163	0	163
	summer	25	0	25
2009	winter	0	0	0
	summer	47	0	47

\* A value is (--) when the fishery/strata was not observed as a whole.

The open access California halibut bottom trawl sector was not observed in 2002 or 2006.

**Table 5.** Estimated bycatch of green sturgeon (number of individual fish) in all U.S. West Coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP) from 2002-2009. Open access CA halibut fisheries were not observed in 2002 or 2006.

Year	WCGOP					A-SHOP			Green Sturgeon Total
	Limited Entry Trawl			CA Halibut		At-Sea Hake			
	WA	OR	CA	Limited Entry	Open Access	Tribal Mothership	Non-Tribal Mothership	Catcher-Processor	
2002	19	13	0	19	--	0	0	0	51
2003	0	0	0	345	15	0	0	0	360
2004	0	10	4	194	65	0	0	0	273
2005	4	4	0	504	270	1	0	0	783
2006	0	5	0	786	--	0	2	0	793
2007	0	5	0	102	0	0	0	0	107
2008	0	0	0	188	0	0	0	0	188
2009	0	37	5	47	0	0	0	0	89

\* A value is (--) when the fishery/strata was not observed as a whole.

Note: Discard survivorship rates have not been applied to these estimates for reasons cited in the text (see Results section).

**Table 6.** WCGOP coverage rates, number of eulachon observed, and eulachon bycatch ratios from limited entry bottom trawl vessels landing in Washington, Oregon, and California from 2002-2009. Coverage rates were computed as the proportion of FMP groundfish landings that were observed (see NWFSC 2010a for more details). Bycatch ratios were calculated for each state of landing and season as the observed catch of eulachon (in numbers) divided by the observed weight (mt) of retained groundfish (except Pacific hake). Winter season is January-April and November-December and summer season is May-October.

Year	Season	Washington			Oregon			California		
		Coverage rate	Number observed	Bycatch ratio	Coverage rate	Number observed	Bycatch ratio	Coverage rate	Number observed	Bycatch ratio
2002	winter	23%	0	0.0000	14%	78	0.1289	12%	0	0.0000
	summer	5%	0	0.0000	15%	39	0.0735	13%	0	0.0000
2003	winter	10%	0	0.0000	19%	10	0.0111	11%	0	0.0000
	summer	9%	0	0.0000	12%	0	0.0000	14%	0	0.0000
2004	winter	39%	0	0.0000	27%	0	0.0000	33%	0	0.0000
	summer	20%	0	0.0000	19%	0	0.0000	21%	1	0.0013
2005	winter	17%	0	0.0000	26%	0	0.0000	20%	0	0.0000
	summer	21%	0	0.0000	22%	0	0.0000	19%	0	0.0000
2006	winter	18%	0	0.0000	20%	0	0.0000	19%	0	0.0000
	summer	23%	0	0.0000	18%	0	0.0000	20%	0	0.0000
2007	winter	24%	0	0.0000	14%	0	0.0000	18%	0	0.0000
	summer	7%	0	0.0000	18%	13	0.0110	19%	0	0.0000
2008	winter	2%	0	0.0000	18%	0	0.0000	18%	0	0.0000
	summer	35%	0	0.0000	24%	0	0.0000	19%	0	0.0000
2009	winter	26%	0	0.0000	24%	0	0.0000	19%	0	0.0000
	summer	31%	0	0.0000	24%	16	0.0084	18%	0	0.0000

**Table 7.** Total estimated bycatch of eulachon in the limited entry bottom trawl fishery from 2002-2009, by state and season. Winter season is January-April and November-December and summer season is May-October.

Year	Season	Estimated eulachon bycatch (number of individual fish)			
		WA	OR	CA	Coastwide
<b>2002</b>	winter	0	552	0	552
	summer	0	267	0	267
<b>2003</b>	winter	0	51	0	51
	summer	0	0	0	0
<b>2004</b>	winter	0	0	0	0
	summer	0	0	4	4
<b>2005</b>	winter	0	0	0	0
	summer	0	0	0	0
<b>2006</b>	winter	0	0	0	0
	summer	0	0	0	0
<b>2007</b>	winter	0	0	0	0
	summer	0	72	0	72
<b>2008</b>	winter	0	0	0	0
	summer	0	0	0	0
<b>2009</b>	winter	0	0	0	0
	summer	0	67	0	67

**Table 8.** Number of eulachon observed, observed pink shrimp landings (mt), eulachon bycatch ratios, and total pink shrimp landings (mt) in the Oregon and California pink shrimp trawl fisheries, observed by the WCGOP from 2002 - 2009. Bycatch rates were calculated as the observed number of eulachon divided by the retained weight (mt) of pink shrimp. Annual pink shrimp fisheries occur between April and October.

	Number of eulachon observed	Observed pink shrimp landings (mt)	Eulachon Bycatch ratio	Total pink shrimp landings (mt)
<b>Oregon</b>				
2004	11,290	427	26.4692	5,537
2005	11,668	403	28.9635	7,159
2006*	--	--	--	5,532
2007	14,084	650	21.6689	9,129
2008	22,633	672	33.6566	11,576
2009	63,174	737	85.7712	10,049
<b>California</b>				
2004	350	91	3.8577	997
2005	0	22	0.0000	861
2006*	--	--	--	64
2007	977	23	43.0944	289
2008	5,907	133	44.3267	945
2009	0	130	0.0000	1,184

\* A value is (--) when the fishery/strata was not observed as a whole. The Oregon and California pink shrimp fisheries were not observed in 2006.

**Table 9.** Total estimated bycatch of eulachon in the Oregon and California pink shrimp trawl fisheries from 2002-2009. Annual pink shrimp fisheries occur between April and October.

Year	Estimated eulachon bycatch (number of individual fish)		
	Oregon	California	Coastwide
<b>2004</b>	146,560	3,845	150,405
<b>2005</b>	207,362	0	207,362
<b>*2006</b>	--	--	--
<b>2007</b>	197,807	12,456	210,263
<b>2008</b>	389,604	41,910	431,514
<b>2009</b>	861,888	0	861,888

\* A value is (--) when the fishery/strata was not observed as a whole.  
The Oregon and California pink shrimp fisheries were not observed in 2006.

**Table 10.** Estimated bycatch of eulachon (number of individual fish) in all U.S. West Coast fisheries observed by the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP) from 2002-2009. Pink shrimp fisheries were not observed in 2002, 2003, or 2006.

Year	WCGOP					A-SHOP			Eulachon Total
	Limited Entry Trawl			Pink Shrimp		At-Sea Hake			
	WA	OR	CA	OR	CA	Tribal Mothership	Non-tribal Mothership	Catcher- Processor	
<b>2002</b>	0	819	0	--	--	0	0	0	819
<b>2003</b>	0	51	0	--	--	0	0	0	51
<b>2004</b>	0	0	4	146,560	3,845	0	0	0	150,409
<b>2005</b>	0	0	0	207,362	0	0	0	0	207,362
<b>2006</b>	0	0	0	--	--	0	0	145	145
<b>2007</b>	0	72	0	197,807	12,456	0	4	6	210,345
<b>2008</b>	0	0	0	389,604	41,910	0	6	37	431,557
<b>2009</b>	0	67	0	861,888	0	32	6	30	862,023

\* A value is (--) when the fishery/strata was not observed as a whole.

## Appendix A

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Common and scientific names of species included in the Pacific Coast Groundfish Fishery Management Plan, as amended through Amendment 19 (PFMC 2008).

### SHARKS

Big skate, *Raja binoculata*  
California skate, *R. inornata*  
Leopard shark, *Triakis semifasciata*  
Longnose skate, *R. rhina*  
Soupfin shark, *Galeorhinus gyoferus*  
Spiny dogfish, *Squalus acanthias*

### RATFISH

Ratfish, *Hydrolagus colliei*

### MORIDS

Finescale codling, *Antimora microlepis*

### GRENADIERS

Pacific rattail, *Coryphaenoides acrolepis*

### ROUNDFISH

Cabezon, *Scorpaenichthys marmoratus*  
Kelp greenling, *Hexagrammos decagrammus*  
Lingcod, *Ophiodon elongatus*  
Pacific cod, *Gadus macrocephalus*  
Pacific whiting, (hake) *Merluccius productus*  
Sablefish, *Anoplopoma fimbria*

### FLATFISH

Arrowtooth flounder, (turbot) *Atheresthes stomias*  
Butter sole, *Isopsetta isolepis*  
Curlfin sole, *Pleuronichthys decurrens*  
Dover sole, *Microstomus pacificus*  
English sole, *Parophrys vetulus*  
Flathead sole, *Hippoglossoides elassodon*  
Pacific sanddab, *Citharichthys sordidus*  
Petrale sole, *Eopsetta jordani*  
Rex sole, *Glyptocephalus zachirus*  
Rock sole, *Lepidopsetta bilineata*  
Sand sole, *Psettichthys melanostictus*  
Starry flounder, *Platichthys stellatus*

## ROCKFISH

Includes all genera and species of the family Scopaenidae, even if not listed, that occur in the Washington, Oregon, and California area. The Scopaenidae genera are *Sebastes*, *Scorpaena*, *Sebastolobus*, and *Scorpaenodes*.

Aurora, *Sebastes aurora*  
Bank, *S. rufus*  
Black, *S. melanops*  
Black-and-yellow, *S. chrysomelas*.  
Blackgill, *S. melanostomus*  
Blue, *S. mystinus*  
Bocaccio, *S. paucispinis*  
Bronzespotted, *S. gilli*  
Brown, *S. auriculatus*  
Calico, *S. dalli*  
California scorpionfish, *Scorpaena guttata*  
Canary, *Sebastes pinniger*  
Chameleon, *S. phillipsi*  
Chilipepper, *S. goodei*  
China, *S. nebulosus*  
Copper, *S. caurinus*  
Cowcod, *S. levis*  
Darkblotched, *S. crameri*  
Dusky, *S. ciliatus*  
Dwarf-red, *S. rufianus*  
Flag, *S. rubrivinctus*  
Freckled, *S. lentiginosus*  
Gopher, *S. carnatus*  
Grass, *S. rastrelliger*  
Greenblotched, *S. rosenblatti*  
Greenspotted, *S. chlorostictus*  
Greenstriped, *S. elongatus*  
Halfbanded, *S. semicinctus*  
Harlequin, *S. variegatus*  
Honeycomb, *S. umbrosus*  
Kelp, *S. atrovirens*  
Longspine thornyhead, *Sebastolobus altivelis*  
Mexican, *Sebastes macdonaldi*  
Olive, *S. serranoides*  
Pink, *S. eos*  
Pinkrose, *S. simulator*  
Pygmy, *S. wilsoni*  
Pacific ocean perch, *S. alutus*  
Quillback, *S. maliger*  
Redbanded, *S. babcocki*  
Redstripe, *S. proriger*

Rosethorn, *S. helvomaculatus*  
Rosy, *S. rosaceus*  
Rougheye, *S. alentianus*  
Sharpchin, *S. zacentrus*  
Shortbelly, *S. jordani*  
Shortraker, *S. borealis*  
Shortspine thornyhead, *Sebastolobus alascanus*  
Silvergray, *Sebastes brevispinus*  
Speckled, *S. ovalis*  
Splitnose rockfish, *S. diploproa*  
Squarespot, *S. hopkinsi*  
Starry, *S. constellatus*  
Stripetail, *S. saxicola*  
Swordspine, *S. ensifer*  
Tiger, *S. nigrocinctus*  
Treefish, *S. serriceps*  
Vermilion, *S. miniatus*  
Widow, *S. entomelas*  
Yelloweye, *S. ruberrimus*  
Yellowmouth, *S. reedi*  
Yellowtail, *S. flavidus*

## Appendix B

Species identification codes used in the Pacific Coast Fisheries Information Network (PacFIN) database and assigned to WCGOP observer data. Columns on the far right specify which species were included in discard ratio denominators and expansion factors as groundfish, as identified in the Pacific Coast Groundfish Fishery Management Plan, or as nearshore species.

PacFIN Species ID	PacFIN Common Name	FMP Groundfish	NS Species
ALBC	ALBACORE		
AKSK	ALASKA SKATE		
AMCK	ATKA MACKEREL		
APLC	ALASKA PLAICE		
ARR1	NOM. AURORA ROCKFISH	yes	
ARRA	AURORA ROCKFISH	yes	
ART1	NOM. ARROWTOOTH FLOUNDER	yes	
ARTH	ARROWTOOTH FLOUNDER	yes	
ASKT	ALEUTIAN SKATE		
ASRK	PACIFIC ANGEL SHARK		
BABL	BLACK ABALONE		
BANK	BANK ROCKFISH	yes	
BCAC	BOCACCIO	yes	
BCC1	NOM. BOCACCIO	yes	
BCLM	BUTTER CLAM		
BGL1	NOM. BLACKGILL ROCKFISH	yes	
BHAG	BLACK HAGFISH		
BISC	BROWN IRISH LORD		yes
BKCR	BLUE KING CRAB		
BLCK	BLACK ROCKFISH	yes	yes
BLGL	BLACKGILL ROCKFISH	yes	
BLK1	NOM. BLACK ROCKFISH	yes	yes
BLPT	BLACK EELPOUT		
BLSK	BLACK SKATE		
BLU1	NOM. BLUE ROCKFISH	yes	yes
BLUR	BLUE ROCKFISH	yes	yes
BMCK	BULLET MACKEREL		
BMRL	BLUE MARLIN		
BMSL	BLUE OR BAY MUSSEL		
BNK1	NOM. BANK ROCKFISH	yes	
BRNZ	BRONZESPOTTED ROCKFISH	yes	
BRW1	NOM. BROWN ROCKFISH	yes	yes
BRWN	BROWN ROCKFISH	yes	yes
BRZ1	NOM. BRONZESPOTTED ROCKFISH	yes	
BSCL	BUFFALO SCULPIN		yes
BSJK	BLACK SKIPJACK		
BSKT	BIG SKATE	yes	
BSOL	BUTTER SOLE	yes	

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
BSRK	BLUE SHARK		
BSRM	UNSP. BAIT SHRIMP		
BTCR	BAIRDI TANNER CRAB		
BTNA	BLUEFIN TUNA		
BTRY	BAT RAY		
BYEL	BLACK-AND-YELLOW ROCKFISH	yes	yes
BYL1	NOM. BLACK-AND-YELLOW ROCKFISH	yes	yes
CBZ1	NOM. CABEZON	yes	yes
CBZN	CABEZON	yes	yes
CEEL	SPOTTED CUSK-EEL		
CHL1	NOM. CALIFORNIA HALIBUT		
CHLB	CALIFORNIA HALIBUT		
CHN1	NOM. CHINA ROCKFISH	yes	yes
CHNA	CHINA ROCKFISH	yes	yes
CHNK	CHINOOK SALMON		
CHUM	CHUM SALMON		
CKLE	BASKET COCKLE		
CLC1	NOM. CALICO ROCKFISH	yes	yes
CLCO	CALICO ROCKFISH	yes	yes
CLP1	NOM. CHILIPEPPER	yes	
CLPR	CHILIPEPPER	yes	
CMCK	CHUB MACKEREL		
CMEL	CHAMELEON ROCKFISH	yes	
CML1	NOM. CHAMELEON ROCKFISH	yes	
CMSL	CALIFORNIA MUSSEL		
CNR1	NOM. CANARY ROCKFISH	yes	
CNRY	CANARY ROCKFISH	yes	
COHO	COHO SALMON		
COP1	NOM. COPPER ROCKFISH	yes	yes
COPP	COPPER ROCKFISH	yes	yes
CPLN	CAPELIN		
CSKT	CALIFORNIA SKATE	yes	
CSL1	NOM. CURLFIN SOLE	yes	
CSLK	CALIFORNIA SLICKHEAD		
CSRK	BROWN CAT SHARK		
CSOL	CURLFIN SOLE	yes	
CTRB	C-O SOLE		
CUDA	PACIFIC BARRACUDA		
CWC1	NOM. COWCOD ROCKFISH	yes	
CWCD	COWCOD ROCKFISH	yes	
DARK	DARK ROCKFISH	yes	
DBR1	NOM. DARKBLOTCHED ROCKFISH	yes	
DBRK	DARKBLOTCHED ROCKFISH	yes	
DCRB	DUNGENESS CRAB		
DFLT	UNSP. DEEP FLOUNDERS	yes	
DOVR	DOVER SOLE	yes	

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
DRDO	DORADO		
DSOL	DEEPSEA SOLE		
DSRK	SPINY DOGFISH	yes	
DTRB	DIAMOND TURBOT		
DUSK	DUSKY ROCKFISH	yes	
DVR1	NOM. DOVER SOLE	yes	
DWRF	DWARF-RED ROCKFISH	yes	
EELS	UNSPECIFIED EELS		
EGL1	NOM. ENGLISH SOLE	yes	
EGLS	ENGLISH SOLE	yes	
ESTR	EASTERN OYSTER		
ETNA	BIGEYE TUNA		
EULC	EULACHON		
EURO	EUROPEAN OYSTER		
FLAG	FLAG ROCKFISH	yes	
FLG1	NOM. FLAG ROCKFISH	yes	
FNTS	FANTAIL SOLE		
FRCK	FRECKLED ROCKFISH	yes	
FSOL	FLATHEAD SOLE	yes	
GABL	GREEN ABALONE		
GBAS	GIANT SEA BASS		
GBL1	NOM. GREENBLOTCHED ROCKFISH	yes	
GBLC	GREENBLOTCHED ROCKFISH	yes	
GCLM	GAPER CLAM		
GDUK	GEODUCK		
GGRD	GIANT GRENADIER		
GKCR	GOLDEN KING CRAB		
GPH1	NOM. GOPHER ROCKFISH	yes	yes
GPHR	GOPHER ROCKFISH	yes	yes
GPRW	GOLDEN PRAWN		
GRAS	GRASS ROCKFISH	yes	yes
GRDR	UNSP. GRENADIERS	yes	
GREN	PACIFIC GRENADIER	yes	
GRS1	NOM. GRASS ROCKFISH	yes	yes
GSP1	NOM. GREENSPOTTED ROCKFISH	yes	
GSPT	GREENSPOTTED ROCKFISH	yes	
GSQD	GIANT SQUID		
GSR1	NOM. GREENSTRIPED ROCKFISH	yes	
GSRK	GREENSTRIPED ROCKFISH	yes	
GSRM	GHOST SHRIMP		
GSTG	GREEN STURGEON		
GTRB	GREENLAND TURBOT		
HBRK	HALFBANDED ROCKFISH	yes	
HCLM	HORSE CLAMS		
HLQN	HARLEQUIN ROCKFISH	yes	
HNY1	NOM. HONEYCOMB ROCKFISH	yes	

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
HNYC	HONEYCOMB ROCKFISH	yes	
HTRB	HORNYHEAD TURBOT		
ISRK	BIGEYE THRESHER SHARK		
JCLM	CALIFORNIA JACKKNIFE CLAM		
JMCK	JACK MACKEREL		
KFSH	GIANT KELPFISH		
KGL1	NOM. KELP GREENLING	yes	yes
KLP1	NOM. KELP ROCKFISH	yes	yes
KLPG	KELP GREENLING	yes	yes
KLPR	KELP ROCKFISH	yes	yes
KMKA	KAMCHATKA FLOUNDER		
KSTR	KUMAMOTO OYSTER		
LCD1	NOM. LINGCOD	yes	yes
LCLM	NATIVE LITTLENECK		
LCOD	LINGCOD	yes	yes
LDAB	LONGFIN SANDDAB		
LDB1	NOM. LONGFIN SANDDAB		
LOBS	CALIF. SPINY LOBSTER		
LSKT	LONGNOSE SKATE	yes	
LSP1	NOM. LONGSPINE THORNYHEAD	yes	
LSPN	LONGSPINE THORNYHEAD	yes	
LSRK	LEOPARD SHARK	yes	
LSTR	OLYMPIA OYSTER		
LUVR	LOUVAR		
MACL	MUD CLAMS		
MAKO	SHORTFIN MAKO SHARK		
MCLM	MANILA CLAM		
MEEL	MONKEYFACE EEL		
MISC	MISC. FISH/ANIMALS		
MOLA	COMMON MOLA		
MRLN	STRIPED MARLIN		
MSC2	MISCELLANEOUS FISH		
MSHP	PLAINFIN MIDSHIPMAN		
MSQD	MARKET SQUID		
MSRM	MUD SHRIMP		
MXR1	NOM. MEXICAN ROCKFISH	yes	
MXRF	MEXICAN ROCKFISH	yes	
NANC	NORTHERN ANCHOVY		
NRCK	NORTHERN ROCKFISH	yes	
NSHR	NORTHERN NEAR-SHORE ROCKFISH	yes	yes
NSLF	NORTHERN SHELF ROCKFISH	yes	
NSLP	NORTHERN SLOPE ROCKFISH	yes	
NUSF	NOR. UNSP. SHELF ROCKFISH	yes	
NUSP	NOR. UNSP. SLOPE ROCKFISH	yes	
NUSR	NOR. UNSP. NEAR-SHORE ROCKFISH	yes	yes
OABL	OTHER ABALONE		

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
OANC	OTHER ANCHOVY		
OBAS	OTHER BASS		
OCLM	OTHER CLAM		
OCRB	OTHER CRAB		
OCRK	OTHER CROAKER		
OCTP	UNSP. OCTOPUS		
ODSR	OTHER DEMERSAL RKFSH	yes	
OECH	OTHER ECHINODERM		
OFLT	OTHER FLATFISH	yes	
OGRN	OTHER GROUND FISH	yes	
OLV1	NOM. OLIVE ROCKFISH	yes	yes
OLVE	OLIVE ROCKFISH	yes	yes
OMSK	OTHER MOLLUSKS		
OPLG	OTHER PELAGIC RKFSH	yes	
ORCK	OTHER ROCKFISH	yes	
ORND	OTHER ROUND FISH	yes	
OSCL	OTHER SCALLOP		
OSKT	OTHER SKATES	yes	
OSLR	OTHER SLOPE RKFSH	yes	
OSRK	OTHER SHARK		
OSRM	OTHER SHRIMP		
OSTR	OTHER OYSTER		
OTCR	OPILO TANNER CRAB		
OTNA	OTHER TUNA		
OURC	OTHER SEA URCHINS		
OWFS	OCEAN WHITEFISH		
PABL	PINK ABALONE		
PBNT	PACIFIC BONITO		
PBTR	PACIFIC BUTTERFISH		
PCLM	PISMO CLAM		
PCOD	PACIFIC COD	yes	
PDAB	PACIFIC SANDDAB	yes	
PDB1	NOM. PACIFIC SANDDAB	yes	
PFNS	PACIFIC FLATNOSE	yes	
PGMY	PYGMY ROCKFISH	yes	
PHAG	PACIFIC HAGFISH		
PHLB	PACIFIC HALIBUT		
PHRG	PACIFIC HERRING		
PINK	PINK SALMON		
PLCK	WALLEYE POLLOCK	yes	
PNK1	NOM. PINK ROCKFISH	yes	
PNKR	PINK ROCKFISH	yes	
POMF	PACIFIC POMFRET		
POP	PACIFIC OCEAN PERCH	yes	
POP1	GEN. SHELF/SLOPE RF	yes	
POP2	NOMINAL POP	yes	
PRCL	PURPLE CLAM		

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
PROW	PROWFISH		
PRR1	NOM. PINKROSE ROCKFISH	yes	
PRRK	PINKROSE ROCKFISH	yes	
PSDN	PACIFIC SARDINE		
PSHP	PINK SHRIMP		
PSRK	PELAGIC THRESHER SHARK		
PSTR	PACIFIC OYSTER		
PTR1	NOM. PETRALE SOLE	yes	
PTRL	PETRALE SOLE	yes	
PUGT	PUGET SOUND ROCKFISH	yes	
PWHT	PACIFIC WHITING	yes	
QCLM	NORTHERN QUAHOG CLAM		
QFSH	QUEENFISH		
QLB1	NOM. QUILLBACK ROCKFISH	yes	yes
QLBK	QUILLBACK ROCKFISH	yes	yes
RABL	RED ABALONE		
RATF	SPOTTED RATFISH	yes	
RCK1	BOCACCIO+CHILIPEPPER RCKFSH	yes	
RCK2	UNSP. BOLINA RCKFSH	yes	yes
RCK3	UNSP. DPWTR REDS RCKFSH	yes	
RCK4	UNSP. REDS RCKFSH	yes	
RCK5	UNSP. SMALL REDS RCKFSH	yes	
RCK6	UNSP. ROSEFISH RCKFSH	yes	
RCK7	UNSP. GOPHER RCKFSH	yes	yes
RCK8	CANARY+VERMILION RCKFSH	yes	
RCK9	BLACK+BLUE ROCKFISH	yes	yes
RCKG	ROCK GREENLING		
RCLM	RAZOR CLAM		
RCRB	ROCK CRAB		
RDB1	NOM. REDBANDED ROCKFISH	yes	
RDBD	REDBANDED ROCKFISH	yes	
REDS	REDSTRIPE ROCKFISH	yes	
REX	REX SOLE	yes	
REX1	NOM. REX SOLE	yes	
REYE	ROUGHEYE ROCKFISH	yes	
RFLT	REMAINING FLATFISH	yes	
RGL1	NOM. ROCK GREENLING		
RGRN	REMAINING GROUND FISH	yes	
RHRG	ROUND HERRING		
RKCR	RED KING CRAB		
ROS1	NOM. ROSY ROCKFISH	yes	
ROSY	ROSY ROCKFISH	yes	
RPRW	RIDGEBACK PRAWN		
RRCK	REMAINING ROCKFISH	yes	
RRND	REMAINING ROUND FISH	yes	
RSCL	RED IRISH LORD		yes

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
RSL1	NOM. ROCK SOLE	yes	
RSOL	ROCK SOLE	yes	
RSRM	GRASS SHRIMP		
RST1	NOM. ROSETHORN ROCKFISH	yes	
RSTN	ROSETHORN ROCKFISH	yes	
RURC	RED SEA URCHIN		
RZCL	ROSY RAZOR CLAM		
SABL	SABLEFISH	yes	
SAIL	SAILFISH		
SARY	PACIFIC SAURY		
SBL1	NOM. SHORTBELLY ROCKFISH	yes	
SBLY	SHORTBELLY ROCKFISH	yes	
SCLM	SOFT-SHELLED CLAM		
SCLP	UNSP. SCULPIN		
SCOR	CALIFORNIA SCORPIONFISH	yes	yes
SCR1	NOM. CALIF. SCORPIONFISH	yes	yes
SDB1	NOM. SPECKLED SANDDAB		
SFL1	NOM. STARRY FLOUNDER	yes	
SFLT	UNSP. SHALLOW FLOUNDERS	yes	
SHAD	UNSPECIFIED SHAD		
SHP1	NOM. CALIFORNIA SHEEPHEAD		yes
SHPD	CALIFORNIA SHEEPHEAD		yes
SHRP	SHARPCHIN ROCKFISH	yes	
SKCR	SCARLET KING CRAB		
SLGR	SILVERGREY ROCKFISH	yes	
SLNS	SLENDER SOLE		
SMLT	UNSP. SMELT		
SNOS	SPLITNOSE ROCKFISH	yes	
SNS1	NOM. SPLITNOSE ROCKFISH	yes	
SOCK	SOCKEYE SALMON		
SPK1	NOM. SPECKLED ROCKFISH	yes	
SPKL	SPECKLED ROCKFISH	yes	
SPRW	SPOTTED PRAWN		
SPSK	SANDPAPER SKATE		
SQID	UNSP. SQUID		
SQR1	NOM. SQUARESPOT	yes	
SQRS	SQUARESPOT ROCKFISH	yes	
SRFP	SURFPERCH SPP.		
SRKR	SHORTRAKER ROCKFISH	yes	
SSCL	SHARPNOSE SCULPIN		
SSDB	SPECKLED SANDDAB		
SSHR	SOUTHERN NEAR-SHORE ROCKFISH	yes	yes
SSKT	STARRY SKATE		
SSLF	SOUTHERN SHELF ROCKFISH	yes	
SSLP	SOUTHERN SLOPE ROCKFISH	yes	
SSO1	NOM. SAND SOLE	yes	

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
SSOL	SAND SOLE	yes	
SSP1	NOM. SHORTSPINE THORNYHEAD	yes	
SSPF	SHORTBILL SPEARFISH		
SSPN	SHORTSPINE THORNYHEAD	yes	
SSRD	Deep So. Near-shore RF	yes	yes
SSRK	SOUPFIN SHARK	yes	
SSRS	Shallow So. Near-shore RF	yes	yes
STAR	STARRY ROCKFISH	yes	
STL1	NOM. STRIPETAIL ROCKFISH	yes	
STLH	STEELHEAD		
STNA	SKIPJACK TUNA		
STR1	NOM. STARRY ROCKFISH	yes	
STRK	STRIPETAIL ROCKFISH	yes	
STRY	STARRY FLOUNDER	yes	
SUSF	SOU. UNSP. SHELF ROCKFISH	yes	
SUSP	SOU. UNSP. SLOPE ROCKFISH	yes	
SUSR	SOU. UNSP. NEAR-SHORE ROCKFISH	yes	yes
SWRD	SWORDFISH		
SWS1	NOM. SWORDSPINE ROCKFISH	yes	
SWSP	SWORDSPINE ROCKFISH	yes	
TCOD	PACIFIC TOMCOD		
TGR1	NOM. TIGER ROCKFISH	yes	
THD1	NOM. THORNYHEADS	yes	
THDS	THORNYHEADS (MIXED)	yes	
TIGR	TIGER ROCKFISH	yes	
TRE1	NOM. TREEFISH	yes	yes
TREE	TREEFISH	yes	yes
TSRK	COMMON THRESHER SHARK		
UABL	UNSPECIFIED ABALONE		
UCLM	UNSPECIFIED CLAM		
UCRB	UNSPECIFIED CRAB		
UDAB	UNSP. SANDDABS	yes	
UDF1	UNSP. DEEP-91 FLOUNDERS	yes	
UDF2	UNSP. DEEP-95 FLOUNDERS	yes	
UDM1	UNSP. DEMERSAL-91	yes	
UDNR	UNSP. DEEP NEAR-SHORE RF	yes	yes
UDSR	UNSP. DEMERSAL RKFSH	yes	
UDW1	SHORTTRAKER+ROUGHEYE	yes	
UECH	UNSPECIFIED ECHINODERM		
UFL1	FLOUNDERS (NO FSOL)	yes	
UFLT	UNSP. FLATFISH	yes	
UGLG	UNSP. GREENLING		yes
UGRN	UNSP. GROUND FISH	yes	
UHAG	UNSPECIFIED HAGFISH		
UHLB	UNSPECIFIED HALIBUT		
UJEL	UNSP. JELLYFISH		

<b>PacFIN Species ID</b>	<b>PacFIN Common Name</b>	<b>FMP Groundfish</b>	<b>NS Species</b>
UKCR	UNSP. KING CRAB		
UMCK	UNSP. MACKEREL		
UMSK	UNSPECIFIED MOLLUSKS		
UPLG	UNSP. PELAGIC RKFSH	yes	
UPOP	UNSP. POP GROUP	yes	
URCK	UNSP. ROCKFISH	yes	
URK1	SRKR+REYE+NRCK+SHRP	yes	
URND	UNSP. ROUNDFISH	yes	
USCL	UNSPECIFIED SCALLOP		
USCU	UNSP. SEA CUCUMBERS		
USF1	UNSP. SHALLOW-91 FLOUNDERS	yes	
USHR	UNSP. NEAR-SHORE ROCKFISH	yes	yes
USKT	UNSP. SKATE	yes	
USLF	UNSP. SHELF ROCKFISH	yes	
USLP	UNSP. SLOPE ROCKFISH	yes	
USLR	UNSP. SLOPE RKFSH	yes	
USMN	UNSP. SALMON		
USR1	UNSP. SLOPE-91	yes	
USR2	UNSP. SLOPE-93	yes	
USRK	UNSP. SHARK		
USRM	UNSP. OCEAN SHRIMP		
USTG	UNSP. STURGEON		
USTR	UNSPECIFIED OYSTER		
UTCR	UNSP. TANNER CRAB		
UTNA	UNSPECIFIED TUNA		
UTRB	UNSP. TURBOTS	yes	
UURC	UNSP. SEA URCHINS		
VCLM	VARNISH CLAM		
VRM1	NOM. VERMILLION ROCKFISH	yes	
VRML	VERMILION ROCKFISH	yes	
WABL	WHITE ABALONE		
WBAS	WHITE SEABASS		
WCLM	WASHINGTON CLAM		
WCRK	WHITE CROAKER		
WDOW	WIDOW ROCKFISH	yes	
WDW1	NOM. WIDOW ROCKFISH	yes	
WEEL	WOLF EEL		
WHOO	WAHOO		
WSTG	WHITE STURGEON		
YEY1	NOM. YELLOWEYE ROCKFISH	yes	
YEYE	YELLOWEYE ROCKFISH	yes	
YLTL	YELLOWTAIL		
YMTH	YELLOWMOUTH ROCKFISH	yes	
YSOL	YELLOWFIN SOLE		
YTNA	YELLOWFIN TUNA		
YTR1	NOM. YELLOWTAIL ROCKFISH	yes	
YTRK	YELLOWTAIL ROCKFISH	yes	

