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Pacific Halibut Bycatch in the US West Coast IFQ Groundfish Fisheries (2011) and non-IFQ Groundfish Fisheries (2002-2011)

NOAA

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EXECUTIVE SUMMARY

Pacific halibut mortality estimates are provided for 2002 through 2011 from all fishery sectors observed by the Northwest Fishery Science Center Groundfish Observer Program. These included:

- IFQ fisheries (2011-present)
- Limited entry (LE) bottom trawl (2002-2010)
- Groundfish targeting non-nearshore fixed gear (2002-present)
- Nearshore fixed gear (2003-present)
- Pink shrimp trawl (2004-present)
- California halibut trawl (2002-present)
- At-sea Pacific hake (2002-present)

Final estimates are shown in Table ES-1, which is synonymous with Table 21 in the report. In 2011, the IFQ non-hake bottom trawl sector constituted the largest source of discard mortality of Pacific halibut among the sectors analyzed, followed by the non-nearshore fixed gear sector. Within the non-nearshore fixed gear sector, the majority of 2011 estimated discard mortality occurred in the limited entry (LE) sablefish endorsed component, which consists of federally permitted vessels fishing sablefish tier quota during the primary season from April through October. Specifically, discard rates were highest on LE sablefish endorsed vessels fishing with longline gear in the area north of Point Chehalis, Washington. A smaller amount of Pacific halibut mortality also occurred on LE non-sablefish endorsed vessels fishing longline gear and open access (OA) vessels targeting non-nearshore groundfish species with hook-&-line gear.

The 2011 estimate of the IFQ P. halibut discard mortality was only slightly higher (33.2 mt) than the 2011 non-IFQ non-nearshore fixed gear estimate (Figure ES1). Results from prior years indicate that discard mortality of Pacific halibut increased from 2003 through 2006 and then dropped in 2007. Discard mortality increased gradually during the 2007-09 time period, but dropped again in 2010 (Figure ES-1). Pacific halibut discard in the nearshore fixed gear sector, pink shrimp trawl fishery, California halibut trawl fishery, and at-sea Pacific hake fishery represent a very small component of the overall total Pacific halibut mortality.

There are a few significant changes in this (2012) report. First, data are reported from the first year of fishing under IFQ groundfish management (2011). This required revising our methods for estimating Pacific halibut discard, given 100% observer coverage and changes in sampling protocols. We use ratios to estimate the small amount of discard that was not sampled by observers. Note that, in 2011, the LE California halibut sector is covered under the IFQ fishery, whereas the OA California halibut sector is not part of the IFQ fishery. Second, we summarize P. halibut discard mortality by year for the at-sea Pacific hake fishery. The remainder of the 2011 Pacific halibut bycatch estimates were calculated as in the prior report.

Table ES1. Pacific halibut discard mortality estimates (metric tons, 2002-2011) for all sectors observed by the NWFSC Groundfish Observer Program. Discard mortality rates were applied in the bottom trawl fisheries (LE and IFQ), IFQ hook-&-line, IFQ pot, and non-IFQ, non-nearshore fixed gear sectors, for which some information regarding survivorship was available.

Year	LE bottom trawl	IFQ Fishery (first year: 2011)						Non-nearshore fixed gear			Nearshore fixed gear*	Pink shrimp*	CA halibut*‡	At-sea Hake*	Total discard mortality
		Shoreside Hake*	LE CA Halibut*	Bottom Trawl	Midwater Trawl*	Hook and Line	Pot	LE endorsed	LE non-endorsed	OA					
2002	344.8							23.2	0.0	-	-	-	0.0	1.1	392.3
2003	124.4							32.5	0.0	-	0.0	-	0.0	2.6	192.1
2004	133.1							40.2	0.0	-	1.0	0.0	0.8	1.1	216.4
2005	286.5							36.7	0.0	-	2.2	0.1	0.0	2.0	364.2
2006	242.5							107.2	0.0	-	0.5	-	0.0	0.8	458.3
2007	208.8							21.0	0.2	3.6	0.1	0.2	0.1	1.2	256.3
2008	207.8							39.5	0.4	7.1	0.4	0.0	0.3	4.0	298.9
2009	251.1							49.7	0.0	6.4	1.3	0.0	0.0	0.3	358.5
2010	181.0							22.4	0.1	5.3	0.1	0.0	0.0	1.6	232.9
2011		0.03	0.0	31.3	***	1.0	0.9	21.9	3.4	2.8	2.0	0.2	0.0	0.6	64.1
Total	1980.1	0.03	***	31.3	0.00	1.0	0.9	394.3	4.2	25.2	7.6	0.5	1.3	15.3	2833.9

‡ Since 2011, CA Halibut only includes Open Access sector because the Limited Entry sector is covered under the IFQ Fishery.

*Mortality rate of 100% applied

**Table ES2.** A comparison of 2011 Pacific halibut IBQ total discard mortality (mortality rates applied; mt, north of 40°10´ N latitude) between the Vessel Account System (VAS) and the NWFSC Observer Program final estimation. The two systems use different approaches (see Methods) to estimate P. halibut mortality.

Source	Total IBQ mortality of P. halibut (mt)
VAS	32.14
Observer Program	32.99

Table ES3. Pacific halibut bycatch by month for vessels fishing bottom trawl gear in the IFQ fishery during 2011. The number of vessels per area-depth-month stratum does not meet confidentiality requirements; therefore we only present monthly estimates.

Month	Expanded Discard (mt)	Sampled Discard (mt)	Total Bycatch (mt)
Jan	0.16	2.06	2.22
Feb	0.14	3.77	3.91
Mar	0.05	6.33	6.38
Apr	0.03	4.57	4.60
May	0.02	6.90	6.92
June	0.13	4.47	4.60
July	0.68	9.44	10.12
Aug	0.65	13.70	14.34
Sept	0.16	1.86	2.03
Oct	0.12	3.29	3.41
Nov	0.01	1.61	1.62
Dec	0.09	4.96	5.05

Figure ES1. Total estimated P. halibut discard mortality (metric tons) for 2002-2011 from all sectors observed by the NWFSC Groundfish Observer Program. Estimates are not included for sectors and years where there were insufficient observer data.

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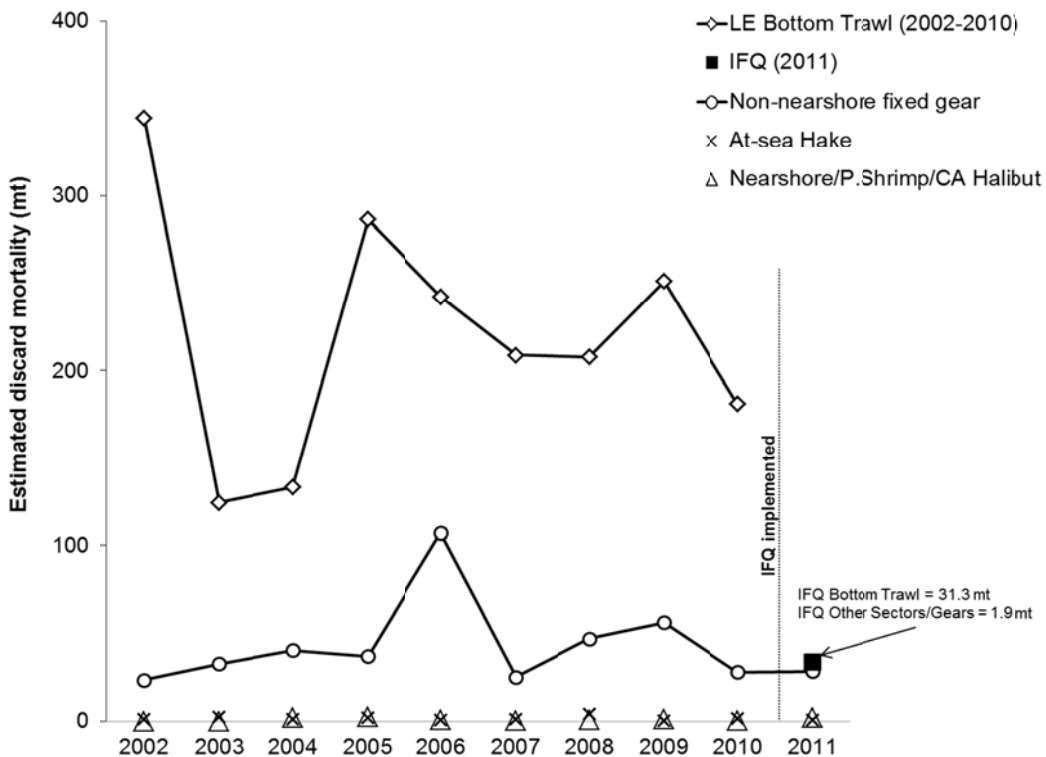
INTRODUCTION

Pacific halibut (*Hippoglossus stenolepis*) is found in coastal waters throughout the North Pacific. Off the west coast of the United States, it inhabits continental shelf areas (< 150 fm) from Washington to central California (Clark and Hare 1998). This species has long supported a directed commercial fishery in the US and Canada, but it is also caught as bycatch in other fisheries that target demersal species inhabiting similar depths and seafloor habitat types. The objective of this report is to provide estimates of Pacific halibut bycatch in the U.S. west coast groundfish fishery from 2002-2011.

West Coast Groundfish Fishery

The west coast groundfish fishery is a multi-species fishery that utilizes a variety of gear types. The fishery harvests species designated in the Pacific Coast Groundfish Fishery Management Plan (FMP; PFMC 2011) and is managed by the Pacific Fishery Management Council (PFMC). Over 90 species are listed in the groundfish FMP, including a variety of rockfish, flatfish, roundfish, skates, and sharks. These species are found in both federal (> 5.6 km) and state waters (0-5.6 km). Groundfish are both targeted and caught incidentally by trawl nets, hook-&-line gears, and fish pots.

Under the FMP, the groundfish fishery consists of four management components:

Limited Entry (LE) – The LE component includes all commercial fishers who hold a federal limited entry permit. The total number of limited entry permits available is capped and permitted vessels are allotted a larger portion of the total allowable catch for commercially desirable species than non-permitted vessels.

Open Access (OA) – The OA component includes commercial fishers who are not federally permitted. However, California Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife have instituted permit programs for certain OA sectors.

Recreational – This component includes recreational anglers who target or incidentally catch groundfish species.

Tribal – This component includes native tribal commercial fishers in Washington State that have treaty rights to fish groundfish. Estimates of Pacific halibut bycatch from tribal fisheries are not included in this report.

These four components can be further subdivided into sectors based on gear type, target species, permits and various regulatory factors. This report includes data from the following sectors:

- IFQ fishery (formerly LE bottom trawl and At-Sea Hake, 2002-2010): This sector is subdivided into the following components due to differences in gear type and target strategy:
    - Bottom trawl: Bottom trawl nets are used to catch a variety of groundfish species. Catch is delivered to shore-based processors.

- o Mid-water non-hake trawl: Midwater trawl nets are used to target mid-water non-hake species, primarily yellowtail rockfish. Catch is delivered to shore-based processors.
- o Pot: Pot gear is used to target groundfish species, primarily sablefish. Catch is delivered to shore-based processors.
- o Hook-and-line: Longlines are primarily used to target groundfish species, mainly sablefish. Catch is delivered to shore-based processors.
- o LE California halibut trawl: Bottom trawl nets are used to target California halibut by fishers holding a state California halibut permit and a LE federal trawl groundfish permit. Catch is delivered to shore-based processors.
- o Shoreside hake trawl: Midwater trawl nets are used to catch Pacific hake. Catch is delivered to shore-based processors.
- o At-sea motherships and catcher-processors: Midwater trawl nets are used to catch Pacific hake. Catcher vessels deliver unsorted catch to a mothership. The catch is sorted and processed aboard the mothership. Catcher-processors catch and process at-sea. This component also includes the at-sea processing component of the tribal sector. The tribal sector must operate within defined boundaries in waters off Northwest Washington. The catch can be delivered to a contracted mothership by catcher vessels for processing or be caught and processed by a contracted catcher-processor.
- OA pink shrimp trawl: Trawl nets are used to target pink shrimp. Catch is delivered to shore-based processors.
- OA California halibut trawl: Trawl nets are used to target California halibut by fishers holding a state California halibut permit. Catch is delivered to shore-based processors.

- LE fixed gear (non-nearshore): This sector is subdivided into two components due to differences in permitting and management:
  - o LE sablefish endorsed season: Longlines and pots are used to target sablefish. Catch is generally delivered to shore-based processors.
  - o LE non-sablefish endorsed: Longlines and pots are used to target groundfish, primarily sablefish and thornyheads. Catch is delivered to shore-based processors or sold live.
- OA fixed gear (non-nearshore): Fixed gear, including longlines, pots, fishing poles, stick gear, etc. is used to target non-nearshore groundfish, primarily sablefish. Catch is delivered to shore-based processors.
- Nearshore fixed gear: A variety of fixed gear, including longlines, pots, fishing poles, stick gear, etc. are used to target nearshore rockfish and other nearshore species managed by state permits in Oregon and California. Catch is delivered to shore-based processors or sold live.

Northwest Fisheries Science Center (NWFSC) Groundfish Observer Program

The NWFSC Groundfish Observer Program observes commercial sectors that target or take groundfish as bycatch. The observer program has two units: the West Coast Groundfish Observer Program (WCGOP) and the At-Sea Hake Observer Program (A-SHOP).

The NWFSC Groundfish Observer Program was established in May 2001 by NOAA Fisheries (NMFS) in accordance with the Pacific Fishery Management Plan (50 CFR Part 660) (50 FR

20609). This regulation requires all vessels that catch groundfish in the US EEZ from 3-200 miles offshore carry an observer when notified to do so by NMFS or its designated agent. Subsequent state rule-making has extended NMFS's ability to require vessels fishing in the 0-3 mile state territorial zone to carry observers.

The NWFSC Groundfish Observer Program's goal is to improve estimates of total catch and discard by observing the shore-based and at-sea groundfish sectors along the U.S. west coast. The WCGOP and A-SHOP observe distinct sectors of the groundfish fishery. The WCGOP observes a number of different sectors of the groundfish fishery, including IFQ shore-based sectors, limited entry and open access (OA) fixed gear, and 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. The A-SHOP observes the following Pacific hake, at-sea sub-sectors of the IFQ fishery: catcher-processor, mothership, mothership catcher-vessel, and tribal vessels. These components of the at-sea Pacific hake/whiting fishery are summarized for the first time in this report.

Pacific Halibut Management and Fishery Interaction

The International Pacific Halibut Commission (IPHC), a body founded through treaty agreement between the US and Canada, sets the Pacific halibut (P. halibut) annual total allowable catch (TAC) for area 2A. The IPHC refers to U.S. waters off the states of Washington, Oregon and California collectively as Area 2A. The TAC is based on bycatch mortality, which takes into account potential survival after being discarded. Regulations for Area 2A are set by NOAA Fisheries Northwest Regional Office. P. halibut catch in Area 2A is divided between tribal and non-tribal fisheries, between commercial and recreational fisheries, and between recreational fisheries in different states (Washington, Oregon and California). The Pacific Fishery Management Council describes this P. halibut catch division each year in a catch-sharing plan. In some years, the LE fixed gear sablefish endorsed sector is allowed to retain and land P. halibut. In all other West Coast commercial groundfish fishery sectors, P. halibut is prohibited and must be discarded at-sea.

In 2011, the limited entry (LE) bottom trawl sector of the U.S. west coast groundfish fishery began fishing under an Individual Fishing Quota (IFQ) management program. An IFQ is defined as a federal permit under a limited access system to harvest a quantity of fish, representing a portion of the total allowable catch of a fishery that can be received or held for exclusive use by a person (MSA 16 USC 1802(23)).

The implementation of the IFQ management program resulted in changes to the methods used for estimating fishing mortality. These changes include:
- Vessels must carry NMFS observers on all IFQ fishing trips.
- Observer sampling priorities.
- The use of multiple gear types fished under a Federal groundfish permit (trawl or fixed gear).
- New programs to monitor landings.

- IFQ quota tracking system.
- Mandatory electronic reporting of shore-based landings.
- Limit of one (1) reporting area (IFQ area) fished per trip.
- IFQs established for a subset of groundfish managed under the Fishery Management Plan (FMP).

Under the IFQ program, Pacific halibut is managed at the permit level, through Individual Bycatch Quota (IBQ) pounds. An IBQ accounts for bycatch mortality, which can assume some level of survivorship. This is the only species managed under IBQ for the west coast groundfish IFQ fishery. Each federal groundfish permit with a trawl endorsement is allocated IBQ pounds for P. halibut caught north of 40° 10' N. latitude. Pacific halibut caught south of 40° 10' N. latitude are not managed as an IFQ program quota.

Data collection and reporting for this fishery is described in the "Pacific Halibut Data Collection in the shore-based IFQ Fishery" and "Inseason IBQ Weight Calculations" sections by gear type. The shore-based IFQ fishery includes all IFQ fishery components with the exception of at-sea motherships and catcher-processors. Motherships and catcher-processors have a bycatch quota for Pacific halibut, but it is not accounted for at the permit level.

With the exception of the IFQ fishery, P. halibut bycatch mortality is accounted for at the fishery sector level only. P. halibut is regularly caught as bycatch in the LE sablefish endorsed fixed gear, LE non-sablefish endorsed fixed gear, and OA fixed gear sectors.

METHODS

Data sources

Data sources for this analysis include onboard observer data (from the WCGOP and A-SHOP), and landing receipt data (referred to as fish tickets). In 2011, observer data was used as the sole source for discard estimation in this fishery. State-collected trawl logbook data from 2011 are not used in this report. A list of fisheries, coverage priorities and data collection methods employed by WCGOP in each observed fishery can be found in the IFQ and Non-IFQ WCGOP manuals (NWFSC 2012). A-SHOP program information and documentation on data collection methods can be found in the observer manual (NWFSC 2012).

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 weights recorded by observers are adjusted based on trip-level fish ticket records. This process is described in further detail in annual reports produced by the WCGOP (NWFSC 2012) and was conducted prior to the analyses presented in this report.

For data processing purposes, species and species groups were defined (NWFSC 2012) based on management. A complete listing of groundfish species is defined in the Groundfish Fishery Management Plan (PFMC 2011).

Fish ticket landing receipts 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 ticket and species-composition data are submitted by state agencies to the Pacific Fisheries Information Network (PacFIN) regional database. 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.

Shore-based IFQ Fishery

The methods used to report inseason IBQ estimates are separate from those methods used to estimate final 2011 fleet-wide P. halibut mortality. However, in 2011, estimates from the two methods resulted in very similar fleet-wide estimates of P. halibut mortality (Table ES2).

Pacific Halibut Data Collection in the shore-based IFQ Fishery
The WCGOP designed sampling methodologies that ensure P. halibut mortality can be estimated, regardless of the limitations imposed by the vessel, catch composition, or catch quantity. Three pieces of information are necessary to estimate Pacific halibut mortality (Table 1):

1. A count of individual P. halibut in the haul or sample
2. Actual or visual length measurements (cm)
3. A viability obtained by physical assessment of individual P. halibut using IPHC designed dichotomous keys that relate the physical condition of the fish to a viability code (Appendices N & O, NWFSC 2012).   This is only done for P. halibut caught with bottom trawl or pot gear.

Observers could sample all or a subset of P. halibut caught in a haul/set. The proportion of P. halibut sampled is based on the number of P. halibut caught in the haul/set, the level of assistance provided by the crew, as well as other variables (e.g., physical space, time of day, weather. Sampling and assessment of P. halibut is dependent on crew assistance and cooperation. Regulations prohibit vessel crew from discarding any P. halibut without first notifying the observer. The vessel crew must comply with any and all requests by the observer to ensure proper P. halibut sampling, including but not limited to: modifying P. halibut sorting procedures, assisting the observer by delivering the P. halibut to the observer, and modifying operations to ensure P. halibut sampling is completed. The following table describes the P. halibut data obtained on IFQ-permitted vessels fishing different gear types.

On vessels fishing fixed gear (pot or hook-&-line), observers must sample at least 50% of the gear per set. Actual length measurements are obtained on bottom trawl and pot vessels, but only visual length estimates are made on vessels fishing hook-&-line gear. Visual estimates are done in 10 cm increments (55-64 cm, 65-74 cm, etc.).

Table 1. Data collected from Pacific halibut caught on IFQ vessels using different types of gear.

Gear	Count	Length Measurement	Viability
Bottom trawl	all in the haul	actual, all or subset	yes
Pot	all in sampled portion	actual, all or subset	yes
Hook -and- line	all in sampled portion	visual, all or subset	no

The crew's cooperation is vital to the observer's sampling success when hook-&-line fishing. When an observer samples for P. halibut, the crew are not permitted to shake loose or discard any P. halibut before the observer has an opportunity to estimate the fish length, nor can they restrict the observer's view of the line as it comes out of the water. If requested by the observer, the crew is required to physically hand an individual fish to the observer or slow the gear retrieval.

Viability is assessed at the point of release when returned to sea. On vessels using "resuscitation boxes" or other techniques to increase the likelihood of survival, condition sampling is performed prior to the fish being returned to sea. Observations of several condition characteristics are used to assign each fish to one of three viability categories: Excellent, Poor, or Dead (Appendices N & O, NWFSC 2012, Williams and Chen 2004). Observer field estimates of viability for Pacific halibut discarded in the IFQ fishery by vessels fishing bottom trawl or pot gear are used to compute the total estimated mortality of discarded Pacific halibut. Below we refer to estimated mortality of discarded P. halibut, with appropriate mortality rate applied (Tables 2 & 3 or 100%) in the IFQ fishery, north of the 40°10′ N. latitude line as IBQ weight, or simply, IBQ.

Viability categories are used to assign mortality rates to P. halibut. Mortality rates for vessels fishing bottom trawl gear are based on mortality data collected by Hoag (1975),who found some survivorship among fish in the dead condition category. Mortality rates for vessels fishing pot gear are based on research conducted by the IPHC.

Table 2. Mortality rates used for each of the condition categories (m_c) for IFQ bottom trawl vessels (Clark, Hoag 1992)

m_c	Rate
m_{exc}	0.20
m_{poor}	0.55
m_{dead}	0.90

Table 3. Mortality rates used for each of the condition categories (m_c) for IFQ pot gear vessels (IPHC)

m_c	Rate
m_{exc}	0.00
m_{poor}	1.00
m_{dead}	1.00

Inseason reporting to the Vessel Account System

The Vessel Account System (VAS) is a NOAA, Northwest Regional Office (NWR) database that allows fishers to manage their IFQ quota pounds. On a weekly basis, the WCGOP provided trip-level estimates of discarded P. halibut IBQ to the Pacific States Marine Fisheries Commission (PSMFC). The PSMFC then uploaded the data to the VAS. Occasionally, non-automated (i.e., manual) calculations of P. halibut IBQ were necessary. Manual calculations of P. halibut IBQ occurred as observer program resources allowed and were uploaded directly to the VAS.

In 2011, fishers experienced delays in the reporting of some trips to the VAS. The main cause of IBQ reporting delays to the VAS in 2011 was that the observer did not enter data in a timely manner. While the observer program set a requirement that all trips be entered within three days from the end of the trip, contract observer provider logistics and vessel activity prevented this from occurring. Private third-party companies function as contract observer providers in this fishery. Trip information could also be delayed because a manual calculation was required. A manual calculation was triggered when the observer did not collect all the required data or did not sample all the hauls in the trip. Scenarios triggering a manual calculation and the equations used for those calculations are given in Appendix B.

Fishers were also concerned that IBQ weights could change throughout the year. This was due to the requirement that IBQ weight be reported to the VAS in "near-real-time". "Near-real-time" reporting does not allow sufficient time for data quality control. Therefore, as data moved through the quality control process, changes to one or more of the data elements used to calculate IBQ weight could occur. When this happened, the database recalculated the IBQ weight and resent the data in the next weekly PSMFC upload. After the 2011 observer data had completed the QA/QC process and was finalized, the entire WCGOP dataset was reloaded to the VAS to ensure all discard was accounted for accurately.

The WCGOP database calculates IBQ weight at the haul-level when the observer collects all the required data elements. The calculation is dependent on which gear type is fished.

Inseason IBQ Weight Calculations for Bottom Trawl Gear
The sampled P. halibut lengths are converted to weight using the IPHC length-weight conversion table (Appendix C). The total weight of P. halibut in the haul is calculated as:

$$W = \frac{w}{n} \cdot N$$

where, for each haul:
W = total weight of P. halibut
w = sampled weight of P. halibut
n = sampled number of P. halibut
N = total number of P. halibut

IBQ weight for each haul is then calculated as:

$$W_{IBQ} = \sum_c \left(\frac{w_c}{\Sigma_c\, w_c} \cdot W \cdot m_c \right)$$

where, for each haul:

c = viability condition category
W_{IBQ} = IBQ weight (mortality rate applied) of P. halibut
W = total weight of P. halibut in haul
w = sampled weight of P. halibut
m = mortality rate (Table 2)

Inseason IBQ Weight Calculations for Pot Gear
The sampled P. halibut lengths are converted to weight using the IPHC length-weight conversion table. Observers are not always able to sample 100% of all gear units due to time constraints and logistics, therefore sample weights need to be expanded to the haul/set level. The total weight of P. halibut in the set is calculated as:

$$W = \left(\frac{w}{n} \cdot N \right) \cdot \left(\frac{P}{p} \right)$$

where, for each set:
W = total weight of P. halibut
w = sampled weight of P. halibut
n = sampled number of P. halibut
N = total number of P. halibut
P = total number of pots fished
p = sampled number of pots

IBQ weight for each set is then calculated as:

$$W_{IBQ} = \sum_c \left(\frac{w_c}{\Sigma_c\, w} \cdot W \cdot m_c \right)$$

where, for each set:
c = viability condition category
W_{IBQ}= IBQ weight (mortality rate applied) of P. halibut
W = total weight of P. halibut in set
w = sampled weight of P. halibut
m = mortality rate (Table 3)

Inseason IBQ Weight Calculations for Hook-&-Line Gear
The visual estimates of Pacific halibut length (10 cm increments) are converted to weight using the IPHC length-weight conversion table. Observers are not always able to sample 100% of all gear units due to time constraints and logistics, therefore sample weights need to be expanded to the haul/set level.   The total weight of P. halibut in the set is calculated as:

$$W_{IBQ} = \left(\frac{H}{h} \cdot w\right) \cdot 0.16$$

where, for each set:

W_{IBQ} = IBQ weight (mortality rate applied) of P. halibut
w = sampled weight of P. halibut
H = total number of hooks fished
h = sampled number of hooks
0.16 = IPHC mortality rate applied to hook-&-line gear

Inseason IBQ Weight Manual Calculation Scenarios
In 2011, there were a number of scenarios that resulted in the inability to calculate IBQ weight through the automated process (Appendix B). The most prevalent causes were the pre-sorting of P. halibut by the crew and improper sampling. In these scenarios, observer program staff reviewed the trip and calculated IBQ weight manually.

To determine the most appropriate method to manually calculate IBQ weight (Appendix B), the observer program data management team consulted with the IPHC. For bottom trawl and pot gear, the IPHC preferred the use of actually measured fish from other properly sampled hauls within the same trip, rather than the use of visually estimated lengths from the haul. All calculations utilized data from the same trip or a different trip from the same vessel. In other words, there was never a circumstance where data from Vessel A was used to calculate IBQ weight for Vessel B.

In addition to scenarios where the observer did not collect all required data, there were also instances of hauls where P. halibut was not sampled by the observer or all the gear was lost. In these instances, properly sampled hauls were used to estimate IBQ weight for the unsampled haul. Methods for expanding P. halibut weight to unsampled or partially sampled hauls varied by gear type.

To calculate P. halibut IBQ weight for unsampled trawl hauls, the sum of all IBQ weight from other properly sampled hauls is divided by the sum of tow duration (hours) from sampled hauls and multiplied by the tow duration of the unsampled haul.

$$W_{IBQ} = \left(\frac{\sum_t w_{IBQ}}{\sum_t d}\right) \times D$$

where, for each tow:
t = tow
W_{IBQ} = unsampled IBQ weight (mortality rate applied) of P. halibut
w_{IBQ} = sampled IBQ weight (mortality rate applied) of P. halibut
d = tow duration (hr) of sampled haul
D = tow duration (hr) of unsampled haul

To calculate P. halibut IBQ weight when trawl gear is lost (i.e., entire net or codend is lost), the sum of all P. halibut expanded species weight from other properly sampled hauls is divided by the sum of tow durations from sampled hauls, multiplied by the tow duration of the unsampled haul. For lost trawl gear, a mortality rate for the "dead" P. halibut viability condition (0.90) is applied.

$$W_{IBQ} = \left(\frac{\Sigma_t \, w}{\Sigma_t \, d}\right) \times D \times 0.90$$

where, for each tow with lost gear:
t = tow
W_{IBQ} = IBQ weight (mortality rate applied) of unsampled P. halibut
w = weight of sampled P. halibut
d = tow duration of sampled haul
D = tow duration of unsampled haul
0.90 = mortality rate for "dead" P. halibut viability condition for trawl gear

To calculate P. halibut IBQ weight in unsampled fixed gear sets, the sum of all P. halibut IBQ weight from sets with similar properties (i.e., date, depth, target, gear type, area; determined by WCGOP data managers) is divided by the sum of the number of gear units sampled, and the result is multiplied by the total number of gear units fished from the unsampled set.

$$W_{IBQ} = \left(\frac{\Sigma_t \, w_{IBQ}}{\Sigma_t \, g}\right) \times G$$

where, for each set:
t = set
W_{IBQ} = unsampled IBQ weight (mortality rate applied) of P. halibut
w_{IBQ} = sampled IBQ weight (mortality rate applied) of P. halibut
g = number of sampled gear units (e.g., hooks, pots)
G = total number of gear units (e.g., hooks, pots) fished in the unsampled set

To calculate P. halibut IBQ weight when fixed gear is lost, the sum of P. halibut weight from the sampled portion of the set, or, if all gear is lost, from sets with similar properties is divided by the sum of units sampled, and the result is multiplied by the total hooks from the unsampled set. For any lost fixed gear, a mortality rate for the "dead" P. halibut viability condition (1.0) is applied.

$$W_{IBQ} = \left(\frac{\Sigma_t \, w}{\Sigma_t \, g}\right) \times G \times 1.0$$

where, for each set with lost gear:
t = set

W_{IBQ} = unsampled IBQ weight (mortality rate applied) of P. halibut
w = sampled IBQ weight of P. halibut
g = number of sampled gear units (e.g., hooks, pots)
G = total number of gear units (e.g., hooks, pots) fished in the unsampled set
1.0 = mortality rate for "dead" P. halibut viability condition for fixed gear

Final Shore-based IFQ Fishery Bycatch Estimation

We stratified IFQ Pacific halibut bycatch data based on sector (shoreside non-hake groundfish, shoreside Pacific hake, at-sea Pacific hake, and limited entry California halibut) and gear (bottom trawl, mid-water trawl, pot, hook-&-line). Within the shoreside non-hake groundfish sector, we further stratified using area and depth based on gear type (bottom trawl, pot, hook-&-line). We maintained area and depth strata that were applied to bottom trawl, hook-&-line, and pot gear in previous reports (see Table 4 of this report for specific strata; Heery, Bellman 2010, Jannot, Bellman 2011) because prior work had demonstrated that these variables were correlated with Pacific halibut bycatch (Heery et al. 2010). However, we removed the 'retained catch of other species' strata (see Heery et al. 2010) because qualitative information suggested that the incentives of the IFQ system had significantly changed fishing behavior and therefore, the utility of retained species as a stratum will need to be re-evaluated. Observations from IFQ vessels fishing mid-water trawl gear targeting Pacific hake or other mid-water target species were not post-stratified. Similarly, observations of IFQ vessels targeting California halibut with bottom trawl gear were not post-stratified. In addition to the strata described above, we also provide bycatch estimates north and south of the North/South groundfish management line (40°10′ N. lat.) for each sector and gear type.

Despite the 100% observer coverage mandate in 2011, there were some rare occasions (e.g., observer illness) when tows or sets were either only partially sampled, or not sampled. We used ratio estimators to apportion unsampled weight to specific species, including Pacific halibut, within each stratum. To obtain the estimated weight of Pacific halibut (W) when the entire haul or set was unsampled, the unsampled weight, summed across unsampled hauls within the stratum, was multiplied by the ratio of the weight of Pacific halibut (summed across fully sampled hauls within a stratum) divided by the total weight of all species in all fully sampled hauls within a stratum:

$$W_{p,s} = \sum_p x_{p,s} \times \frac{\sum_f w_{f,s}}{\sum_f x_{f,s}}$$

where, for each stratum:
s = stratum, which could include, area, depth, gear, and sector
p = unsampled haul
f = fully sampled haul
x = weight of catch
W = estimated weight of P. halibut
w = sampled weight of P. halibut

The unsampled weight of partially sampled hauls or sets was categorized into weight of non-IFQ species (NIFQ) or IFQ species. Unsampled IFQ species weight was further categorized into IFQ flatfish (IFQFF), IFQ rockfish (IFQRF), IFQ roundfish (IFQRD) and IFQ mixed species (IFQM). IFQM included all 2011 IFQ managed species (see 76 FR 27508 for a listing of IFQ species in 2011). NIFQ included all species encountered that were not designated as an IFQ species in 2011 management. IFQFF included all 2011 IFQ flatfish species managed as a complex under the groundfish FMP. North of the 40°10′ North latitude groundfish management line, Pacific halibut would be included in unsampled IFQFF or IFQM categories. South of the groundfish management line, Pacific halibut would only be included in the unsampled NIFQ category.

To obtain the estimated weight of Pacific halibut (W) in partially sampled hauls or sets, the unsampled weight, summed across partially sampled hauls within the stratum, was multiplied by the ratio of the weight of Pacific halibut (summed across fully sampled hauls within a stratum) divided by the weight of all species occurring within a category (NIFQ, IFQFF, IFQM) in all fully sampled hauls within a stratum. Estimated Pacific halibut weight was summed across unsampled categories and then added to the weight of any Pacific halibut that was sampled in the partially sampled hauls:

$$ W_{p,s} = \sum_y \left(\sum_p x_{p,y,s} \times \frac{\sum_f w_{f,s}}{\sum_f x_{f,y,s}} \right) + \sum_p w_{p,s} $$

where, for each stratum:
s = stratum, which could include, area, depth, gear, and sector
y = unsampled category (either NIFQ, IFQFF, or IFQM)
p = partially sampled haul
f = fully sampled haul
x = weight of catch
W = estimated weight of P. halibut
w = sampled weight of P. halibut

Expanded weights of Pacific halibut obtained using the equations above for unsampled or partially sampled hauls were then added to the sampled weight of Pacific halibut (from fully sampled hauls) within each stratum to obtain the total Pacific halibut weight per stratum.

Viability analysis
We used observer field estimates of viability for Pacific halibut discarded in the IFQ fishery by vessels fishing bottom trawl or pot gear to compute the total estimated mortality of discarded Pacific halibut by IFQ gear/sector and stratum.

To account for the impact of fish size on survivorship, we computed a weighted mortality rate for each condition category. Length measurements associated with each viability record were

converted to weight based on the IPHC length-weight relationship:

$$W = 6.921 \times 10^{-6} \cdot L^{3.24}$$

where:
L = fork length (cm)
W = weight (lbs., head off, eviscerated)

A discard mortality rate for each condition category was then computed as the proportion of P. halibut sampled weight in a viability category multiplied by the viability category-specific mortality rate (see Tables 2 & 3 above):

$$DMR_{csj} = m_c \times P_{csj}$$

where:
s = stratum, which could include, area, depth, gear, and sector
c = viability condition (Excellent, Poor, Dead)
j = year
m_c = mortality rate
P = proportion of sampled P. halibut weight (w)
DMR = discard mortality rate

Discard mortality rates for each condition category c and stratum s were then multiplied by gross discard estimates to compute total estimated discard mortality for each of the two gear types:

$$F_{sj} = \sum_c \left(B_{sj} \cdot DMR_{sj} \right)$$

where:
s = stratum, which could include, area, depth, gear, and sector
c = viability condition (Excellent, Poor, Dead)
j = year
F = total estimated discard mortality
B = estimated bycatch

Viability data are collected from only a subsample of the Pacific halibut that observers encounter. Based on previous evaluations by Wallace and Hastie (2009), we expect that survivorship of Pacific halibut in bottom trawl tows are most directly affected by the length of the tow and the amount of catch that fills the net. These variables are not part of the bycatch ratio stratification process (above), and their use in stratifying viability data would make it difficult to then apply discard mortality rates to initial gross estimates of bycatch. We found that tow duration was directly related to depth, one of the variables used to stratify discard ratios and initial gross discard estimates for bottom trawl gear. Because depth and tow duration appeared to co-vary, we used depth and area to stratify IFQ viability data collected from bottom trawl gear. For IFQ viability data collected from pot gear, only area is used to stratify the data.

Final estimates of Pacific halibut bycatch and discard mortality are presented in the context of the estimated mortality of legal-sized halibut. This was computed by applying the proportion of sampled P. halibut weight in each depth stratum that was from legal-sized fish (82 cm or larger) to initial estimates. Viabilities were then applied to gross legal-sized discard estimates in the same manner as described above.

Length Frequencies
The length frequency distribution for Pacific halibut in the 2011 IFQ fishery is provided in Table 9. Pacific halibut pose unique challenges for observer sampling. Observers typically measure the length of Pacific halibut and then convert the measurement to weight using the IPHC length-weight conversion table. Occasionally, observers actually weigh individual fish. Sometimes crew members presort the catch by removing Pacific halibut and immediately return them to sea. Vessel crews presort Pacific halibut to increase the likelihood of survival of the discarded fish. Presorting is most prevalent on vessels fishing with hook-&-line gear. If Pacific halibut were brought on-board using hook-&-line gear, almost all individuals would be injured because of their interaction with the vessel 'crucifier' (gear used to strip the bait and any catch off of the hook and gangion line). Therefore, shake-offs prior to the crucifier (a form of pre-sorting) is almost universal on IFQ hook-&-line vessels. Another case of pre-sorting can occur when halibut are too heavy and/or awkward to weigh in observer baskets. In all cases of pre-sorting, random samples are not available. Therefore, observers visually estimate the length of the halibut in ten-centimeter units (40cm, 50cm , 60cm, etc.), which are later converted to weight using the IPHC length-weight conversion table.

Table A1 (Appendix A) provides the actual observed length frequency distributions of discarded Pacific halibut for vessels fishing IFQ using bottom trawl or pot gear. These length frequencies have been weighted based on the ratio of total estimated P. halibut discard weight to the weight of P. halibut that was measured in each stratum (see Appendix A for further details). Because size-specific mortality rates were not available, we were not able to compute the length frequency distribution of discarded fish that died. However, we have summarized the proportion of length measurements in each condition category (Excellent, Poor, and Dead) in Table 2A (Appendix A) to inform size-specific modeling of mortality. The frequency of sampled fish within each condition category was weighted in the same manner as length frequency distributions and then summarized for each 2 cm length bin.

Non-nearshore Fixed Gear Fishery
The WCGOP samples each non-nearshore fixed gear sector through separate random selection processes, with the limited entry (LE) sablefish endorsed season permits receiving the highest level of coverage, then LE non-sablefish endorsed permits, and open access (OA) fixed gear the lowest. LE sablefish endorsed vessels that fish outside of the primary season or that have reached their tier quota in the primary season are not observed. Given this sampling structure and anticipated differences in variance from one sector to the next, we chose to maintain sector as a stratification variable in our analysis. Testing of alternative stratification schemes (Heery et al. 2010) indicated that latitude and gear type were the most important variables with respect to Pacific halibut bycatch in the non-nearshore fixed gear groundfish fishery. Bycatch estimates were produced separately for each sector and gear combination. Two latitudinal strata were

applied to the LE sablefish endorsed longline sector (north and south of Point Chehalis, Washington = 46° 53.30′ N. lat.) because previous modeling demonstrated that these strata significantly improved the fit of predicted bycatch amounts to the amounts observed (Heery et al. 2010). Point Chehalis, WA was used in previous estimates of Pacific halibut bycatch in the LE sablefish endorsed season longline sector because of its relevance to groundfish management and its apparent ability to split out higher bycatch rates off the northern coast of Washington (Heery and Bellman 2009). Evaluations of latitudinal strata for the other fixed gear sectors did not improve the fit of models to an extent that justified their use. Thus, we maintained the same stratification for the other groundfish fixed gear sectors that was used previously (Heery and Bellman 2009; Heery et al. 2010; Jannot et al. 2011).

Discard Estimation

A deterministic approach was used to estimate Pacific halibut discard for all sectors of the non-nearshore groundfish fixed gear fishery. Discard ratios were computed from observer data as the discarded weight of Pacific halibut divided by the retained weight of either sablefish or all FMP groundfish (except Pacific hake), depending on the sector (Table 11; FMP groundfish species: NWFSC 2012). Ratio denominators were identified for each sector of the non-nearshore fixed gear fishery based on the targeting behavior of that sector. Discard ratios were then multiplied by the total sector landed weight of either sablefish or FMP groundfish (except Pacific hake), corresponding to the denominator used to compute the observed discard ratio for each sector. This provided an expanded gross estimate of Pacific halibut discard for each sector. A discard mortality rate (discussed below) was then applied to compute estimated discard mortality.

Total landed weights for each sector are obtained from fish ticket landing receipts. Fish tickets for fixed gear that included recorded weights for sablefish were included in the non-nearshore fixed gear sector. Commercial fixed gear fish tickets with recorded nearshore species weight were not used in this portion of the fixed gear analysis, regardless of whether they included recorded weights for sablefish (Figure 1). In addition, fixed gear fish tickets without recorded sablefish or nearshore species were included in the non-nearshore fixed gear sector only if groundfish landings were greater than non-groundfish landings based on a unique vessel and landing date.

Non-nearshore fixed gear sector fish tickets were partitioned into the three commercial fixed-gear sectors (LE sablefish endorsed season, LE non-sablefish endorsed, and OA fixed gear) through the following process. Commercial fixed-gear fish tickets were first divided out by whether the vessel had a federal groundfish permit (limited entry) or no federal groundfish permit (open access). OA fish tickets were placed in the OA fixed gear groundfish sector. Next, LE fish tickets were separated based on whether the vessel's federal groundfish permit(s) had a sablefish endorsement with tier quota for the primary season or if it was not endorsed (also referred to as 'zero' tier). Fish tickets for all LE sablefish vessels with tier endorsements that were operating within this period and within their allotted tier quota were placed in the LE sablefish endorsed sector. If LE sablefish endorsed vessels fished outside of the primary season (November through March) or made trips within the season after they had reached their tier quota, the fish tickets were placed in the LE non-sablefish endorsed sector. In addition, fish tickets from non-endorsed LE vessels were also placed in the LE non-sablefish endorsed sector.

Further processing of fish tickets identified and removed the directed commercial Pacific halibut fishery landings from the non-nearshore fixed gear analysis. The directed Pacific halibut fishery occurs for only a few days each year, during 10-hour openings that are designated by the IPHC. LE and OA fixed gear vessels that typically target groundfish can participate in the directed fishery. For most fixed gear vessels, (other than LE sablefish endorsed longline vessels north of Point Chehalis, prior to 2010) this is the only time during which they are allowed to land Pacific halibut. Fish tickets that included Pacific halibut landings on or within the 2 days after a directed fishery opening were considered to be part of the directed fishery and not part of the non-nearshore fixed gear fishery targeting federal FMP groundfish. These fish tickets were removed prior to our analysis. For years prior to 2010, this approach may have resulted in the removal of some non-directed fishery landings north of Point Chehalis, but any bias introduced by this step is considered to be extremely small given the short time period across which fish tickets were removed. In the previous Pacific halibut reports, derby fish tickets were identified as those for which Pacific halibut comprised the largest landed weight on the fish ticket. This filtering step was applied to the area north of Point Chehalis only. Estimates from the previous reports are maintained in the tables (Tables 10, 12-15) and presented here for comparison purposes.

WCGOP observer data were stratified according to sector and gear type (longline and pot/trap). As discussed earlier, one additional latitudinal stratum at Point Chehalis, Washington (46° 53.30' N lat.) was used for the LE sablefish endorsed longline sector. Some retention of Pacific halibut was allowed in the LE sablefish endorsed season in the area north of Point Chehalis up until October 2009. Since October 2009, retention of Pacific halibut north of Point Chehalis has not been permitted (75 FR 23615; 76 FR 14300). The Point Chehalis line was the only latitudinal stratification incorporated into our analysis and was only applied to the LE sablefish endorsed sector. Discard amounts provided for the other two fixed gear sectors represent coastwide estimates.

The number of observed trips, sets, and vessels are summarized for each sector, gear type, and area and depth (where applicable) (Table 10). The landed weight of sablefish and FMP groundfish (excluding Pacific hake) is used as a measure for expanding discard from observed trips to the entire fleet (Table 11). Observed discard ratios were calculated by sector, gear group and area based on the following equation:

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

where:
s: stratum (sector / gear group / area)
t: observed sets
d: observed discard (mt) of Pacific halibut
r: observed retained weight (mt) of sablefish or all FMP groundfish except Pacific hake
F: weight (mt) of retained sablefish or all FMP groundfish excluding Pacific hake recorded on fish tickets in strata s

$\hat{D}_s$: Discard estimate for stratum *s*

For all strata, except the LE non-sablefish endorsed longline and the OA sectors, discard ratios were calculated by dividing the stratum discard weight of Pacific halibut by the retained catch weight of sablefish. Retained groundfish was used as the ratio denominator for the LE non-sablefish endorsed longline and the OA sectors because these sectors target a wider range of groundfish species. A broader denominator was therefore necessary to effectively capture the level of fishing effort in these sectors. Please refer to earlier reports for further details of data pooling and discard ratios in prior years of observer coverage.

Where FMP groundfish (excluding Pacific hake) was used to compute discard ratios, any retained weights recorded by the observer not appearing on fish tickets were excluded from the denominator. This prevents 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. By using only the retained groundfish weight from fish tickets in discard ratio denominators, we prevent double-counting of retained weights. This is not a factor when using a single species in the denominator, such as sablefish, as any retained weights in observer and fish ticket data that share the same species code will match and adjust properly.

Table 12 demonstrates the expansion factors for each fishery sector and gear type. The discard rate applied yielded an expanded gross P. halibut discard estimate for each stratum. If landings were made by a fixed gear sector for which there were no or very few WCGOP observations, the most appropriate observed discard ratio was selected and applied to those landings based on similarities in the fishery management structure, fishing and discard behavior, and the gear fished. The LE sablefish endorsed vessels fishing outside of the primary season with pot gear often land a small amount of groundfish; however, this portion of the fleet is not observed by the WCGOP program. Given similarities in gear type and catch composition, OA fixed gear pot observations were selected as the most appropriate source of information for an observed discard rate (Table 11).

Discard Mortality Rates
Once an initial gross estimate of P. halibut discard had been produced, this value was multiplied by a discard mortality rate (Table 14) to generate a final discard mortality estimate (Table 15 and Figure 3). Ideally, discard mortality would have been approximated based on viabilities in a manner similar to the approach used for IFQ bottom trawl and pot gear. WCGOP observers do record viability conditions as Pacific halibut are discarded from non-IFQ longline vessels. However, much of the time, Pacific halibut are removed from the line before being brought onboard. This is to ensure safety, as longline vessels are often small, and to have the least possible impact on Pacific halibut survivorship. Because these fish are not typically brought onboard, the observer is not able to effectively assess viability or gain a random sample from

Pacific halibut catch. Although viabilities from pot gear would be appropriate to use in estimating discard mortality, bycatch of Pacific halibut in pot gear is infrequent and the sample size of viability conditions from this gear type was too small to utilize in this analysis.

Thus, Pacific halibut viabilities recorded from the non-nearshore fixed gear fishery were not used in our analysis. Discard mortality rates therefore had to be identified through other means. Review of the literature on Pacific halibut bycatch revealed little that could be applied to the entire discard estimate. Several studies have examined the survivorship of Pacific halibut in various conditions (Kaimmer and Trumble 1998, Trumble, Kaimmer 2000). However, without any information on the state of Pacific halibut that were being discarded, the findings from these examinations could not be put to use.

Instead, we relied on discard mortality rates computed for groundfish fisheries off Alaska (Williams 2008). An 18% discard mortality rate was applied to estimates for pot gear, coinciding with the DMR used for the sablefish pot CDQ fishery in Alaska. For longline gear, we used a discard mortality rate of 16%, an average of DMRs over all years for the Bering Sea/Aleutian region longline fishery (Williams 2008).

For additional context, we present the length frequency distribution of Pacific halibut from visual estimates and actual lengths measured in the LE sablefish endorsed sector (Table 16) and the proportion of sampled Pacific halibut discard of legal (>82 cm) and sublegal ($\leq$ 82 cm) sizes in the non-nearshore fixed gear fishery (Table 17). The majority of Pacific halibut lengths recorded in this fishery have been collected through visual length estimation, rounded to the nearest 10 cm. In other words, specimens that are 76 cm and 82 cm are both visually estimated to be 80 cm. With this level of resolution, it was not possible to compute the exact proportion of sublegal versus legal Pacific halibut from visually estimated lengths. Visual estimates were instead summarized in the manner in which they are recorded; with sublegal and legal sized halibut falling within the 75-84 cm length bin. In 2011, observers were instructed to record more actual lengths from randomly sampled Pacific halibut on non-nearshore fixed gear boats, with the help of vessel crew. However, sample sizes from 2011 were too low for use in analyses.

Other Fisheries

Pacific halibut was also observed in the nearshore groundfish fixed gear sector and the pink shrimp and OA California halibut trawl fisheries. Bycatch estimates for these three fishery sectors were computed based on the following equation:

$$\hat{B} = \frac{\sum_t b_t}{\sum_t r_t} \times F$$

where:
b: observed discard (mt) of Pacific halibut on set/haul t
r: observed retained weight (mt) of target species on set/haul t
F: weight (mt) of retained target species

$\hat{B}$: Bycatch estimate

The nearshore fixed gear fishery targets a variety of groundfish species that inhabit areas shallower than 50 fathoms. All species included in the nearshore target group as listed in the WCGOP data processing appendix were included in the denominator when calculating bycatch ratios for the nearshore fixed gear sector. Pink shrimp and California halibut were considered the target species in their respective fisheries.

Bycatch estimates are presented for the nearshore fixed gear sector, pink shrimp trawl fishery, and the OA portion of the California halibut trawl fishery (LE California halibut is covered under the IFQ fishery). For more information regarding the differences between the two California halibut trawl components, see annual data reports published by the WCGOP (NWFSC 2012). Discard mortality rates were not applied to bycatch estimates for these other fishery sectors due to a lack of information regarding survivorship.

RESULTS

IFQ Fishery

For most strata, 95% or more of the observed IFQ tows or sets were sampled (Table 4). The exceptions were vessels fishing bottom trawl gear: (a) greater than 60 fathoms north of Point Chehalis, WA (87% sampled); (b) less than 60 fathoms between Point Chehalis and 40°10' N. latitude (92% sampled); or (c) less than 60 fathoms south of 40°10' N. latitude (94% sampled; Table 4). Unsampled catch categorized as non-IFQ species represented the largest portion of the unsampled tows or sets (Table 4), as only every third haul or set was required to be sampled for non-IFQ species under WCGOP sampling protocol (NWFSC 2012).

The total estimated weight of Pacific halibut from unsampled tows or sets represents a small fraction (2.2 mt ~ 3%) of the total gross discard weight of P. halibut in this fishery (Table 5). Fifty percent of the total estimated weight (1.1 mt) was from the IFQ mixed species category (Table 5). Most of the remainder was estimated from uncategorized (all species) unsampled catch (0.7 mt). Weight estimated from the IFQ flatfish and non-IFQ species groups represents a very small portion of the total estimated discard weight of Pacific halibut (Table 5). In terms of viability, the majority of individuals were classified as either Excellent or Dead, irrespective of gear type, area or depth (Table 6).

Estimated discard mortality from all sectors and gears of the 2011 IFQ fishery was 87% less than the estimated discard mortality from the 2010 LE bottom trawl fishery (Figure ES1). There are at least two possible explanations for this drop. First, IBQs for P. halibut might have increased fisher incentives to avoid P. halibut bycatch and thereby changed fisher behavior (i.e., fish different grounds or gear differently than in past). Second, during 2011, the fleet was experimenting with P. halibut excluders, including cooperating with NMFS on developing and testing P. halibut excluders on trawl vessels (Lomeli and Wakefield).   Gross bycatch estimates and total discard mortality estimates were largest for vessels fishing bottom trawl gear, north of the 40°10′ N. latitude management line in depths greater than 60 fathoms (Tables 7, 8). This

gear-area-depth stratum accounts for ~75% of 2011 Pacific halibut discard mortality in the fishery. The next largest fraction (~21%) of total discard mortality is found in the same gear-area combination in shallow waters (<60 fm). Together, bottom trawl gear fishing north of the 40°10´ N. latitude management line accounts for 96% of the 2011 Pacific halibut discard mortality in the IFQ fishery (Tables 7, 8).

Estimated bycatch weight of P. halibut from the at-sea hake component of the 2011 IFQ fishery was low (0.6 mt) relative to the majority of prior years' reported. At-sea hake sectors reported a range of P. halibut bycatch weight from 0.3 to 4 mt during the period from 2002 to 2011. This is the first report to incorporate P. halibut bycatch weight from at-sea hake sectors of the groundfish fishery.

Non-nearshore Fixed Gear Fishery

From 2010 to 2011, estimated discard mortality of Pacific halibut in the LE sablefish endorsed season longline sector increased in the area north of Point Chehalis, WA but decreased south of Point Chehalis (Table 14). In 2011, north of Point Chehalis fleet-wide sablefish landings decreased slightly but the observed P. halibut discard ratio nearly doubled relative to 2010 (Table 12). This indicates that perhaps vessels were encountering Pacific halibut more frequently in 2011 than in 2010. South of Point Chehalis, 2011 saw a drop in landings and in the discard ratio relative to 2010 values (Table 12), indicating that fishing effort by the LE sablefish endorsed longline sector might have been lower in 2011 relative to 2010 in this area. Increased P. halibut discard mortality north of Point Chehalis and decreased mortality south of Point Chehalis led to a 2011 coastwide estimate very close to the 2010 coastwide estimate for this sector (Table 14 & Figure 3). Gross estimated discard of P. halibut in the LE sablefish endorsed season pot sector was almost the same in 2011 as in 2010 (Table 14).

Discard of Pacific halibut among the non-sablefish endorsed fixed gear sectors (LE and OA) during 2011 showed departures from previous years. First, in 2011, the LE non-sablefish endorsed longline sector showed a marked increase in estimated discard mortality relative to 2010 (Table 14). Conversely, the estimated discard mortality for OA fixed gear vessels fishing with hook-&-line gears in 2011 was about half (17.2 mt) of the discard mortality estimated for the same sector in 2010 (32.6 mt; Table 14). This follows the trend of decreasing estimated discard mortality in this sector since 2008 (Table 14).

A large source of uncertainty in our estimates of Pacific halibut discard mortality on non-nearshore fixed gear vessels is the actual discard mortality rate applied to initial gross estimates computed from observer data. A small sample size of observed viability data are available from sablefish vessels fishing with pots, but not enough to be used in discard mortality estimation. Instead, we relied on findings from observed pot vessels in Alaska that assign specimens to the same condition codes used for trawl gear and then apply the discard mortality rates assumed by Williams (2008). This informed our decision to increase the discard mortality rate applied to pot estimates to 18% from 16%. As more viability information is collected by WCGOP observers from pot vessels, we intend to apply this directly to compute discard mortality in a manner consistent with the methods of Williams (2008).

Just as for trawl gear, discard mortality rates have been determined experimentally for Pacific halibut caught with longline gear (Kaimmer and Trumble 1998, Trumble et al. 2000). To apply these rates, Pacific halibut caught on longlines are assigned to one of four condition categories (minor, moderate, severe, and dead) based on the extent of their injuries at the time of release. Kaimmer and Trumble (1998) derived discard mortality rates for each of these categories using mark-recapture data. Their rates were later updated by Trumble et al. (2000) to account for hook sizes that are more consistent with gear used on the West Coast for commercial purposes.

For reasons described earlier, Pacific halibut were infrequently brought onboard observed fixed gear vessels from 2002 to 2010, resulting in a small and potentially biased sample of viability data. Mortality rates specified by Trumble et al. (2000) cannot therefore be used in conjunction with these data to assess overall discard mortality. However, changes were implemented in the 2011 WCGOP data collection protocol that allowed observers on fixed gear vessels to collect a random sample of Pacific halibut from which to gather viability data. Sample sizes for the 2011 calendar year are too low for analytical purposes, but data will continue to be collected in 2012. In the interim, discard mortality rates of 16% for longline gear and 18% for pot gear (Williams 2008) are thought to be the best option currently available.

Other Fisheries

Very small amounts of Pacific halibut bycatch were observed in other fisheries. Even without the application of discard mortality rates, bycatch estimates for the nearshore groundfish fixed gear sector, pink shrimp trawl fishery, and the OA sector of the California halibut trawl fishery made up a minor portion of the total mortality estimate for Pacific halibut. Bycatch estimates of P. halibut for these sectors provided in Tables 18, 19, and 20 are not intended to represent mortality values, as discard mortality rates for these sectors are not available.

SUMMARY & CONCLUSIONS

•   In the 2011 IFQ fishery, methods for estimating the relatively small amount of Pacific halibut weight in unsampled and partially sampled hauls were developed for each sector and gear type fished. The weight of P. halibut estimated from these hauls represents ~3% of the total discard mortality of P. halibut in the IFQ fishery.
•   Estimated discard mortality from the entire 2011 IFQ fishery represents an 87% decrease relative to the 2010 LE bottom trawl fishery.
•   The 2011 estimate of Pacific halibut mortality in the LE non-sablefish endorsed longline sector was much greater than in any prior year. The 2011 OA fixed gear longline sector exhibited a decline in estimated P. halibut mortality relative to the 2010 estimate.
•   Estimated P. halibut mortality in all other non-IFQ sectors are well within the range observed in previous years.
•   This report represents the first time we present summarized P. halibut discard from the at-sea Pacific hake fishery for the years 2002-2011.
•   The spatial distribution of P. halibut catch observed by the WCGOP (2002-2011) off the U.S. west coast is presented for the first time in this report. Gear types represented include a combination of bottom trawl, midwater trawl, shrimp trawl, fixed gear hook-&-line and pot gear.

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TABLES

Table 4. The number of observed vessels, trips, and tows; the number of tows and metric tons of Pacific halibut sampled, and the number of unsampled catch categories as a function of gear or sector, area and depth stratification in the 2011 U.S. west coast IFQ fisheries. Unsampled portions of the catch can be uncategorized or categorized into IFQ flatfish, IFQ mixed (any IFQ fish) or non-IFQ groups.

Stratum	Observed			Sampled		No. of Unsampled Categories			
	No. vessels	No. trips	No. tows	No. tows	P. halibut discard (mt)	IFQ flatfish	IFQ mixed	Non-IFQ	Uncategorized
Bottom Trawl									
North of Pt Chehalis									
0 to 60 fm	13	46	306	292	7.28	2	5	10	3
> 60 fm	22	146	1113	965	18.07	3	8	138	6
Pt Chehalis to 40°10'									
0 to 60 fm	20	137	1135	1045	9.71	12	2	65	19
> 60 fm	56	755	5127	4915	20.16	5	14	178	29
South of 40°10'									
0 to 60 fm	3	23	66	62	0.17	3	0	1	0
> 60 fm	15	241	1376	1338	0.16	3	0	34	3
Pot									
North of Pt Chehalis	3	12	63	62	1.03	0	0	0	0
Pt Chehalis to 40°10'	8	75	716	713	2.30	0	0	1	2
South of 40°10'	11	148	738	736	0.00	0	0	2	0
Hook and Line									
North of 40°10'	6	21	411	402	6.03	0	0	0	1
South of 40°10'	6	71	212	211	0.00	0	0	1	0
LE California Halibut									
All South of 40°10'	3	63	157	155	0.00	0	0	2	0
Shoreside Hake									
All North of 40°10'	26	913	1701	1699	0.03	0	0	2	0
Midwater Trawl									
North of 40°10'	**	**	**	**	**	**	**	**	**

** Confidential

Table 5. Values used to calculate the expanded weight (mt) of Pacific halibut (PHLB) from each unsampled category in the 2011 U.S. west coast groundfish IFQ fishery. Unsampled catch weight could be assigned to one of four categories: IFQ flatfish species, IFQ mixed species, non-IFQ species, or all species (IFQ & non-IFQ). The sampled weight (mt), discard ratio, unsampled weight (mt) and estimated Pacific halibut gross discard (mt) are presented within each category, as a function of gear or sector, depth (bottom trawl only), management area, and area north or south of Point Chehalis, WA. The sum of expanded weight (mt) is the sum of the estimated gross P. halibut discard across categories. The sampled PHLB in unsampled hauls (or sets) is the sampled weight of P. halibut in partially sampled hauls (or sets). The sum of the PHLB in unsampled hauls is the sum of the expanded weights plus the sampled PHLB in unsampled hauls. The total discard (gross) is the sum of the PHLB in unsampled hauls plus the sampled PHLB.

Gear or Sector	Depth (fm)	Management Area	Area	Sampled PHLB	IFQ Flatfish Sampled	Discard Ratio	Unsampled	Est. Discard	Mixed IFQ Species Sampled	Discard Ratio	Unsampled	Est. Discard	Non-IFQ Species Sampled	Discard Ratio	Unsampled	Est. Discard	All Species (IFQ & Non-IFQ) Sampled	Discard Ratio	Unsampled	Est. Discard	Sum of Est. Discard Wght.	Sampled PHLB in Unsamp. hauls	Sum of PHLB in Unsamp. hauls	Total Discard
Bottom Trawl	0 - 60	N. 4010	N. Pt Chehalis	7.28	58	0.126	0.16	0.02	78	0.094	5.22	0.49	56	0.000	2.66	0.00	133	0.055	2.29	0.13	0.64	0.16	0.80	8.07
Bottom Trawl	0 - 60		Pt Chehalis - 4010	9.71	90	0.108	0.97	0.10	110	0.088	2.40	0.21	171	0.000	6.76	0.00	281	0.035	5.71	0.20	0.51	0.95	1.46	11.18
Bottom Trawl	0 - 60	S.4010	S. 4010	0.17	5	0.000	0.04	0.00	5	0.000	0.00	0.00	12	0.014	0.01	0.00	17	0.010	0.00	0.00	0.00	0.00	0.00	0.17
Bottom Trawl	> 60	N. 4010	N. Pt Chehalis	18.07	102	0.178	1.03	0.18	128	0.141	1.01	0.14	196	0.000	15.03	0.00	325	0.056	4.79	0.27	0.59	4.39	4.99	23.06
Bottom Trawl	> 60		Pt Chehalis - 4010	20.16	168	0.120	0.78	0.09	325	0.062	4.00	0.25	721	0.000	18.25	0.00	1046	0.019	7.54	0.15	0.49	1.90	2.38	22.55
Bottom Trawl	> 60	S.4010	S. 4010	0.16	155	0.000	0.10	0.00	270	0.000	0.00	0.00	217	0.001	2.87	0.00	487	0.000	1.36	0.00	0.00	0.00	0.00	0.16
Pot		N. 4010	N. Pt Chehalis	1.03	1	0.981	0.00	0.00	2	0.676	0.00	0.00	0	0.000	0.00	0.00	2	0.580	0.00	0.00	0.00	0.00	0.00	1.03
Pot			Pt Chehalis - 4010	2.30	2	0.942	0.00	0.00	8	0.290	0.00	0.00	3	0.000	0.00	0.00	11	0.204	0.01	0.00	0.00	0.00	0.00	2.31
Pot		S.4010	S. 4010	0.00	0	0.000	0.00	0.00	6	0.000	0.00	0.00	7	0.000	0.00	0.00	13	0.000	0.00	0.00	0.00	0.00	0.00	0.00
Hook & Line		N. 4010		6.03	7	0.845	0.00	0.00	22	0.276	0.00	0.00	56	0.000	0.00	0.00	78	0.077	0.00	0.00	0.00	0.02	0.02	6.06
Hook & Line		S. 4010		0.00	0	0.000	0.00	0.00	4	0.000	0.00	0.00	21	0.000	0.00	0.00	25	0.000	0.00	0.00	0.00	0.00	0.00	0.00
Shoreside hake		N.4010		0.03	0	0.991	0.00	0.00	521	0.000	0.00	0.00	3	0.000	1.37	0.00	525	0.000	0.00	0.00	0.00	0.00	0.00	0.03
LE CA Halibut		S. 4010		0.00	1	0.000	0.00	0.00	1	0.000	0.00	0.00	74	0.000	0.01	0.00	75	0.000	0.00	0.00	0.00	0.00	0.00	0.00
Midwater Trawl		N. 4010		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

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Table 6. Pacific halibut viabilities in the 2011 groundfish IFQ fishery by gear, depth (bottom trawl only), management area, and area north or south of Point Chehalis, WA. The condition of sampled Pacific halibut was identified as Excellent (Exc), Poor, or Dead (Appendices N and O, WCGOP manual 2012), consistent with IPHC protocol. The number of fish in each category was weighted based on the length-weight relationship as described in the Methods.

Year	Gear	Depth (fm)	Management Area	Area	Number				Weighted percentages in each category		
					Exc	Poor	Dead	Total	Exc	Poor	Dead
2011											
	Bottom Trawl	0 - 60	N. 4010	N. Pt Chehalis	522	138	309	969	57%	14%	28%
				Pt Chehalis - 4010	1217	182	201	1600	82%	9%	9%
			S. 4010	S. 4010	0	0	10	10	0%	0%	100%
		> 60	N. 4010	N. Pt Chehalis	1168	455	941	2564	48%	18%	34%
				Pt Chehalis - 4010	1005	562	1204	2771	38%	20%	42%
			S. 4010	S. 4010	7	1	6	14	48%	6%	46%
	Pot		N. 4010	N. Pt Chehalis	53	3	19	75	84%	2%	14%
				Pt Chehalis - 4010	149	10	65	224	69%	5%	26%
			S. 4010	S. 4010	0	0	0	0			

Table 7. Estimated gross discard (mt) and discard mortality (mt) of Pacific halibut in the 2011 groundfish IFQ fishery by gear type, depth (bottom trawl only), management area, and area north or south of Point Chehalis, WA. Estimates were allocated to the three condition categories based on information presented in Table 6. DMR = Discard Mortality Rate.

Year	Gear	Depth (fm)	Management Area	Area	Estimate Gross Discard (mt)				Estimated Discard Mortality (mt)				DMR
					Exc	Poor	Dead	Total	m(Exc)	m(Poor)	m(Dead)	m(Total)	
2011													
	Bottom Trawl	0 - 60	N. 4010	N. Pt Chehalis	4.64	1.15	2.28	8.07	0.93	0.63	2.06	3.62	45%
				Pt Chehalis - 4010	9.11	1.02	1.04	11.18	1.82	0.56	0.94	3.32	30%
			S. 4010	S. 4010	0.00	0.00	0.17	0.17	0.00	0.00	0.15	0.15	90%
		> 60	N. 4010	N. Pt Chehalis	11.17	4.15	7.75	23.06	2.23	2.28	6.97	11.49	50%
				Pt Chehalis - 4010	8.61	4.52	9.42	22.55	1.72	2.49	8.47	12.68	56%
			S. 4010	S. 4010	0.08	0.01	0.08	0.16	0.02	0.01	0.07	0.09	54%
	Pot		N. 4010	N. Pt Chehalis	0.86	0.02	0.15	1.03	0.00	0.02	0.15	0.17	16%
				Pt Chehalis - 4010	1.59	0.11	0.61	2.31	0.00	0.11	0.61	0.71	31%
			S. 4010	S. 4010	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table 8. Estimated Pacific halibut bycatch (mt), discard mortality (mt), legal-sized (82 cm) mortality (mt), and percent of legal-sized discard by weight in the 2011 groundfish IFQ fishery by gear or sector, depth (bottom trawl only), management area, and area north or south of Point Chehalis, WA.

Year	Gear or Sector	Depth (fm)	Management Area	Area	Total bycatch (mt)	Total discard mortality (mt)	Estimated legal-sized mortality (mt)	Estimated % legal-sized discarded, by weight
2011								
	Bottom Trawl	0 - 60	N. 4010	N. Pt Chehalis	8.07	3.62	1.98	55%
				Pt Chehalis - 4010	11.18	3.32	2.06	62%
			S. 4010	S. 4010	0.17	0.15	0.15	100%
		> 60	N. 4010	N. Pt Chehalis	23.06	11.49	8.11	71%
				Pt Chehalis - 4010	22.55	12.68	8.72	69%
			S. 4010	S. 4010	0.16	0.09	0.09	97%
	Pot		N. 4010	N. Pt Chehalis	1.03	0.17	0.13	77%
				Pt Chehalis - 4010	2.31	0.71	0.53	74%
			S. 4010	S. 4010	0.00	0.00	0.00	
	Hook and Line		N. 4010		6.06	0.97	0.43	45%
			S. 4010		0.00	0.00	0.00	
	Shoreside hake		N. 4010		0.03	0.03	0.00	100%
	LE CA Halibut		S. 4010		0.00	0.00	0.00	

Table 9. Pacific halibut length frequencies collected by WCGOP observers during the 2011 groundfish IFQ fishery by gear type. (a) Actual measurement of P. halibut lengths (cm). (b) Visual estimates of P. halibut lengths (cm). Note that there were no actual measurements from vessels fishing with hook-&-line gear. The lower limits on the length intervals are inclusive, while the upper limits are exclusive. Numbers are numbers of individual P. halibut per bin by gear type.

a.

Actual Length bin (cm)	Bottom Trawl	Pot
17-22	1	0
37-42	1	0
42-47	2	1
47-52	12	0
52-57	37	2
57-62	193	9
62-67	586	12
67-72	890	22
72-77	1308	38
77-82	1101	53
82-87	1017	48
87-92	750	41
92-97	584	24
97-102	381	22
102-107	267	4
107-112	174	4
112-117	118	6
117-122	59	3
122-127	39	3
127-132	20	2
132-137	12	2
137-142	5	1
142-147	9	0
147-152	2	0
152-157	0	0
157-162	0	0
162-167	0	0
167-172	0	1
172-177	0	0
177-182	0	0
182-187	0	0
187-192	0	0
192-197	0	0
197-202	0	1

b.

Visual Length bin (cm)	Bottom Trawl	Pot	Hook and Line
30	0	1	3
40	2	2	48
50	3	1	120
60	3	2	237
70	16	4	201
80	12	11	139
90	7	7	68
100	6	7	26
110	1	1	20
120	6	2	11
130	1	1	1
140	3	0	3
150	2	0	1
160	0	0	1

Table 10. Number of observed trips, sets, and vessels by year in the non-nearshore groundfish fixed gear fishery, which includes limited entry (LE) sablefish endorsed season, LE non-sablefish endorsed, and open access (OA) fixed gear sectors.

Year	LE Sablefish Endorsed			LE Non-Sablefish Endorsed	OA Fixed Gear	
	Longline				Hook-and-line	
	North of Pt Chehalis	South of Pt Chehalis	Pot	Longline	Gears	Pot
	Number of observed trips					
2002	23	47	23	11	0	0
2003	25	25	35	130	41	16
2004	13	35	13	62	43	96
2005	31	73	39	35	34	43
2006	31	34	39	121	11	38
2007	36	40	30	158	50	45
2008	17	60	24	122	58	55
2009	13	34	27	138	68	30
2010	18	126	43	226	69	40
2011	18	84	22	201	68	60
	Number of observed sets					
2002	207	181	247	22	0	0
2003	191	158	362	219	49	50
2004	115	205	139	130	53	182
2005	388	275	491	60	37	50
2006	291	159	288	196	12	39
2007	381	136	154	303	66	72
2008	194	345	329	220	68	74
2009	178	109	67	271	101	45
2010	251	503	314	470	104	69
2011	284	389	227	426	100	84
	Number of observed vessels					
2002	9	18	6	4	0	0
2003	8	8	6	17	13	7
2004	6	13	3	14	15	17
2005	10	18	7	11	10	14
2006	9	10	7	21	8	15
2007	9	14	4	36	25	20
2008	6	13	6	32	33	20
2009	4	6	3	34	33	18
2010	5	20	7	38	37	26
2011	7	20	3	38	40	28

Table 11. Expansion factors and WCGOP observed discard rate by gear type for limited entry (LE) and open access (OA) non-nearshore groundfish fixed gear sectors used to expand discard estimates of Pacific halibut to the fleet-wide level.

Fishery		Expansion Factor	Observed Discard Rate Applied	
LE Sablefish Endorsed	Longline Pot	Retained Sablefish	LE Sablefish Endorsed	Longline Pot
LE Non-Sablefish Endorsed	Longline Pot	Retained Groundfish Retained Sablefish	LE Non-Sablefish Endorsed OA Fixed Gear *	Longline Pot
OA Fixed Gear	Hook-and-line Pot	Retained Groundfish	OA Fixed Gear *	Hook-and-line Pot

* No discard ratio or discard estimate was computed in the OA fixed gear sector for 2002-2006 because the WCGOP only covered OA vessels in California during this time.

Table 12. Total sablefish and groundfish landings (mt) and observed Pacific halibut discard ratios for each sector and gear type in the non-nearshore groundfish fixed gear fishery. Sablefish landings were used as the discard ratio denominator and expansion factor in all cases except the limited entry (LE) non-sablefish endorsed and OA fixed gear sectors, where target species include a variety of groundfish species.

	LE Sablefish Endorsed			LE Non-Sablefish Endorsed		OA Fixed Gear	
	Longline		Pot	Longline	Pot	Hook-and-Line Gears	Pot
	North of Pt Chehalis	South of Pt Chehalis					
Expansion factor **Total fleet landings** *(Based on fish tickets)*	*Sablefish landings (mt)*			*Groundfish landings (mt)*	*Sablefish landings (mt)*	*Groundfish landings (mt)*	
2002	390	407	354	452	6	387	108
2003	499	569	604	485	7	547	186
2004	698	654	626	377	6	474	184
2005	641	676	615	519	7	625	376
2006	684	708	611	441	4	487	439
2007	489	607	426	462	9	270	249
2008	385	663	421	652	18	430	238
2009	418	984	487	695	18	671	364
2010	259	1030	503	1021	34	769	302
2011	223	919	377	1238	25	445	255
Observed Pacific halibut discard ratios							
2002	0.3297	0.0283	0.0114	0.0000	*	*	*
2003	0.3532	0.0467	0.0005	0.0003	*	*	*
2004	0.2369	0.0746	0.0526	0.0000	*	*	*
2005	0.3318	0.0204	0.0043	0.0000	*	*	*
2006	0.7827	0.1636	0.0271	0.0000	*	*	*
2007	0.2184	0.0334	0.0092	0.0032	(0.0035)	0.0785	0.0035
2008	0.3715	0.1453	0.0151	0.0041	(0.0010)	0.0986	0.0010
2009	0.6436	0.0413	0.0017	0.0003	(0.0007)	0.0545	0.0007
2010	0.2642	0.0632	0.0088	0.0004	(0.0016)	0.0424	0.0016
2011	0.4780	0.0281	0.0110	0.0172	(0.0003)	0.0305	0.0003

* No discard ratio is provided for the OA fixed gear sector for 2002-2006 because the WCGOP only covered OA vessels in California during this time. Since 2007-2008 OA pot discard rates were used to estimate LE non-endorsed discard, discard ratios for this sector were also excluded.

Table 13. Summary of the percent of observed trips that caught Pacific halibut by sector, gear, and area (where applicable) in the non-nearshore groundfish fixed gear fishery. Observed mean, minimum, and maximum annual catch and discard weight (mt) are provided, along with the percent of Pacific halibut catch weight that was discarded per year.

	LE Sablefish Endorsed			LE Non-Sablefish Endorsed		OA Fixed Gear	
	Longline		Pot	Longline	Pot	Hook-and-Line Gears	Pot
	North of Pt Chehalis	South of Pt Chehalis					
% of observed trips that caught Pacific halibut							
2002	95.7%	46.8%	17.4%	0.0%	--	--	--
2003	100.0%	52.0%	8.6%	0.8%	--	0.0%	0.0%
2004	100.0%	71.4%	38.5%	0.0%	--	0.0%	0.0%
2005	96.8%	58.9%	33.3%	0.0%	--	0.0%	0.0%
2006	100.0%	76.5%	56.4%	0.0%	--	9.1%	0.0%
2007	94.4%	47.5%	33.3%	1.9%	--	26.0%	6.7%
2008	100.0%	78.3%	83.3%	3.3%	--	34.5%	5.5%
2009	84.6%	35.3%	33.3%	7.0%	--	38.2%	10.0%
2010	83.3%	46.8%	51.2%	1.3%	--	21.7%	2.5%
2011	88.9%	42.9%	45.5%	6.0%	--	30.9%	6.7%
Observed annual catch (mt) of Pacific halibut							
Mean	45.4	11.6	2.0	0.3	--	0.9	0.0
Min	12.1	2.3	0.1	0.0	--	0.1	0.0
Max	117.2	36.6	5.4	1.4	--	1.6	0.0
Observed annual discard (mt) of Pacific halibut							
Mean	40.2	11.6	2.0	0.3	--	0.9	0.0
Min	9.5	2.3	0.1	0.0	--	0.1	0.0
Max	109.6	36.6	5.4	1.4	--	1.6	0.0
% of Pacific halibut catch that was discarded							
2002	80.1%	95.5%	100.0%	n.o.c.	--	--	--
2003	82.5%	99.5%	100.0%	100.0%	--	n.o.c.	n.o.c.
2004	79.0%	97.7%	100.0%	n.o.c.	--	n.o.c.	n.o.c.
2005	84.8%	100.0%	100.0%	n.o.c.	--	n.o.c.	n.o.c.
2006	93.5%	97.9%	100.0%	n.o.c.	--	100.0%	n.o.c.
2007	80.6%	100.0%	100.0%	100.0%	--	100.0%	100.0%
2008	87.4%	100.0%	100.0%	100.0%	--	100.0%	100.0%
2009	100.0%	100.0%	100.0%	100.0%	--	100.0%	100.0%
2010	100.0%	100.0%	100.0%	100.0%	--	100.0%	100.0%
2011	100.0%	100.0%	100.0%	100.0%	--	100.0%	100.0%

n.o.c. No observed catch of Pacific halibut and thus a % discarded calculation is not possible.
 -- No WCGOP observers were depolyed for the sector/year/gear type combination.

Table 14. Estimated Pacific halibut gross discard (mt) and discard mortality (mt) in the limited entry (LE) sablefish endorsed season, LE non-sablefish endorsed, and open access (OA) fixed gear sectors of the non-nearshore groundfish fishery. Estimated discard mortality (mt) was computed by multiplying a 16% (longline) or 18% (pot) discard mortality rate by gross discard estimates. Discard estimates were not initially computed for the 2002-2006 OA fixed gear sector because the WCGOP only observed OA fixed gear vessels off of California during that time. To produce potential values for these years, a combined discard rate was used from 2007-2008 with coastwide observations.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LE Sablefish Endorsed (mt)										
Longline										
North of Pt Chehalis										
Gross discard estimate	128.7	176.2	165.3	212.6	535.5	106.8	143.2	268.8	70.8	106.7
Estimated discard mortality (16%)	20.6	28.2	26.5	34.0	85.7	17.1	22.9	43.0	11.3	17.1
South of Pt Chehalis										
Gross discard estimate	11.5	26.6	48.7	13.8	115.9	20.3	96.3	40.7	65.0	25.8
Estimated discard mortality (16%)	1.8	4.3	7.8	2.2	18.5	3.2	15.4	6.5	10.4	4.1
Coastwide										
Gross discard estimate	140.2	202.7	214.1	226.4	651.4	127.1	239.5	309.4	135.9	132.5
Estimated discard mortality (16%)	22.4	32.4	34.3	36.2	104.2	20.3	38.3	49.5	21.7	21.2
Pot										
Coastwide										
Gross discard estimate	4.1	0.3	33.0	2.6	16.5	3.9	6.4	0.8	4.5	4.1
Estimated discard mortality (18%)	0.7	0.1	5.9	0.5	3.0	0.7	1.1	0.1	0.8	0.7
LE Non-Sablefish Endorsed (mt)										
Longline										
Coastwide										
Gross discard estimate	0.0	0.1	0.0	0.0	0.0	1.5	2.6	0.2	0.4	21.3
Estimated discard mortality (16%)	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.1	3.4
Pot										
Coastwide										
Gross discard estimate	*	*	*	*	*	0.03	0.02	0.01	0.05	0.01
Assuming OA fixed gear 07-08 pot discard rate for 2002 - 2006 *	[0.0]	[0.0	[0.0]	[0.0]	[0.0]					
Estimated discard mortality (18%)	*	*	*	*	*	0.0	0.0	0.0	0.0	0.0
OA Fixed Gear (mt)										
Hook-and-line Gears										
Coastwide										
Gross discard estimate	*	*	*	*	*	21.8	44.1	39.6	32.6	17.2
Assuming 07-08 discard rate for 2002 - 2006	[28.7]	[40.3]	[29.3]	[55.8]	[37.4]					
Estimated discard mortality (16%)	*	*	*	*	*	3.5	7.1	6.3	5.2	2.7
Pot										
Coastwide										
Gross discard estimate	*	*	*	*	*	0.9	0.2	0.3	0.5	0.1
Assuming 07-08 discard rate for 2002 - 2006	[0.2]	[0.4]	[0.4]	[0.8]	[0.9]					
Estimated discard mortality (18%)	*	*	*	*	*	0.2	0.0	0.0	0.1	0.0

* The LE non-sablefish endorsed pot sector has not been observed by the WCGOP and therefore estimates are based on discard rates from observed OA fixed gear pot vessels. Because the OA fixed gear pot sector was only observed on a coastwide basis in 2007 and 2008, estimates for LE non-sablefish endorsed pot are only available in these years as well.

Table 15. Estimated Pacific halibut discard mortality (mt) from each sector of the non-nearshore groundfish fixed gear fishery from 2002 through 2011.

	Estimated discard mortality (mt)			
	LE Sablefish Endorsed	LE Non-Sablefish Endorsed	OA Fixed Gear	All Sectors
2002	23.1	0.0	0.0	23.1
2003	32.5	0.0	0.0	32.5
2004	39.5	0.0	0.0	39.5
2005	36.6	0.0	0.0	36.6
2006	106.9	0.0	0.0	106.9
2007	21.0	0.2	3.6	24.8
2008	39.3	0.4	7.1	46.9
2009	49.7	0.0	6.4	56.1
2010	22.4	0.1	5.3	27.8
2011	21.9	3.4	2.8	28.1

Table 16. Pacific halibut length frequencies collected by WCGOP observers during the LE sablefish endorsed fishery, including both pot and longline gear, from 2002-2011. (a) Actual measurement of P. halibut lengths (cm). (b) Visual estimates of P. halibut lengths (cm). Note that observers were only required to collect actual measurements from LE sablefish endorsed vessels in 2011. The lower limits on the length intervals are inclusive, while the upper limits are exclusive. Numbers are numbers of individual P. halibut per bin.

LE Sablefish Endorsed Fishery 2002-2011

a.

Actual Length bin (cm)	Length freq.	Percent length freq.
27 - 32	0	0.00
32 - 37	0	0.00
37 - 42	0	0.00
42 - 47	1	0.00
47 - 52	7	0.00
52 - 57	8	0.01
57 - 62	24	0.02
62 - 67	63	0.04
67 - 72	135	0.09
72 - 77	264	0.17
77 - 82	281	0.18
82 - 87	223	0.14
87 - 92	178	0.11
92 - 97	148	0.10
97 - 102	82	0.05
102 - 107	50	0.03
107 - 112	32	0.02
112 - 117	24	0.02
117 - 122	15	0.01
122 - 127	11	0.01
127 - 132	3	0.00
132 - 137	3	0.00
137 - 142	1	0.00
142 - 147	1	0.00
145 - 149	0	0.00
150 - 154	0	0.00
155 - 159	0	0.00
160 - 164	0	0.00
165 - 169	0	0.00
170 - 174	0	0.00
175 - 179	0	0.00
180 - 184	0	0.00
185 - 189	0	0.00

b.

Visual Length bin (cm)	Length freq.	Percent length freq.
10	0	0.00
20	0	0.00
30	5	0.00
40	33	0.00
50	256	0.01
60	2737	0.14
70	4495	0.23
80	4763	0.24
90	3915	0.20
100	2084	0.11
110	776	0.04
120	327	0.02
130	108	0.01
140	21	0.00
150	5	0.00
160	0	0.00
170	0	0.00
180	0	0.00
190	0	0.00

Table 17. Pacific halibut actual and visual length data approximating legal (≥ 82 cm) versus sublegal definitions (IPHC), collected by the WCGOP in the LE sablefish endorsed fixed gear sector.

	Pacific halibut lengths	
	Number	Percentage
Actual length		
< 80 cm	783	50%
≥ 80 cm	771	50%
Visual estimate		
0 - 74 cm	7526	39%
75 - 84 cm	4763	24%
85 - 150 cm	7236	37%

Table 18. Coverage information, bycatch ratios, and bycatch estimates for Pacific halibut in the nearshore fixed gear groundfish fishery by state. The WCGOP began observing the California nearshore fishery in 2003 and the Oregon nearshore fishery in 2004. Bycatch estimates in this table are not intended to represent mortality values, as discard mortality rates are not available for the nearshore fixed gear fishery.

	Observed							Total fleet catch of nearshore species (mt)	Estimated		
	Fleet observer coverage rate *	Number of observed sets	% of sets with Pacific halibut	Pacific halibut bycatch (kg)	Nearshore species retained (kg)	Pacific halibut bycatch rate	SE		Pacific halibut bycatch (mt)	Lower bound (mt)	Upper bound (mt)
Nearshore fixed gear groundfish fishery sector											
Oregon											
2002 *not observed*			-	-	-	-	-	279	-	-	-
2003 *not observed*			-	-	-	-	-	208	-	-	-
2004	4.9%	207	1.9%	48.9	10,210	0.0048	0.0027	210	1.005	0.002	2.123
2005	6.3%	167	0.6%	32.5	11,419	0.0028	0.0028	180	0.513	0.002	1.520
2006	11.6%	379	1.3%	62.8	19,396	0.0032	0.0016	168	0.543	0.005	1.081
2007	8.9%	242	0.4%	7.8	16,103	0.0005	0.0005	180	0.087	0.002	0.257
2008	7.6%	183	0.5%	27.2	14,285	0.0019	0.0019	189	0.360	0.002	1.066
2009	6.2%	219	2.3%	80.1	13,852	0.0058	0.0028	224	1.298	0.060	2.536
2010	7.6%	210	0.5%	6.1	13,209	0.0005	0.0005	173	0.080	0.002	0.237
2011	8.1%	246	2.0%	89.6	15,891	0.0056	0.0031	195	1.100	0.002	2.275
California											
2002 *not observed*			-	-	-	-	-	380	-	-	-
2003	3.2%	205	0.0%	0.0	8,085	0.0000	0.0000	255	0.000	0.000	0.000
2004	8.0%	422	0.0%	0.0	23,126	0.0000	0.0000	288	0.000	0.000	0.000
2005	4.7%	217	0.9%	79.5	13,108	0.0061	0.0054	280	1.695	0.003	4.665
2006	3.2%	158	0.0%	0.0	8,367	0.0000	0.0000	258	0.000	0.000	0.000
2007	4.5%	224	0.0%	0.0	12,138	0.0000	0.0000	271	0.000	0.000	0.000
2008	2.2%	87	0.0%	0.0	6,543	0.0000	0.0000	293	0.000	0.000	0.000
2009	2.6%	122	0.0%	0.0	6,723	0.0000	0.0000	260	0.000	0.000	0.000
2010	3.2%	117	0.0%	0.0	7,083	0.0000	0.0000	219	0.000	0.000	0.000
2011	3.9%	214	0.5%	77.3	8,448	0.0091	0.0091	216	1.979	0.002	5.857

* Coverage rate in the nearshore sector is defined as the proportion of nearshore target species landings that were observed.

Table 19. Coverage information, bycatch ratios, and bycatch estimates (mt) for Pacific halibut in the pink shrimp trawl fishery. The WCGOP began observing the pink shrimp fishery in 2004, but was not able to observe the fishery in 2006. Bycatch estimates in this table are not intended to represent morality values, as discard mortality rates are not available for the pink shrimp fishery.

	Observed								Estimated		
	Fleet observer coverage rate *	Number of observed tows	% of tows with Pacific halibut	Pacific halibut bycatch (kg)	Pink shrimp retained (kg)	Pacific halibut bycatch rate	SE	Total fleet catch of pink shrimp (mt)	Pacific halibut bycatch (mt)	Lower bound (mt)	Upper bound (mt)
Pink shrimp trawl fishery											
2002 *not observed*		-	-	-	-	-	-	25,375	-	-	-
2003 *not observed*		-	-	-	-	-	-	13,887	-	-	-
2004	6.5%	1026	0.0%	0.0	583,266	0.000000	0.000000	8,974	0.000	0.000	0.000
2005	3.9%	509	0.2%	2.3	424,683	0.000005	0.000005	10,862	0.058	0.109	0.172
2006 *not observed*		-	-	-	-	-	-	8,400	-	-	-
2007	6.2%	951	0.2%	15.3	672,663	0.000023	0.000019	10,935	0.248	0.109	0.649
2008	5.2%	840	0.0%	0.0	805,763	0.000000	0.000000	15,375	0.000	0.000	0.000
2009	6.0%	695	0.0%	0.0	866,905	0.000000	0.000000	14,412	0.000	0.000	0.000
2010	11.6%	1654	0.0%	0.0	2,365,275	0.000000	0.000000	20,327	0.000	0.000	0.000
2011	14.3%	2751	0.1%	27.0	4,216,533	0.000006	0.000004	29,460	0.189	0.295	0.422

* Coverage rate in the pink shrimp trawl fishery is defined as the proportion of pink shrimp landings that were observed.

Table 20. Coverage information, bycatch ratios, and bycatch estimates (mt) for Pacific halibut in the California halibut trawl fishery. The fishery is comprised of a limited entry component and an open access component. Beginning in 2011, the limited entry component of the California halibut fishery is observed under the IFQ groundfish fishery (see above). Bycatch estimates in this table are not intended to represent morality values, as discard mortality rates are not available for the California halibut fishery.

	Observed								Estimated		
	Fleet observer coverage rate *	Number of observed tows	% of tows with Pacific halibut	Pacific halibut bycatch (kg)	California halibut retained (kg)	Pacific halibut bycatch rate	SE	Total fleet catch of California halibut (mt)	Pacific halibut bycatch (mt)	Lower bound (mt)	Upper bound (mt)
California halibut trawl fishery											
Limited Entry Sector											
2002	3.2%	52	0.0%	0.0	3,590	0.0000	0.0000	112	0.000	0.000	0.000
2003	17.0%	206	0.0%	0.0	19,104	0.0000	0.0000	112	0.000	0.000	0.000
2004	16.7%	141	0.7%	3.5	23,447	0.0001	0.0001	140	0.021	0.001	0.062
2005	14.1%	221	0.5%	4.7	27,342	0.0002	0.0002	194	0.033	0.002	0.099
2006	11.7%	224	0.9%	2.9	14,286	0.0002	0.0002	123	0.025	0.001	0.063
2007	12.8%	80	1.3%	8.1	5,419	0.0015	0.0015	42	0.063	0.000	0.188
2008	24.6%	118	8.5%	82.6	9,637	0.0086	0.0030	39	0.336	0.108	0.563
2009	6.0%	29	0.0%	0.0	2,898	0.0000	0.0000	48	0.000	0.000	0.000
2010	11.7%	41	0.0%	0.0	6,396	0.0000	0.0000	55	0.000	0.000	0.000
2011	Observed under IFQ Fishery, see Tables 1 & 2										
Open Access Sector											
2002 *not observed*			-	-	-	-	-	90	-	-	-
2003	4.3%	110	0.0%	0.0	1,977	0.0000	0.0000	46	0.000	0.000	0.000
2004	6.4%	244	1.6%	49.4	5,100	0.0097	0.0058	80	0.776	0.001	1.691
2005	9.7%	360	0.0%	0.0	7,489	0.0000	0.0000	77	0.000	0.000	0.000
2006 *not observed*			-	-	-	-	-	61	-	-	-
2007	6.9%	226	0.0%	0.0	2,694	0.0000	0.0000	39	0.000	0.000	0.000
2008	5.2%	197	0.0%	0.0	2,631	0.0000	0.0000	50	0.000	0.000	0.000
2009	0.7%	30	0.0%	0.0	634	0.0000	0.0000	85	0.000	0.000	0.000
2010	3.5%	111	0.0%	0.0	2,349	0.0000	0.0000	67	0.000	0.000	0.000
2011	15.6%	213	0.0%	0.0	12,504	0.0000	0.0000	80	0.000	0.000	0.000

* Coverage rate in the California halibut trawl fishery is defined as the proportion of California halibut landings that were observed.

Table 21. Discard estimates for all fishery sectors observed by the NWFSC Groundfish Observer Program (WCGOP), 2002-2011. Total discard mortality estimates are also provided when discard mortality rates were available.

			IFQ Fishery (first year: 2011)						Non-nearshore fixed gear			Nearshore fixed gear*	Pink shrimp*	CA halibut‡*	At-sea Hake*	Total
	Year	LE bottom trawl (2002-2010)	Shoreside Hake*	LE CA Halibut*	Bottom Trawl	Midwater Trawl*	Hook and Line	Pot	LE endorsed	LE non-endorsed	OA					
Gross discard estimates (mt)	2002	524							144	0.0	-	-	-	0.0	1.1	670
	2003	187							203	0.1	-	0.0	-	0.0	2.6	392
	2004	212							247	0.0	-	1.0	0.0	0.8	1.1	462
	2005	460							229	0.0	-	2.2	0.1	0.0	2.0	694
	2006	391							668	0.0	-	0.5	-	0.0	0.8	1060
	2007	294							131	1.5	22.7	0.1	0.2	0.1	1.2	451
	2008	305							246	2.7	44.3	0.4	0.0	0.3	4.0	603
	2009	385							310	0.2	39.9	1.3	0.0	0.0	0.3	737
	2010	265							140	0.4	33.1	0.1	0.0	0.0	1.6	441
	2011		0.0	0.0	65.2	***	6.1	3.3	137	21.3	17.2	2.0	0.2	0.0	0.6	253
Total discard mortality (mt)	2002	345							23	0.0	0.0	-	-	0.0	1.1	369
	2003	124							32	0.0	0.0	0.0	-	0.0	2.6	160
	2004	133							40	0.0	0.0	1.0	0.0	0.8	1.1	176
	2005	287							37	0.0	0.0	2.2	0.1	0.0	2.0	327
	2006	242							107	0.0	0.0	0.5	-	0.0	0.8	351
	2007	209							21	0.2	3.6	0.1	0.2	0.1	1.2	235
	2008	208							39	0.4	7.1	0.4	0.0	0.3	4.0	259
	2009	251							50	0.0	6.4	1.3	0.0	0.0	0.3	309
	2010	181							22	0.1	5.3	0.1	0.0	0.0	1.6	210
	2011		0.03	0.0	31.3	***	1.0	0.9	22	3.4	2.8	2.0	0.2	0.0	0.6	64

" - " Indicates years of incomplete or no observer coverage for which estimates are not available

‡ Since 2011, CA Halibut only includes Open Access sector because the Limited Entry sector is covered under the IFQ Fishery.

* Mortality rate of 100% applied

FIGURES

Figure 1. Fish ticket data processing for division into 2011 groundfish fishery sectors after retrieval from the Pacific Fisheries Information Network (PacFIN) database. Grey boxes indicate sectors for which federal observer data is available. Fish ticket processing methods are updated regularly, thus this figure might differ from similar figures in previous reports.

Fish Ticket Processing
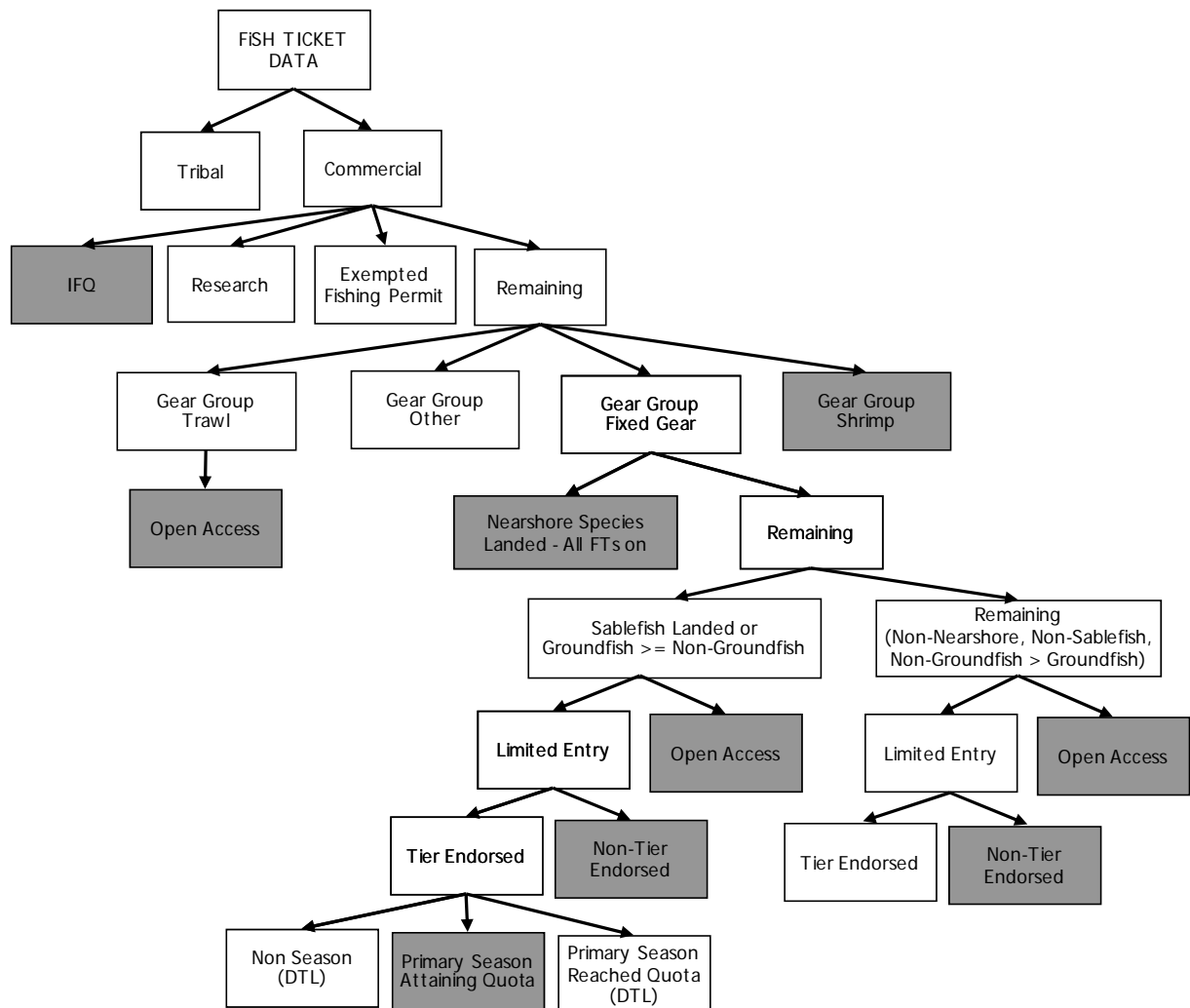
Figure 2a. Spatial distribution of Pacific halibut catch (mt/km^2) observed by the West Coast Groundfish Observer Program, off the U.S. west coast (WA, OR). Gear types observed by the WCGOP include bottom trawl, midwater trawl, shrimp trawl, fixed gear hook-&-line and pot gear. The four catch classifications were defined by dividing the maximum value (2.0697) in half to obtain the 1.0349-2.0697 catch bin. The next lower bin was obtained by dividing the lower bound of the upper bin (1.0348) in half again to obtain the 0.51745-1.0348 catch bin. The remaining observations were allocated into equal proportions into the two lowest classifications. Cells calculated from less than 3 vessels were omitted from the map due to confidentiality.
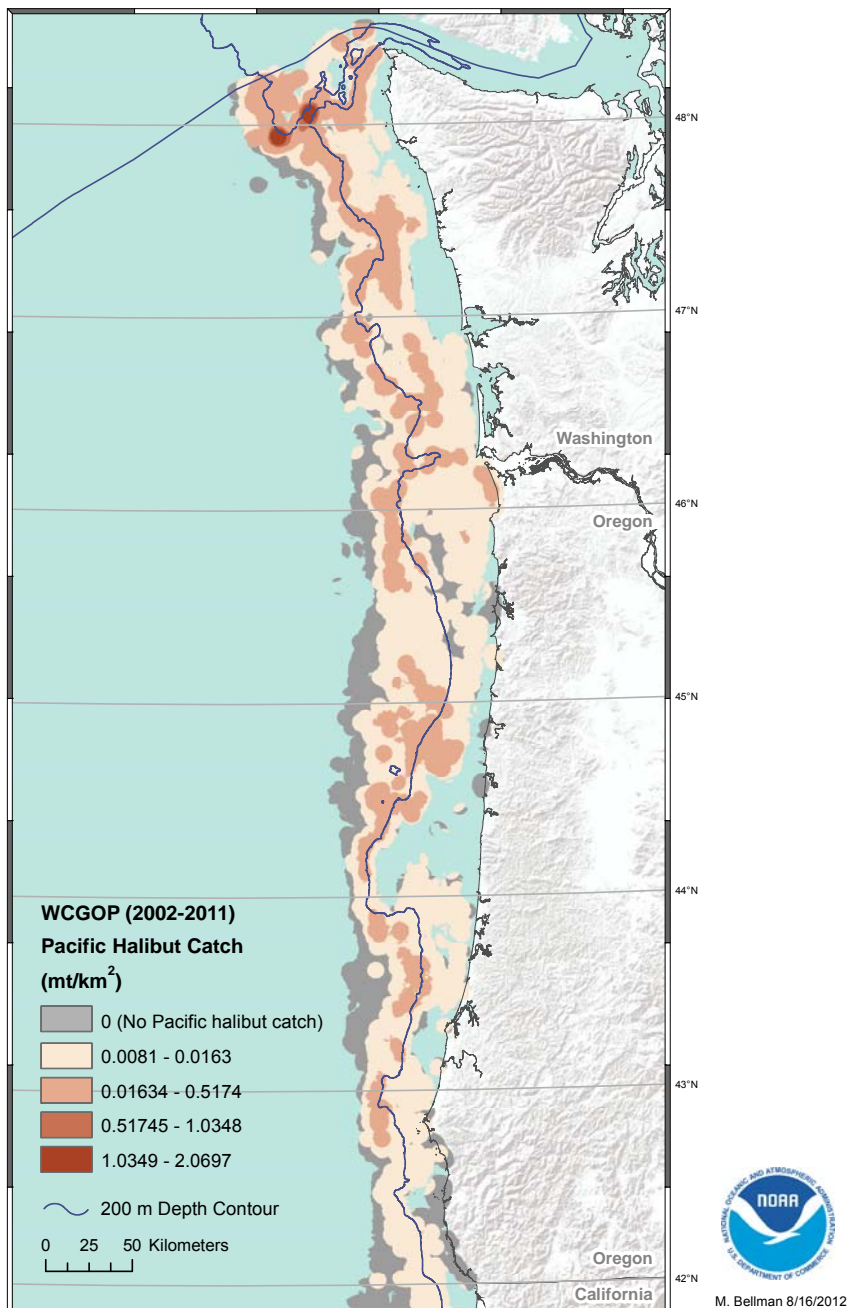
Figure 2b. Spatial distribution of Pacific halibut catch (mt/km^2) and fishing grounds observed by the West Coast Groundfish Observer Program, off the U.S. west coast (CA). See Figure 2a caption for full description.
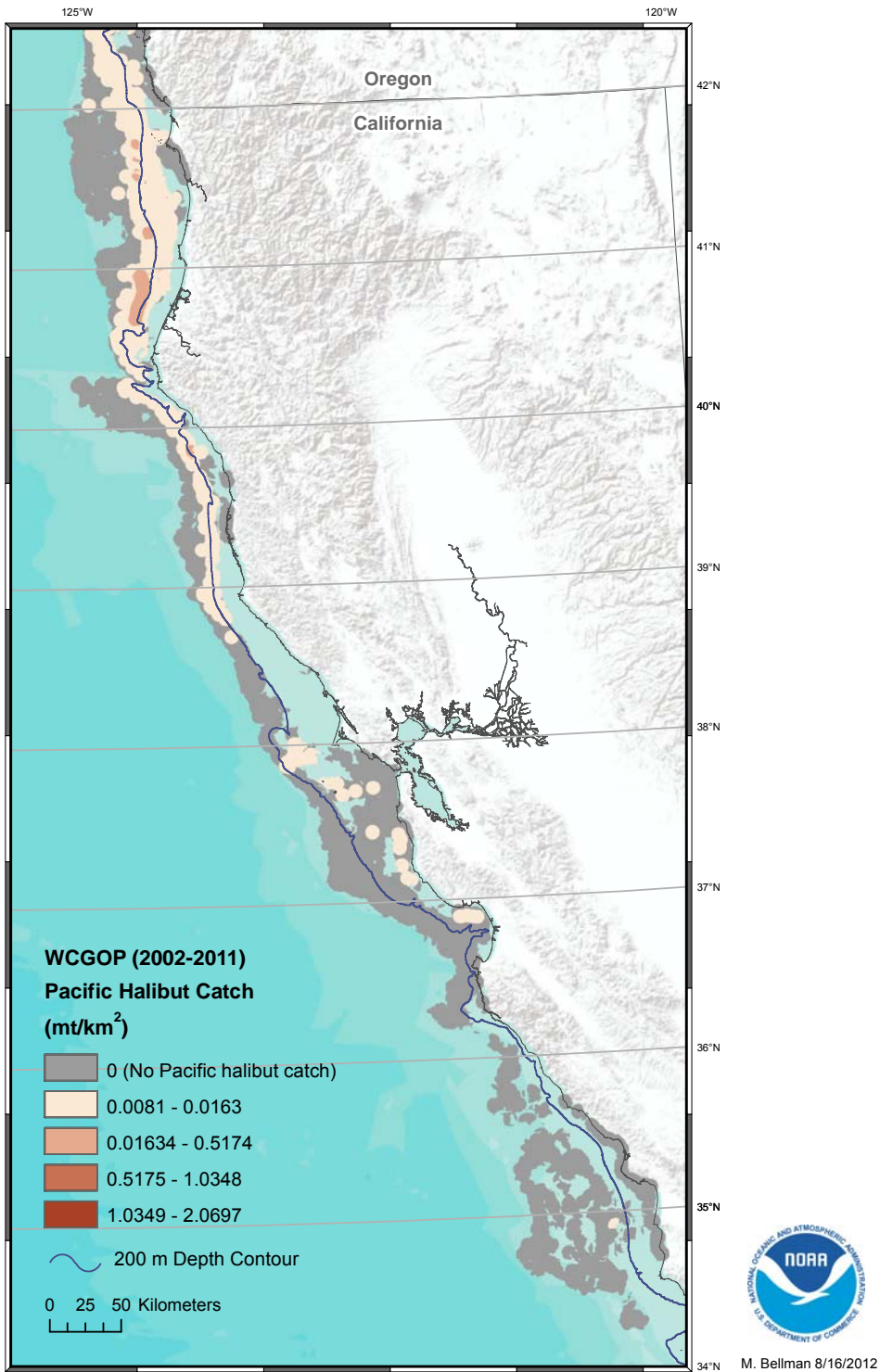
Figure 3. Estimated discard mortality of Pacific halibut in the non-nearshore groundfish fixed gear fishery. Estimates are presented for fixed gear sectors with annual discard estimates exceeding 1 mt, which included all components of the limited entry (LE) sablefish endorsed sector (longline gear (LL) by area and pot gear (POT) coastwide) and the open access (OA) sector using hook-&-line gears. The OA fixed gear sector was only observed in California from 2003-2006 and was not covered in 2002. A fixed average discard rate from 2007 and 2008 data was applied to generate 2002-2006 discard estimates for the OA sector. Although OA 2002-2006 discard estimates are not included in final total mortality summaries, they are shown here for comparison purposes. Other fixed gear sectors include LE non-sablefish endorsed and OA fixed gear vessels fishing with pot gear.
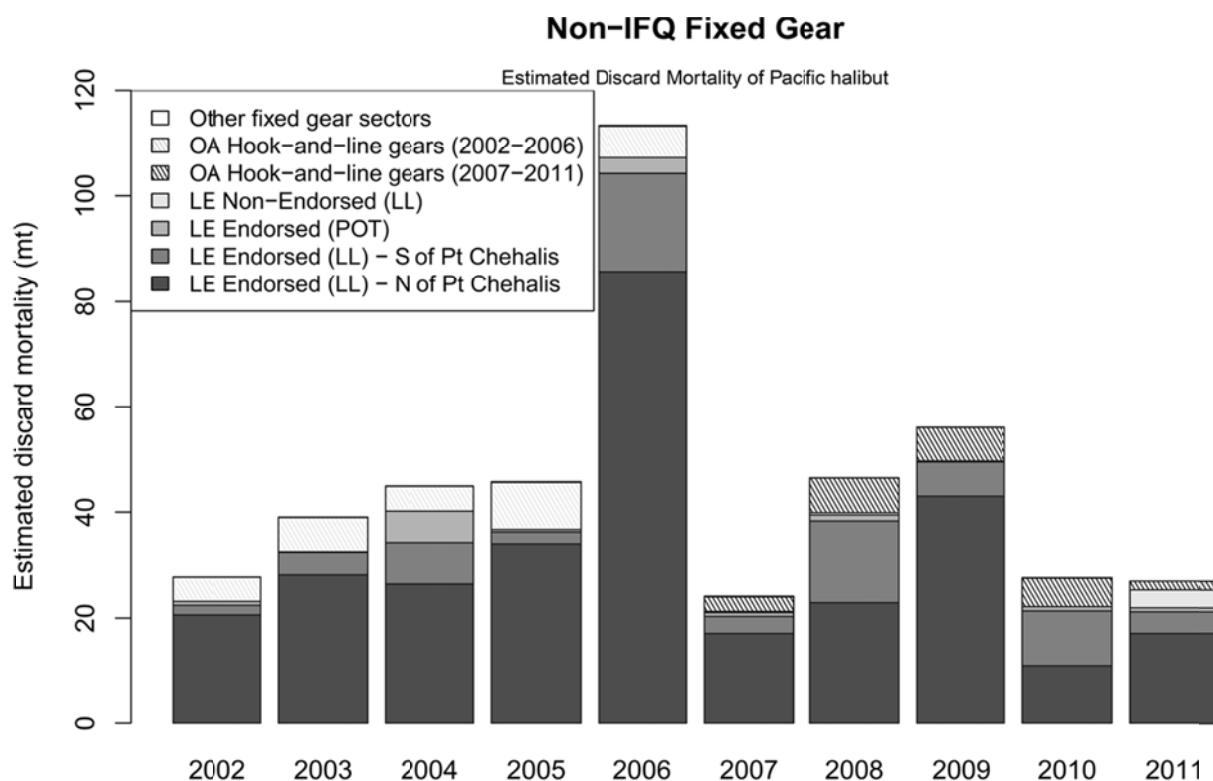
Figure 4. Length frequency distribution of discarded Pacific halibut on WCGOP observed non-IFQ, limited entry (LE) and open access (OA) groundfish fixed gear vessels from September 2003 through December 2011. The majority of Pacific halibut lengths collected in this fishery were visual estimates (solid dark line).
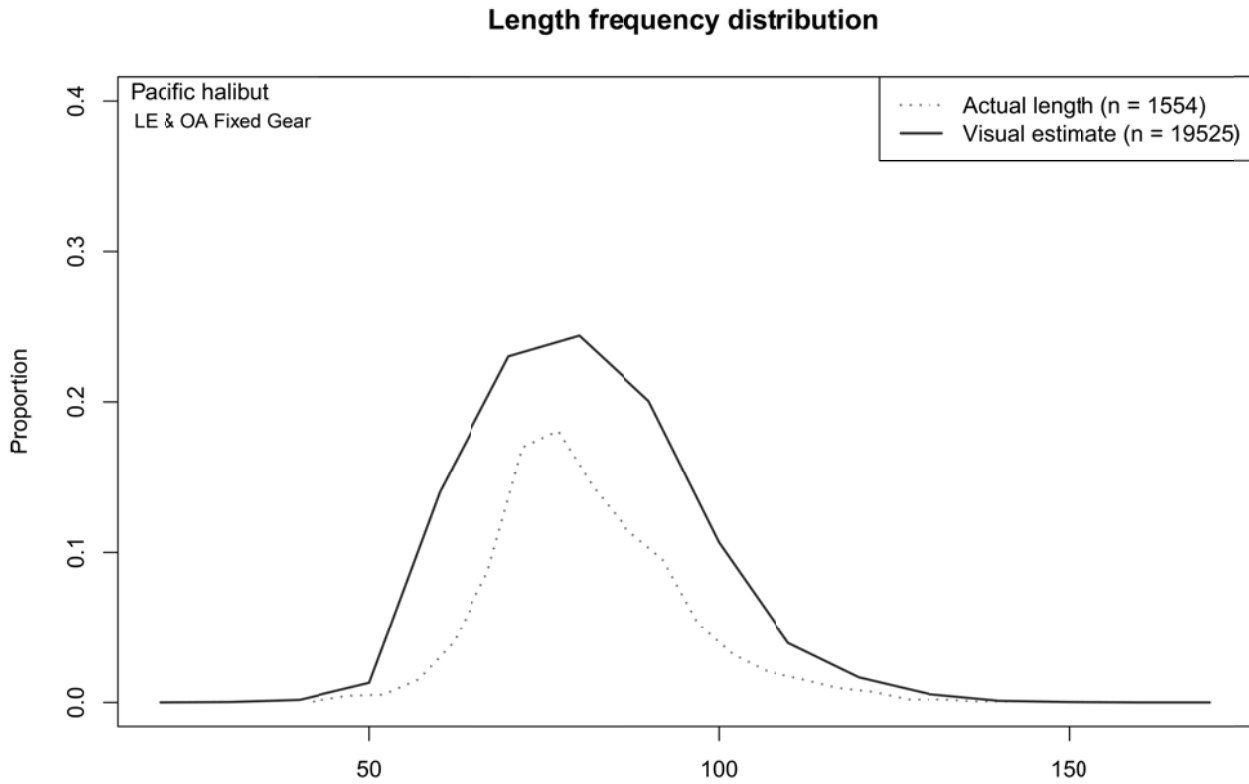
APPENDIX A

Weighted catch composition data from the IFQ fishery for bottom trawl and pot gears. The frequency within each length bin was weighted based on the following equation:

$$n_{wghtd_l} = n_l \times \frac{W_{st}}{\sum_l w_{stl}} \times \frac{\sum_t W_{st}}{W_{st}} \times \frac{\hat{W}_s}{\sum_t W_{st}} = n_l \times \frac{\hat{W}_s}{\sum_l w_{stl}}$$

where:

n_l: number of measured fish in length bin l

w_{stl}: total weight of length l fish measured, as determined through the IPHC length-weight relationship

W_{st}: total observed discard weight of Pacific halibut on tow t, in stratum s

$\hat{W}_s$: estimated total discard weight of Pacific halibut in stratum s

Table A1. Weighted length frequency distributions for Pacific halibut in the 2011 IFQ fishery for bottom trawl and pot gears.

	IFQ Fishery 2011			IFQ Fishery 2011			IFQ Fishery 2011	
Length bin (cm)	Bottom Trawl	Pot	Length bin (cm)	Bottom Trawl	Pot	Length bin (cm)	Bottom Trawl	Pot
18	0.0065	0.0000	80	0.0575	0.1033	142	0.0001	0.0000
20	0.0000	0.0000	82	0.0471	0.0504	144	0.0001	0.0000
22	0.0000	0.0000	84	0.0457	0.0459	146	0.0000	0.0000
24	0.0000	0.0000	86	0.0306	0.0329	148	0.0000	0.0000
26	0.0000	0.0000	88	0.0282	0.0297	150	0.0000	0.0000
28	0.0000	0.0000	90	0.0263	0.0455	152	0.0000	0.0000
30	0.0000	0.0734	92	0.0213	0.0173	154	0.0000	0.0000
32	0.0000	0.0000	94	0.0168	0.0149	156	0.0000	0.0000
34	0.0000	0.0000	96	0.0135	0.0123	158	0.0000	0.0000
36	0.0000	0.0000	98	0.0097	0.0098	160	0.0000	0.0000
38	0.0000	0.0000	100	0.0090	0.0194	162	0.0000	0.0000
40	0.0041	0.0578	102	0.0071	0.0020	164	0.0000	0.0000
42	0.0023	0.0000	104	0.0055	0.0019	166	0.0000	0.0003
44	0.0000	0.0197	106	0.0040	0.0000	168	0.0000	0.0000
46	0.0003	0.0000	108	0.0031	0.0028	170	0.0000	0.0000
48	0.0029	0.0000	110	0.0025	0.0016	172	0.0000	0.0000
50	0.0054	0.0063	112	0.0020	0.0010	174	0.0000	0.0000
52	0.0045	0.0000	114	0.0018	0.0022	176	0.0000	0.0000
54	0.0078	0.0103	116	0.0011	0.0004	178	0.0000	0.0000
56	0.0073	0.0044	118	0.0009	0.0009	180	0.0000	0.0000
58	0.0191	0.0121	120	0.0005	0.0024	182	0.0000	0.0000
60	0.0330	0.0605	122	0.0005	0.0023	184	0.0000	0.0000
62	0.0435	0.0501	124	0.0006	0.0000	186	0.0000	0.0000
64	0.0556	0.0174	126	0.0003	0.0000	188	0.0000	0.0000
66	0.0579	0.0109	128	0.0003	0.0007	190	0.0000	0.0000
68	0.0561	0.0172	130	0.0001	0.0006	192	0.0000	0.0000
70	0.0771	0.0680	132	0.0002	0.0000	194	0.0000	0.0000
72	0.0727	0.0726	134	0.0000	0.0006	196	0.0000	0.0000
74	0.0851	0.0433	136	0.0001	0.0005	198	0.0000	0.0000
76	0.0665	0.0147	138	0.0000	0.0002	200	0.0000	0.0001
78	0.0556	0.0595	140	0.0001	0.0000			

Table A2. Percentage of weighted length measurements in each viability condition category, by gear type in the 2011 IFQ groundfish fishery.

IFQ Fishery 2011

Length bin (cm)	Bottom Trawl			Pot			Length bin (cm)	Bottom Trawl			Pot		
	Excellent	Poor	Dead	Excellent	Poor	Dead		Excellent	Poor	Dead	Excellent	Poor	Dead
18	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	110	56.3%	11.2%	32.5%	100.0%	0.0%	0.0%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	112	56.7%	22.5%	20.8%	100.0%	0.0%	0.0%
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	114	49.8%	25.1%	25.0%	57.6%	0.0%	42.4%
24	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	116	60.8%	13.4%	25.7%	0.0%	0.0%	100.0%
26	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	118	55.9%	9.8%	34.3%	0.0%	0.0%	100.0%
28	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	120	47.5%	28.3%	24.2%	100.0%	0.0%	0.0%
30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	122	54.3%	8.2%	37.5%	100.0%	0.0%	0.0%
32	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	124	39.9%	21.7%	38.3%	0.0%	0.0%	0.0%
34	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	126	41.9%	19.3%	38.8%	0.0%	0.0%	0.0%
36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	128	53.2%	35.4%	11.4%	100.0%	0.0%	0.0%
38	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	130	75.3%	24.7%	0.0%	100.0%	0.0%	0.0%
40	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	132	45.2%	18.4%	36.4%	0.0%	0.0%	0.0%
42	48.7%	51.3%	0.0%	0.0%	0.0%	0.0%	134	79.1%	20.9%	0.0%	100.0%	0.0%	0.0%
44	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	136	25.4%	49.1%	25.4%	100.0%	0.0%	0.0%
46	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	138	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%
48	25.1%	25.1%	49.7%	0.0%	0.0%	0.0%	140	48.9%	51.1%	0.0%	0.0%	0.0%	0.0%
50	29.8%	0.0%	70.2%	0.0%	0.0%	0.0%	142	24.9%	25.4%	49.7%	0.0%	0.0%	0.0%
52	23.0%	42.3%	34.7%	0.0%	0.0%	0.0%	144	59.2%	40.8%	0.0%	0.0%	0.0%	0.0%
54	15.7%	42.8%	41.5%	0.0%	0.0%	100.0%	146	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
56	20.8%	45.3%	33.9%	100.0%	0.0%	0.0%	148	49.4%	0.0%	50.6%	0.0%	0.0%	0.0%
58	19.9%	31.2%	48.9%	67.9%	0.0%	32.1%	150	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
60	32.9%	24.2%	42.9%	57.3%	0.0%	42.7%	152	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
62	37.8%	22.7%	39.6%	38.0%	0.0%	62.0%	154	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
64	39.6%	18.7%	41.7%	34.5%	0.0%	65.5%	156	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
66	36.7%	21.1%	42.3%	50.0%	0.0%	50.0%	158	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
68	42.6%	12.0%	45.4%	69.9%	0.0%	30.1%	160	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
70	41.6%	20.8%	37.7%	62.2%	3.4%	34.4%	162	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
72	38.6%	20.9%	40.5%	77.3%	0.0%	22.7%	164	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
74	40.2%	17.4%	42.4%	69.2%	9.1%	21.7%	166	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
76	45.7%	16.9%	37.4%	43.2%	0.0%	56.8%	168	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
78	41.3%	18.9%	39.8%	59.1%	7.9%	33.0%	170	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
80	45.9%	15.9%	38.2%	57.6%	1.7%	40.7%	172	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
82	45.8%	19.9%	34.3%	86.4%	5.6%	8.0%	174	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
84	50.4%	14.7%	34.9%	59.3%	6.0%	34.7%	176	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
86	44.9%	14.5%	40.6%	85.3%	7.4%	7.4%	178	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
88	41.7%	16.1%	42.2%	92.4%	0.0%	7.6%	180	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
90	48.5%	16.9%	34.5%	70.5%	0.0%	29.5%	182	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
92	47.0%	17.2%	35.8%	55.8%	22.1%	22.1%	184	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
94	51.2%	20.1%	28.7%	52.2%	23.9%	23.9%	186	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
96	49.5%	14.6%	35.9%	45.6%	13.4%	41.0%	188	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
98	50.0%	18.2%	31.8%	53.2%	0.0%	46.8%	190	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
100	53.9%	18.2%	27.9%	77.6%	0.0%	22.4%	192	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
102	47.4%	16.1%	36.5%	100.0%	0.0%	0.0%	194	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
104	53.0%	18.8%	28.2%	100.0%	0.0%	0.0%	196	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
106	54.4%	18.4%	27.2%	0.0%	0.0%	0.0%	198	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
108	54.3%	19.9%	25.8%	18.5%	0.0%	81.5%	200	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%

Table A3. Weighted length frequency distributions for Pacific halibut in the limited entry bottom trawl fishery, 2004-2010.

Length bin (cm)	Weighted length frequency distribution							Length bin (cm)	Weighted length frequency distribution						
	2004	2005	2006	2007	2008	2009	2010		2004	2005	2006	2007	2008	2009	2010
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	94	0.0169	0.0108	0.0099	0.0148	0.0164	0.0151	0.0053
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	96	0.0062	0.0052	0.0066	0.0089	0.0143	0.0087	0.0066
26	0.0000	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000	98	0.0034	0.0058	0.0066	0.0091	0.0110	0.0103	0.0067
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	100	0.0089	0.0045	0.0025	0.0053	0.0080	0.0088	0.0023
30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	102	0.0060	0.0034	0.0029	0.0036	0.0061	0.0069	0.0018
32	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	104	0.0065	0.0023	0.0027	0.0041	0.0083	0.0062	0.0021
34	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	106	0.0043	0.0029	0.0032	0.0031	0.0059	0.0028	0.0013
36	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	108	0.0016	0.0014	0.0019	0.0018	0.0027	0.0025	0.0014
38	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	110	0.0048	0.0015	0.0004	0.0017	0.0018	0.0021	0.0009
40	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	112	0.0015	0.0007	0.0020	0.0010	0.0016	0.0024	0.0013
42	0.0000	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	114	0.0020	0.0010	0.0007	0.0007	0.0020	0.0017	0.0001
44	0.0025	0.0012	0.0057	0.0000	0.0000	0.0010	0.0000	116	0.0026	0.0006	0.0002	0.0000	0.0010	0.0005	0.0005
46	0.0037	0.0000	0.0094	0.0000	0.0000	0.0009	0.0000	118	0.0007	0.0004	0.0003	0.0002	0.0004	0.0002	0.0002
48	0.0000	0.0034	0.0046	0.0000	0.0000	0.0000	0.0000	120	0.0013	0.0005	0.0002	0.0002	0.0005	0.0003	0.0002
50	0.0027	0.0068	0.0092	0.0000	0.0007	0.0010	0.0000	122	0.0008	0.0003	0.0000	0.0004	0.0003	0.0003	0.0002
52	0.0021	0.0069	0.0080	0.0041	0.0001	0.0053	0.0000	124	0.0010	0.0002	0.0001	0.0000	0.0003	0.0002	0.0003
54	0.0156	0.0076	0.0164	0.0042	0.0025	0.0004	0.0000	126	0.0000	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002
56	0.0138	0.0211	0.0242	0.0071	0.0022	0.0019	0.0000	128	0.0002	0.0000	0.0002	0.0000	0.0000	0.0002	0.0000
58	0.0187	0.0331	0.0322	0.0293	0.0027	0.0091	0.0022	130	0.0003	0.0002	0.0001	0.0002	0.0000	0.0002	0.0000
60	0.0400	0.0431	0.0670	0.0593	0.0169	0.0175	0.0056	132	0.0005	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
62	0.0329	0.0719	0.0751	0.0638	0.0285	0.0275	0.0121	134	0.0006	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000
64	0.0428	0.0783	0.1001	0.0932	0.0614	0.0545	0.0155	136	0.0001	0.0001	0.0002	0.0000	0.0000	0.0001	0.0000
66	0.0532	0.0807	0.0979	0.1150	0.0705	0.0606	0.0185	138	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000
68	0.0757	0.0845	0.0870	0.0000	0.0599	0.0835	0.0256	140	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
70	0.0672	0.0851	0.0986	0.1022	0.0871	0.0971	0.0154	142	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
72	0.0774	0.0882	0.0478	0.1029	0.0973	0.0972	0.0314	144	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
74	0.0998	0.0746	0.0588	0.0840	0.1023	0.0941	0.0383	146	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
76	0.0890	0.0538	0.0461	0.0710	0.0743	0.0697	0.0284	148	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
78	0.0658	0.0506	0.0423	0.0539	0.0688	0.0744	0.0349	150	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
80	0.0586	0.0427	0.0372	0.0460	0.0599	0.0527	0.0298	152	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
82	0.0486	0.0320	0.0258	0.0325	0.0443	0.0434	0.0239	154	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
84	0.0337	0.0255	0.0186	0.0316	0.0428	0.0335	0.0227	156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
86	0.0221	0.0166	0.0130	0.0000	0.0300	0.0290	0.0141	158	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
88	0.0235	0.0115	0.0120	0.0154	0.0263	0.0290	0.0122	160	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90	0.0193	0.0127	0.0115	0.0168	0.0225	0.0263	0.0100	162	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
92	0.0157	0.0092	0.0101	0.0122	0.0179	0.0204	0.0094	164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table A4. Percentage of weighted length measurements in each condition category for the limited entry bottom trawl fishery, 2004-2010.

Length bin (cm)	2004 Exc	2004 Poor	2004 Dead	2005 Exc	2005 Poor	2005 Dead	2006 Exc	2006 Poor	2006 Dead	Length bin (cm)	2007 Exc	2007 Poor	2007 Dead	2008 Exc	2008 Poor	2008 Dead	2009 Exc	2009 Poor	2009 Dead
22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
24	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	24	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
26	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	26	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
28	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	28	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	30	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
32	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	32	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
34	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	34	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	36	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
38	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	38	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
40	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	40	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
42	0.0%	0.0%	0.0%	0.0%	88.4%	11.6%	0.0%	0.0%	0.0%	42	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
44	0.0%	0.0%	100.0%	0.0%	70.8%	29.2%	0.0%	0.0%	100.0%	44	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
46	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	46	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
48	0.0%	0.0%	0.0%	22.4%	0.0%	77.6%	0.0%	0.0%	100.0%	48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
50	0.0%	0.0%	100.0%	61.1%	9.9%	29.0%	0.0%	0.0%	100.0%	50	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%
52	100.0%	0.0%	0.0%	23.6%	31.3%	45.2%	0.0%	0.0%	100.0%	52	33.4%	0.0%	66.6%	100.0%	0.0%	0.0%	99.5%	0.5%	0.0%
54	75.5%	11.9%	12.6%	10.0%	20.8%	69.2%	16.9%	0.0%	83.1%	54	35.6%	0.0%	64.4%	0.0%	4.4%	95.6%	42.3%	57.7%	0.0%
56	12.6%	37.9%	49.5%	25.1%	12.7%	62.2%	22.0%	15.2%	62.8%	56	33.9%	0.0%	66.1%	0.0%	0.0%	100.0%	15.7%	65.3%	19.0%
58	21.4%	25.6%	53.0%	15.1%	29.5%	55.4%	4.1%	20.2%	75.7%	58	9.4%	6.8%	83.8%	3.3%	3.3%	93.3%	51.0%	4.4%	44.6%
60	58.6%	14.4%	27.0%	18.2%	21.0%	60.8%	12.9%	25.5%	61.6%	60	5.3%	7.4%	87.2%	9.0%	14.3%	76.8%	28.7%	21.9%	49.4%
62	40.0%	21.6%	38.4%	18.5%	23.7%	57.8%	27.3%	22.3%	50.4%	62	20.8%	9.5%	69.7%	6.1%	15.7%	78.2%	19.3%	19.5%	61.2%
64	33.4%	18.4%	48.2%	25.2%	28.4%	46.4%	31.5%	21.0%	47.5%	64	18.9%	5.3%	75.8%	17.3%	7.5%	75.2%	38.0%	9.4%	52.6%
66	23.9%	24.7%	51.4%	20.9%	26.7%	52.3%	29.6%	17.3%	53.0%	66	9.1%	12.5%	78.4%	25.8%	8.9%	65.4%	26.7%	19.7%	53.6%
68	38.2%	21.9%	39.9%	17.0%	27.5%	55.5%	35.5%	18.8%	45.7%	68	54.5%	45.5%	0.0%	17.4%	13.2%	69.4%	30.1%	17.5%	52.4%
70	29.5%	18.9%	51.6%	20.1%	30.3%	49.5%	30.2%	16.6%	53.2%	70	16.0%	7.6%	76.4%	13.1%	14.0%	73.0%	27.4%	17.5%	55.1%
72	22.9%	17.9%	59.2%	20.3%	27.1%	52.6%	37.2%	21.1%	41.8%	72	14.8%	9.1%	76.0%	19.1%	13.7%	67.2%	22.9%	18.3%	58.8%
74	23.8%	25.5%	50.7%	24.5%	23.4%	52.1%	39.6%	13.9%	46.5%	74	17.6%	16.9%	65.5%	24.8%	13.8%	61.3%	27.7%	14.8%	57.5%
76	24.0%	23.2%	52.8%	26.8%	29.1%	44.1%	31.2%	19.2%	49.6%	76	14.0%	9.9%	76.1%	21.9%	11.5%	66.6%	26.2%	16.6%	57.2%
78	18.8%	18.4%	62.9%	18.1%	23.5%	58.4%	35.0%	21.2%	43.8%	78	15.5%	13.4%	71.2%	24.7%	10.4%	64.9%	18.5%	12.1%	69.4%
80	19.1%	19.6%	61.3%	23.1%	27.9%	49.0%	34.3%	15.4%	50.2%	80	14.7%	11.6%	73.6%	21.2%	11.4%	67.4%	20.5%	14.1%	65.3%
82	14.4%	26.1%	59.5%	30.4%	25.1%	44.6%	31.7%	27.8%	40.5%	82	14.6%	3.0%	82.4%	21.5%	16.1%	62.4%	16.3%	18.5%	65.2%
84	21.7%	9.5%	68.9%	27.0%	18.9%	54.0%	30.1%	13.2%	56.7%	84	17.9%	7.0%	75.1%	15.9%	22.8%	61.3%	17.0%	12.0%	71.0%
86	32.4%	24.0%	43.6%	35.5%	24.7%	39.8%	31.3%	15.0%	53.7%	86	56.6%	43.4%	0.0%	17.6%	22.5%	59.8%	18.6%	15.5%	65.9%
88	27.8%	14.8%	57.5%	31.2%	27.8%	41.0%	22.9%	12.4%	64.7%	88	12.3%	10.5%	77.1%	18.1%	18.8%	63.1%	20.1%	17.2%	62.8%
90	30.2%	34.6%	35.2%	28.0%	16.6%	55.4%	23.8%	18.7%	57.5%	90	6.3%	3.7%	90.0%	23.9%	17.1%	59.0%	18.6%	13.6%	67.8%
92	40.2%	28.1%	31.7%	42.5%	21.7%	35.9%	43.7%	10.7%	45.6%	92	20.7%	8.4%	70.9%	20.9%	25.1%	54.0%	25.3%	11.8%	62.9%
94	26.1%	33.3%	40.6%	33.4%	16.3%	50.3%	35.3%	7.1%	57.6%	94	17.0%	18.4%	64.6%	18.8%	13.3%	67.9%	15.2%	18.4%	66.4%
96	19.9%	30.0%	50.1%	34.6%	19.2%	46.2%	16.5%	13.9%	69.6%	96	16.7%	3.6%	79.7%	15.4%	21.3%	63.4%	27.6%	19.6%	52.8%
98	33.8%	28.4%	37.8%	32.3%	22.8%	44.9%	16.8%	13.0%	70.2%	98	10.4%	8.2%	81.4%	28.4%	29.4%	42.3%	20.2%	16.9%	62.9%
100	14.6%	26.9%	58.5%	28.1%	17.4%	54.5%	48.5%	9.6%	41.9%	100	15.4%	23.2%	61.4%	15.0%	19.4%	65.6%	13.4%	25.5%	61.1%
102	16.0%	49.3%	34.7%	43.1%	6.9%	50.0%	13.7%	0.0%	86.3%	102	40.3%	9.2%	50.6%	27.6%	28.4%	44.1%	24.8%	23.8%	51.4%
104	19.0%	47.5%	33.5%	36.4%	16.2%	47.4%	49.6%	6.4%	44.0%	104	16.7%	15.8%	67.5%	36.6%	11.7%	51.7%	28.0%	8.4%	63.7%
106	23.6%	22.6%	53.9%	58.4%	11.9%	29.7%	10.4%	22.8%	66.8%	106	30.7%	20.1%	49.2%	34.8%	7.7%	57.6%	24.0%	13.5%	62.5%
108	27.6%	3.0%	69.4%	28.6%	22.6%	48.8%	42.2%	15.1%	42.6%	108	29.0%	2.3%	68.7%	19.4%	14.2%	66.4%	18.2%	27.7%	54.1%
110	25.4%	12.6%	62.0%	22.7%	28.1%	49.2%	32.0%	3.1%	64.9%	110	11.7%	45.1%	43.2%	40.2%	8.0%	51.9%	29.6%	10.4%	60.0%
112	95.8%	1.2%	3.0%	16.2%	0.0%	83.8%	7.2%	14.1%	78.7%	112	26.9%	23.3%	49.8%	25.1%	9.2%	65.7%	14.7%	17.4%	67.9%
114	0.0%	26.2%	73.8%	24.4%	4.9%	70.7%	38.9%	0.0%	61.1%	114	20.1%	0.0%	79.9%	22.4%	22.7%	54.9%	31.2%	7.4%	61.5%
116	58.7%	6.9%	34.4%	69.4%	0.0%	30.6%	77.8%	0.0%	22.2%	116	0.0%	0.0%	100.0%	41.6%	4.8%	53.6%	79.5%	0.5%	20.0%
118	2.7%	7.5%	89.9%	44.9%	35.0%	20.1%	33.8%	31.5%	34.7%	118	0.0%	0.0%	100.0%	25.5%	38.6%	35.9%	40.9%	4.4%	54.6%
120	5.7%	26.2%	68.0%	9.5%	28.7%	61.8%	0.0%	0.0%	100.0%	120	85.1%	0.0%	14.9%	65.5%	34.5%	0.0%	48.0%	0.7%	51.2%
122	40.8%	40.3%	18.9%	1.5%	15.2%	83.4%	50.0%	50.0%	0.0%	122	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	34.7%	0.0%	65.3%
124	70.3%	14.8%	14.8%	79.9%	0.0%	20.1%	15.6%	0.0%	84.4%	124	0.0%	0.0%	0.0%	0.0%	70.9%	29.1%	26.1%	37.0%	37.0%
126	0.0%	100.0%	0.0%	89.0%	11.0%	0.0%	47.1%	0.0%	52.9%	126	49.4%	0.0%	50.6%	0.0%	0.0%	100.0%	59.2%	40.8%	0.0%
128	82.0%	9.0%	9.0%	18.7%	0.0%	81.3%	89.8%	0.0%	10.2%	128	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.7%	1.0%	43.3%
130	13.5%	0.0%	86.5%	4.9%	47.6%	47.6%	0.0%	0.0%	100.0%	130	13.8%	0.0%	86.2%	0.0%	0.0%	0.0%	35.0%	65.0%	0.0%
132	100.0%	0.0%	0.0%	20.2%	63.3%	16.5%	0.0%	100.0%	0.0%	132	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
134	80.0%	0.0%	20.0%	100.0%	0.0%	0.0%	22.2%	0.0%	77.8%	134	0.0%	0.0%	0.0%	94.7%	0.0%	5.3%	100.0%	0.0%	0.0%
136	0.0%	0.0%	100.0%	10.5%	16.1%	73.4%	0.0%	0.0%	100.0%	136	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%
138	0.0%	0.0%	0.0%	15.2%	0.0%	84.8%	0.0%	0.0%	0.0%	138	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
140	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	140	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
142	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	142	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
144	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	144	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
146	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	146	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
148	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	148	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
150	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	150	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
152	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	152	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
154	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	154	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
156	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	156	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
158	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	158	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
160	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	160	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
162	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	162	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
164	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	164	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Length bin (cm)	2010 Exc	2010 Poor	2010 Dead
10	0.0%	100.0%	0.0%
12	0.0%	0.0%	0.0%
14	0.0%	0.0%	0.0%
16	0.0%	0.0%	0.0%
18	0.0%	0.0%	0.0%
20	0.0%	0.0%	0.0%
22	0.0%	0.0%	0.0%
24	0.0%	0.0%	0.0%
26	0.0%	0.0%	0.0%
28	0.0%	0.0%	0.0%
30	0.0%	0.0%	0.0%
32	0.0%	0.0%	0.0%
34	0.0%	0.0%	0.0%
36	0.0%	0.0%	0.0%
38	0.0%	0.0%	0.0%
40	0.0%	0.0%	0.0%
42	0.0%	0.0%	0.0%
44	0.0%	0.0%	0.0%
46	0.0%	0.0%	0.0%
48	0.0%	0.0%	0.0%
50	0.0%	0.0%	0.0%
52	0.0%	0.0%	0.0%
54	0.0%	0.0%	0.0%
56	0.0%	0.0%	0.0%

Length bin	2010 Exc	2010 Poor	2010 Dead
58	100.0%	0.0%	0.0%
60	33.4%	0.0%	66.6%
62	15.7%	29.4%	54.9%
64	30.1%	21.2%	48.7%
66	17.8%	15.4%	66.8%
68	15.0%	10.3%	74.8%
70	22.2%	7.4%	70.4%
72	23.6%	17.4%	59.0%
74	13.5%	24.8%	61.7%
76	20.1%	16.9%	63.0%
78	17.0%	17.4%	65.7%
80	10.6%	22.8%	66.6%
82	18.9%	19.9%	61.2%
84	21.9%	25.3%	52.8%
86	14.9%	16.4%	68.7%
88	24.8%	17.8%	57.4%
90	25.8%	24.2%	50.1%
92	5.0%	9.9%	85.1%
94	26.1%	29.2%	44.7%
96	17.4%	39.9%	42.7%
98	14.3%	23.3%	62.4%
100	2.2%	31.0%	66.8%
102	21.7%	20.6%	57.8%
104	18.3%	37.2%	44.6%

Length bin	2010 Exc	2010 Poor	2010 Dead
106	2.4%	0.0%	97.6%
108	0.0%	20.1%	79.9%
110	14.2%	58.8%	27.0%
112	39.9%	0.0%	60.1%
114	0.0%	0.0%	100.0%
116	50.0%	0.0%	50.0%
118	0.0%	100.0%	0.0%
120	0.0%	0.0%	100.0%
122	0.0%	0.0%	100.0%
124	100.0%	0.0%	0.0%
126	0.0%	100.0%	0.0%
128	0.0%	0.0%	0.0%
130	0.0%	0.0%	0.0%
132	0.0%	0.0%	0.0%
134	0.0%	0.0%	0.0%
136	100.0%	0.0%	0.0%
138	0.0%	0.0%	0.0%
140	0.0%	0.0%	0.0%
142	0.0%	0.0%	0.0%
144	0.0%	0.0%	0.0%
146	0.0%	0.0%	0.0%
148	0.0%	0.0%	0.0%
150	0.0%	0.0%	0.0%
152	0.0%	100.0%	0.0%
154	0.0%	0.0%	0.0%

APPENDIX B Manual Pacific Halibut IBQ Expansions for Inseason Management

Table B1. The number of vessels and trips that required manual expansions of P. halibut IBQ weight in the 2011 U.S. west coast groundfish IFQ fishery.

	2011 IFQ Total	Number manually calculated due to PHLB scenarios	Number manually calculated due to unsampled hauls (Trawl)	Number manually calculated due to lost trawl gear	Number manually calculated due to lost fixed gear	Total number of manually calculated discard events	% Manually Calculated
Number of vessels	113	13	16	4	1	24	21.24 *
Number of trips	1164	19	21	4	3	38	3.26

*Percentage of vessels with manually calculated discard may be included in one or more categories

Scenario 1: *Total count of PHLB exists with no length or viability data.*

Resolution: Determine an average mortality weight per individual PHLB in the trip from all sampled hauls. Multiply that average by the total count of PHLB to determine an IBQ.

Scenario 2: *Total count of PHLB exists with actual lengths and no viability data.*

Resolution: Determine catch weight for PHLB using the lengths in the haul and then apply that to the total count for a total weight. Determine CATCH_WEIGHT_MORT for all viabilities (E, P, D) from all other properly sampled hauls in the trip and apply to the CATCH_WEIGHT for IBQ estimate.

Scenario 3: *Total count of PHLB exists with visual estimates of PHLB lengths and no viabilities.*

Resolution: The use of visual lengths was discouraged by the IPHC so the most appropriate method is to determine an average IBQ per individual PHLB in the trip from all sampled hauls. Multiply that average by the total count of PHLB to determine an IBQ.

Scenario 4: *Total count of PHLB exists with visual estimates of PHLB lengths and proper in-hand viabilities.*

Resolution: The use of visual lengths was discouraged by the IPHC, so the most appropriate method here would be to determine an average IBQ per individual PHLB in the trip from all sampled

hauls. Multiply that average by the total count of PHLB to determine an IBQ.

Scenario 5: *Total count of PHLB does not exist without any length or viability data*

Resolution: Confirm PHLB was present in the haul, and no data was collected on them. Determine an average IBQ per haul for all sampled hauls in the trip. This scenario is unlikely and did not occur in 2011.

Scenario 6: *Total count of PHLB does not exist with length and no viability data.*

Resolution: Catch weight for the haul will be determined by taking the measured PHLB sample, convert to weight, divided by the number of fish sampled, multiplied by the average number of PHLB for all sampled hauls in the trip. Then the average mortality rates from the sampled hauls are applied to the calculated PHLB weight. This scenario is unlikely and did not occur in 2011.

Scenario 7: *Total count of PHLB does not exist with length and viability data.*

Resolution: Catch weight for the haul will be determined by taking the length of the PHLB sample, converted to weight, divided by the number of fish sampled, multiplied by the average number of PHLB for all sampled hauls in the trip. Since viabilities and lengths exist, IBQ can be determined using normal protocols and the calculated catch weight. This scenario is unlikely and did not occur in 2011.

Scenario 8: *Total count of PHLB does not exist with visual length and no viability data.*

Resolution: The use of visual lengths was discouraged by the IPHC so the most appropriate method here would be to determine an average IBQ per haul for all sampled hauls in the trip and apply to this haul as well.

Scenario 9: *Total count of PHLB does not exist with visual length and viability data.*

Resolution: The use of visual lengths was discouraged by the IPHC so the most appropriate method here would be to determine an average IBQ per haul for all sampled hauls in the trip and apply to this haul as well.

Scenario 10: *Observer encounters predated fish that are dead and badly damaged so that accurate biological data cannot be collected.*

Resolution: If properly sampled PHLB exist in the haul they can be used to determine the portion of the catch weight attributed to the predated and non-predated fish. The IBQ for the PHLB not predated would be calculated separately using the data collected in the haul. The IBQ for the predated fish would be the portion of the PHLB catch weight attributed to the predated fish multiplied by the mortality rate for "dead" from the IPHC viability tables for that gear.

If all PHLB in the haul are heavily predated then a catch weight for the haul will need to be determined. This can be done by taking the total count of PHLB in the haul times an average catch weight (not IBQ estimates) per PHLB from other hauls in the trip (or like "sets" if PHLB doesn't exist in any other hauls). The estimated catch weight will then be multiplied by the mortality rate for "dead" from the IPHC viability tables for that gear to determine IBQ. In 2011, there were only two instances where a Pacific halibut IBQ was manually calculated due to sand flea predation.

Table B2. Calculations used in manual Pacific halibut IBQ calculations in the 2011 U.S. west coast groundfish IFQ fishery.

SCENARIO	CALCULATION
1	$\sum$CATCH_WEIGHT_MORT for all sampled hauls x CATCH_COUNT for unsampled haul=PHLB IBQ $\sum$CATCH_COUNT for all sampled hauls
2	CATCH_WEIGHT = Σ SPECIMEN_LENGTH* x CATCH_COUNT #_PHLB_SAMPLED_IFQ CATCH_WEIGHT_MORT = CATCH_WEIGHT_MORT Σ (E) + CATCH_WEIGHT_MORT Σ (P) + CATCH_WEIGHT_MORT Σ (D) CATCH_WEIGHT_MORT Σ (E) = Σ (SPECIMEN_LENGTH* where VIABILITY = E) for all sampled hauls x CATCH_WEIGHT x (.20**) Σ SPECIMEN_LENGTH* for all sampled hauls CATCH_WEIGHT_MORT Σ (P) = Σ (SPECIMEN_LENGTH* where VIABILITY = P) for all for all sampled hauls x CATCH_WEIGHT x (.55**) Σ SPECIMEN_LENGTH* for all sampled hauls CATCH_WEIGHT_MORT Σ (D) = Σ (SPECIMEN_LENGTH* where VIABILITY = D) for all sampled hauls x CATCH_WEIGHT x (.90**) Σ SPECIMEN_LENGTH* for all sampled hauls
3, 4, 5	$\underline{\sum\text{CATCH\_WEIGHT\_MORT for all sampled hauls}}$ x CATCH_COUNT for unsampled haul=PHLB IBQ $\sum$CATCH_COUNT for all sampled hauls

6, 7	Average CATCH_COUNT for all sampled hauls = <u>∑CATCH_COUNT for all sampled hauls</u>
	
	                                           Total # sampled hauls
	
	CATCH_WEIGHT = Σ SPECIMEN_LENGTH* x Average CATCH_COUNT for all sampled hauls
	                       #_PHLB_SAMPLED_IFQ
	
	CATCH_WEIGHT_MORT =
	 CATCH_WEIGHT_MORT Σ (E) + CATCH_WEIGHT_MORT Σ (P) + CATCH_WEIGHT_MORT Σ (D)
	
	CATCH_WEIGHT_MORT Σ (E) =
	Σ (SPECIMEN_LENGTH* where VIABILITY = E) for all sampled hauls x CATCH_WEIGHT x (.20**)
	 Σ SPECIMEN_LENGTH* for all sampled hauls
	
	CATCH_WEIGHT_MORT Σ (P) =
	Σ (SPECIMEN_LENGTH* where VIABILITY = P) for all sampled hauls x CATCH_WEIGHT x (.55**)
	 Σ SPECIMEN_LENGTH* for all sampled hauls
	
	CATCH_WEIGHT_MORT Σ (D) =
	Σ (SPECIMEN_LENGTH* where VIABILITY = D) for all sampled hauls x CATCH_WEIGHT x (.90**)
	 Σ SPECIMEN_LENGTH* for all sampled hauls

8, 9	PHLB IBQ = <u>∑CATCH_WEIGHT_MORT for all sampled hauls</u> Total # of sampled hauls
10	CATCH_WEIGHT_MORT = ∑CATCH_WEIGHT _MORT for the properly sampled PHLB + (CATCH_WEIGHT estimate for the predated PHLB* Mortality rate for "dead" for that fishery)

* Converted to weight using P. halibut length-weight conversion table (Appendix C below)

** IPHC mortality rates

APPENDIX C. IPHC length weight conversion table for Pacific halibut

Centimeter	Pounds	Kilograms	Centimeter	Pounds	Kilograms	Centimeter	Pounds	Kilograms	Centimeter	Pounds	Kilograms
10	0.02	0.01	71	9.19	4.17	131	66.82	30.31	191	226.70	102.83
11	0.02	0.01	72	9.61	4.36	132	68.48	31.06	192	230.56	104.58
12	0.02	0.01	73	10.05	4.56	133	70.17	31.83	193	234.48	106.36
13	0.04	0.02	74	10.49	4.76	134	71.89	32.61	194	238.45	108.16
14	0.04	0.02	75	10.98	4.98	135	73.66	33.41	195	242.44	109.97
15	0.07	0.03	76	11.44	5.19	136	75.44	34.22	196	246.50	111.81
16	0.07	0.03	77	11.95	5.42	137	77.25	35.04	197	250.60	113.67
17	0.09	0.04	78	12.46	5.65	138	79.08	35.87	198	255.74	116.00
18	0.11	0.05	79	12.99	5.89	139	80.95	36.72	199	258.93	117.45
19	0.13	0.06	80	13.51	6.13	140	82.87	37.59	200	263.17	119.37
20	0.15	0.07	81	14.07	6.38	141	84.79	38.46	201	267.46	121.32
21	0.18	0.08	82	14.64	6.64	142	86.75	39.35	202	271.79	123.28
22	0.20	0.09	83	15.23	6.91	143	88.76	40.26	203	276.17	125.27
23	0.24	0.11	84	15.83	7.18	144	90.79	41.18	204	280.60	127.28
24	0.26	0.12	85	16.45	7.46	145	92.84	42.11	205	285.10	129.32
25	0.31	0.14	86	17.09	7.75	146	94.93	43.06	206	289.62	131.37
26	0.35	0.16	87	17.75	8.05	147	97.05	44.02	207	294.21	133.45
27	0.40	0.18	88	18.41	8.35	148	99.21	45.00	208	298.84	135.55
28	0.46	0.21	89	19.09	8.66	149	101.39	45.99	209	303.51	137.67
29	0.51	0.23	90	19.80	8.98	150	103.62	47.00	210	308.25	139.82
30	0.57	0.26	91	20.53	9.31	151	105.87	48.02	211	313.03	141.99
31	0.62	0.28	92	21.25	9.64	152	108.16	49.06	212	317.86	144.18
32	0.71	0.32	93	22.02	9.99	153	110.50	50.12	213	322.73	146.39
33	0.77	0.35	94	22.80	10.34	154	112.83	51.18	214	327.67	148.63
34	0.84	0.38	95	23.59	10.70	155	115.24	52.27	215	332.65	150.89
35	0.93	0.42	96	24.41	11.07	156	117.66	53.37	216	337.70	153.18
36	1.01	0.46	97	25.24	11.45	157	120.13	54.49	217	342.79	155.49
37	1.10	0.50	98	26.08	11.83	158	122.62	55.62	218	347.93	157.82
38	1.21	0.55	99	26.96	12.23	159	125.16	56.77	219	353.13	160.18
39	1.32	0.60	100	27.87	12.64	160	127.71	57.93	220	358.38	162.56
40	1.43	0.65	101	28.77	13.05	161	130.32	59.11	221	363.69	164.97
41	1.59	0.72	102	29.70	13.47	162	132.96	60.31	222	369.05	167.40
42	1.68	0.76	103	30.67	13.91	163	135.65	61.53	223	374.45	169.85
43	1.81	0.82	104	31.64	14.35	164	138.36	62.76	224	379.92	172.33
44	1.94	0.88	105	32.63	14.80	165	141.12	64.01	225	385.45	174.84
45	2.09	0.95	106	33.64	15.26	166	143.90	65.27	226	391.03	177.37
46	2.25	1.02	107	34.68	15.73	167	146.72	66.55	227	396.67	179.93
47	2.43	1.10	108	35.74	16.21	168	149.54	67.83	228	402.36	182.51
48	2.58	1.17	109	36.84	16.71	169	152.49	69.17	229	408.09	185.11
49	2.76	1.25	110	37.94	17.21	170	155.45	70.51	230	413.91	187.75
50	2.95	1.34	111	39.07	17.72	171	158.42	71.86	231	419.76	190.40
51	3.15	1.43	112	40.21	18.24	172	161.44	73.23	232	425.69	193.09
52	3.35	1.52	113	41.38	18.77	173	164.51	74.62	233	431.66	195.80
53	3.57	1.62	114	42.59	19.32	174	167.60	76.02	234	437.68	198.53
54	3.79	1.72	115	43.81	19.87	175	170.75	77.45	235	443.76	201.29
55	4.01	1.82	116	45.06	20.44	176	173.92	78.89	236	449.91	204.08
56	4.25	1.93	117	46.32	21.01	177	177.14	80.35	237	456.13	206.90
57	4.52	2.05	118	47.62	21.60	178	180.40	81.83	238	462.39	209.74
58	4.76	2.16	119	48.94	22.20	179	183.71	83.33	239	468.72	212.61
59	5.05	2.29	120	50.29	22.81	180	187.06	84.85	240	475.09	215.50
60	5.31	2.41	121	51.65	23.43	181	190.46	86.39	241	481.55	218.43
61	5.62	2.55	122	53.07	24.07	182	193.87	87.94	242	488.05	221.38
62	5.93	2.69	123	54.48	24.71	183	197.36	89.52	243	494.60	224.35
63	6.24	2.83	124	55.93	25.37	184	200.86	91.11	244	501.24	227.36
64	6.57	2.98	125	57.41	26.04	185	204.43	92.73	245	507.92	230.39
65	6.90	3.13	126	58.91	26.72	186	208.03	94.36	246	514.66	233.45
66	7.25	3.29	127	60.43	27.41	187	211.67	96.01	247	521.48	236.54
67	7.61	3.45	128	61.99	28.12	188	214.71	97.39	248	528.36	239.66
68	7.98	3.62	129	63.56	28.83	189	218.50	99.11	249	535.28	242.80
69	8.38	3.80	130	65.17	29.56	190	222.89	101.10	250	542.29	245.98
70	8.77	3.98									

APPENDIX D

Figure D1. IFQ groundfish fishery data flow from the West Coast Groundfish Observer Program (WCGOP) to the Vessel Account System (VAS) of the NW Regional Office.

IFQ Fishery Data Flow:
Observer to Vessel Account Process