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Pacific Halibut Bycatch in US West Coast Fisheries (2002-2016)

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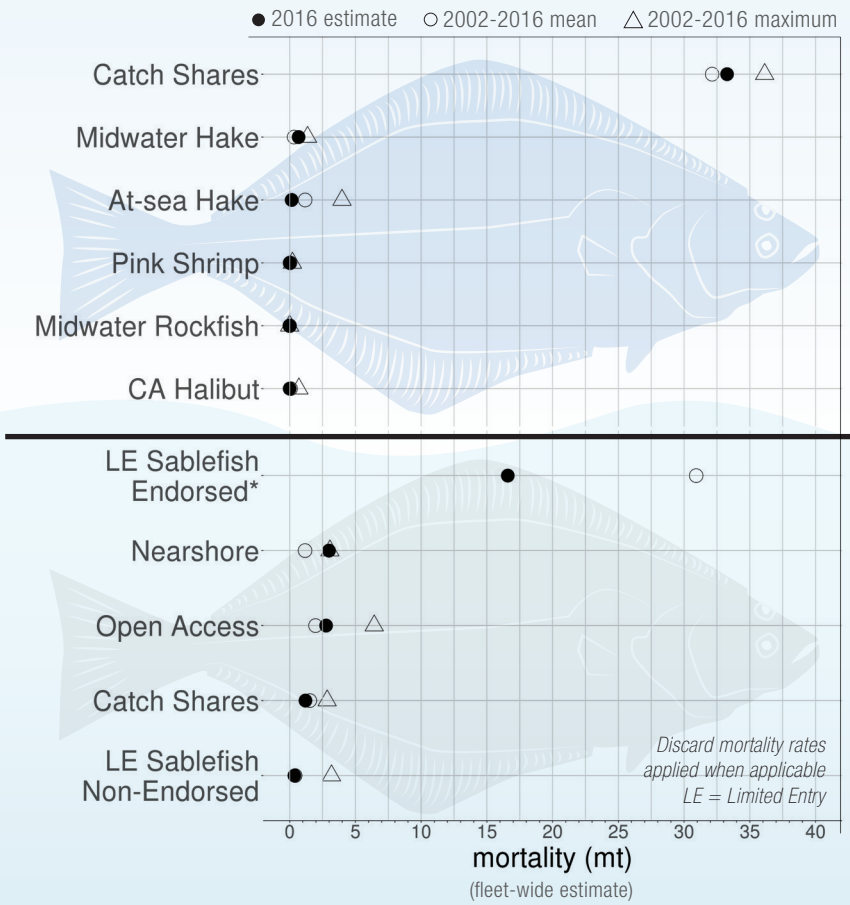
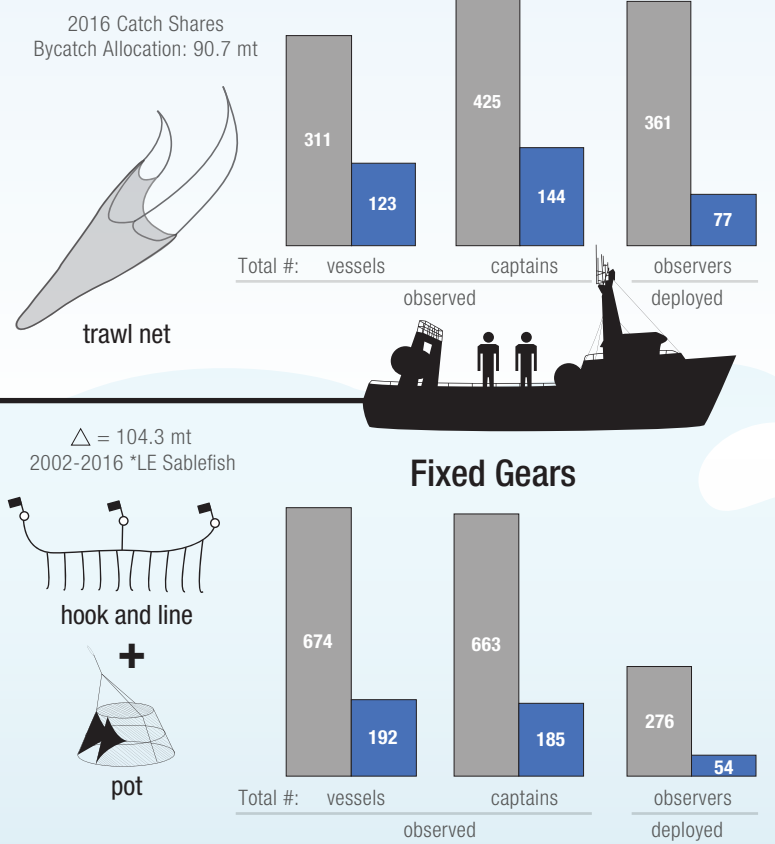
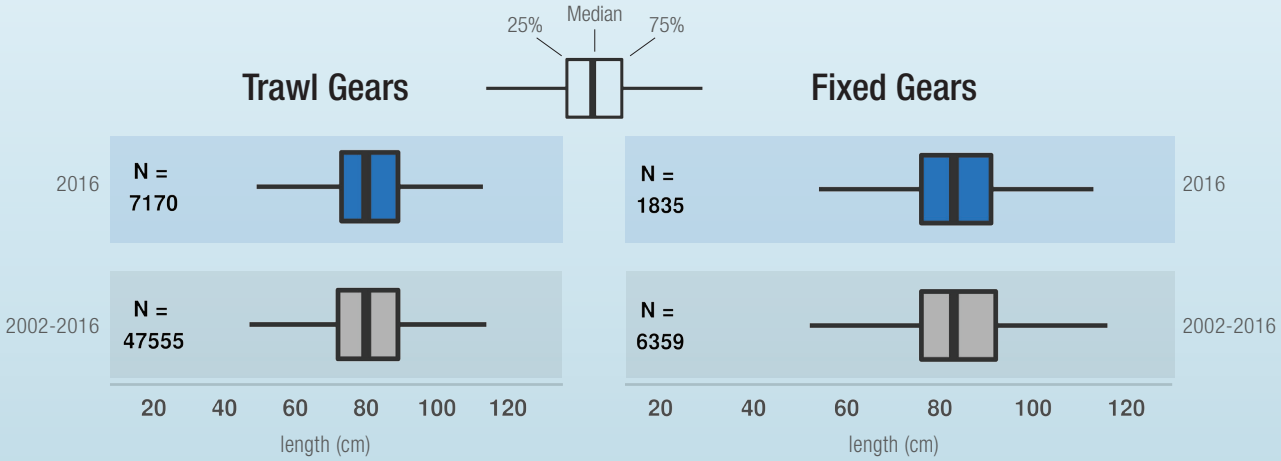
PACIFIC HALIBUT BYCATCH 2002-2016







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Pacific Halibut Bycatch in U.S. West Coast Groundfish Fisheries (2002-2016)

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August 31, 2017

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1 EXECUTIVE SUMMARY

Pacific halibut mortality estimates are provided for the years 2002 through 2016 from all fishery sectors observed by the Northwest Fishery Science Center Groundfish Observer Program (Table 1).

Table 1: Pacific halibut mortality estimates for 2016, and the years of observation, for all fishery sectors observed by the Northwest Fishery Science Center Groundfish Observer Program. Estimates include both individuals discarded at the dock and with mortality rates applied, where appropriate.

Sector	**Years Observed**	**2016 P. halibut discard mortality (mt)**
Individual Fishing Quota (IFQ) fisheries [1]	2011-2016	31.86
IFQ Electronic Monitoring (EM) EFP [2]	2015-2016	3.29
At-sea Pacific hake	2002-2016	0.15
Non-nearshore fixed gear targeting groundfish	2002-2016	19.72
Nearshore fixed gear	2003-2016	2.99
Pink shrimp trawl	2004-2016	0.00
California halibut trawl	2002-2016	0.00

[1]Does not include estimates from IFQ vessels with Electronic Monitoring

[2]EFP = Exempted Fishing Permit

In addition, we provide historical estimates of P. halibut bycatch in the Limited Entry (LE) bottom trawl fishery for the 2002-2010 period and P. halibut bycatch estimates for observed, non-IFQ vessels with an exempted fishing permit (EFP) targeting groundfish (2002-2016). For completeness, we also include the P. halibut landed catch from PacFIN fish tickets reported by non-groundfish fisheries that are not observed by the NWFSC Observer Program for the period 2002-2016.

Final estimates of observed fishery sectors including the IFQ EM EFP are shown in Tables 1, 2 & 47 in the report. We include in these tables (and elsewhere in the report), the small amount of P. halibut landed and subsequently discarded at the dock by IFQ bottom and midwater trawl vessels. These landed and then discarded at the dock amounts are listed by strata in Tables 8 and 9 of the report. IFQ EM EFP P. halibut catch is included in the summaries found in Tables 2, 44 and 47. A comparison of observed discard mortality rates (DMR) on IFQ vessels with and without EM is provided in Appendix E (10.5). In 2016, the IFQ bottom trawl sector constituted the largest source of discard mortality of P. halibut among the sectors analyzed, with the majority of this bycatch between Pt. Chehalis, WA and 40°10′ N. lat., fishing deeper than 60 fathoms. Limited Entry Sablefish Endorsed vessels fishing longline gear caught the next most P. halibut. IFQ bottom trawl and LE Sablefish Endorsed longline vessels together comprised approximately 87% of the 2016 P. halibut discard mortality in observed U.S. West Coast groundfish fisheries.

The 2016 IFQ fishery estimate of P. halibut discard mortality, coast-wide, was 31.86 mt, with an additional 3.29 mt caught by IFQ EM EFP vessels (see Table 44 which is included in the IFQ estimate in Tables 2 and 47). The IFQ total (IFQ + IFQ EM EFP: 35.15 mt) is 0.81 mt less than the 2015 estimate (35.97 mt, see Table 2) but, as in past years, well below the IBQ[1] allocation (90.70 mt). As in prior years, bottom trawl gear produced the largest component of IFQ discard mortality, followed in decreasing magnitude by hook-&-line, midwater trawl and pot gear. In prior reports, discards at the dock by IFQ vessels was only reported in Tables 8, 9, & 10. In this report, we have added the IFQ discards at the dock to the values in Tables 2 and 47; thus IFQ mortality estimates in these tables differ from previous reports.

Following historical patterns, nearly all of 2016 non-nearshore fixed gear estimated P. halibut discard mortality occurred in the LE Sablefish Endorsed component (16.59 mt), which consists of federally permitted vessels fishing sablefish tier quota during the primary season (April-October). Specifically, discard mortality for the non-nearshore fixed gear sector was highest on LE sablefish endorsed vessels fishing with longline gear in the area north of Pt. Chehalis, WA (8.17 mt). A similar amount of P. halibut mortality also occurred on LE sablefish endorsed

[1]IBQ = Individual Bycatch Quota, which is used for P. halibut North of 40°10′ N. lat.

vessels fishing longline gear south of Pt. Chehalis (7.38 mt), but open access (OA) vessels targeting non-nearshore groundfish species with hook-&-line gear caught substantially less than the LE sector (2.77 mt).

The methods for calculating discard mortality in the non-nearshore fixed gear fishery have changed from the last report. In 2015, we presented mortality rates applied using a viability analysis based on observer viability condition of P. halibut on vessels fishing with longline or hook & line gear (see Appendix E of the 2015 P. halibut report). In this report, as requested by the International Pacific Halibut Commission (IPHC), we applied the viability method presented in the previous (2015) report to estimate P. halibut mortality on hook-&-line vessels in the non-nearshore fixed gear fisheries. The viability method was applied retrospectively from 2011 to 2016 in the LE Sablefish Endorsed, Non-Endorsed and OA Fixed Gear fisheries. Therefore, mortality estimates for these sector-year combinations differ slightly from previous reports.

Pacific halibut discard in the nearshore fixed gear, pink shrimp trawl, California halibut trawl, and at-sea Pacific hake fisheries combined represents a very small component of total P. halibut mortality (Table 1; Figure 1).

In Appendix F (10.6), as requested by the IPHC, we present preliminary results of an analysis of the discard ratio in the nearshore, pink shrimp and California halibut fisheries. Specifically, we examined the relationship between observed P. halibut discard and observed effort in these sectors. Small sample sizes in all three sectors preclude definitive conclusions from this analysis; thus, methods used in this report are consistent with past reports. The NWFSC Observer Program might revisit this analysis in future reports.

The NWFSC Observer Program data used in this report has been updated to include the most recent data available (2002-2016). Pacific Fisheries Information Network (PacFIN) data used in this report were accessed April 2016. The estimates for all sectors and years (except LE Trawl 2002-2010) have been recalculated based on these base data. In all other respects, this report uses the same methods as reported in last year's report (Jannot et al. 2016).

Table 2: Pacific halibut discard mortality estimates (mt, including a small amount discarded at the dock in IFQ Bottom Trawl, Midwater Rockfish, and Midwater Hake fisheries) for all sectors observed by the NWFSC Groundfish Observer Program. Mortality rates of less than 100% were applied in the bottom trawl fisheries (LE and IFQ), IFQ hook and line, IFQ pot, and non-IFQ, non-nearshore fixed gear sectors, for which some information regarding gear specific survivorship was available. For all other sectors, a 100% mortality rate was applied because gear specific survivorship information is not available. Rounding of values might mask very small weights in some categories and are presented here as zero (0). All weights are estimated based on whole fish (a.k.a. 'round weight', not head-&-gut). *=confidential data, less than 3 vessels observed; - = no observer coverage.

Year	LE bottom trawl 2002-10	IFQ Fishery [9]						Non-Nearshore fixed gear			Nearshore Fixed Gear [3]	Pink Shrimp [3]	CA Halibut [3,6]	At-sea Hake [3]	Totals		
		Bottom Trawl [1,2,9]	LE CA Halibut [1,3]	Hook &Line	Pot[9]	Midwater Rockfish [3,4,9]	Midwater Hake [2,3,5,9]	LE Endorsed	LE Non-Endorsed	OA					All sectors	<100% mortality rate [7]	100% mortality rate [8]
Total Discard Mortality (mt)																	
2002	344.82							22.71	0.00	-	-	-	0.00	1.14	368.67	367.53	1.14
2003	124.43							30.55	0.03	-	0.00	-	0.00	2.65	157.66	155.01	2.65
2004	133.12							38.49	0.00	-	0.99	0.00	0.70	1.13	174.43	172.31	2.12
2005	286.52							35.53	0.00	-	2.19	0.04	0.03	1.97	326.28	322.08	4.20
2006	242.47							104.30	0.00	-	0.52	-	0.02	0.83	348.14	346.79	1.35
2007	208.81							20.43	0.28	3.49	0.09	0.21	0.03	1.18	234.52	233.04	1.48
2008	207.81							41.12	0.48	6.43	0.35	0.00	0.31	3.98	260.48	256.15	4.33
2009	251.1							52.10	0.04	5.58	1.28	0.00	0.00	0.33	310.43	308.82	1.61
2010	180.97							22.12	0.06	5.22	0.08	0.00	0.00	1.57	210.02	208.37	1.65
2011		31.30	0	0.97	0.89	*	0.35	11.80	3.18	1.82	3.06	0.19	0.00	0.61	54.17	49.96	4.21
2012		36.13	*	2.34	0.51	0.0	0.62	24.97	1.79	2.68	2.25	0.00	0.00	0.64	71.93	68.42	3.51
2013		32.41	see[1]	0.48	0.21	0.0	1.34	2.94	0.00	0.18	1.36	0.00	0.00	1.06	39.98	36.22	3.76
2014		26.32	see[1]	0.61	0.08	0.0	1.36	29.95	0.00	0.38	0.95	0.00	0.00	0.37	60.02	57.34	2.68
2015		33.36	see[1]	1.52	0.38	0.0	0.70	10.20	0.05	0.87	1.42	0.01	0.00	0.06	48.57	46.38	2.19
2016		33.27	see[1]	1.02	0.18	0.0	0.68	16.59	0.36	2.77	2.99	0.00	0.00	0.15	58.01	54.19	3.82

[1]Starting in 2013, LE CA Halibut estimates are combined with IFQ Bottom Trawl estimates.
[2]Includes a small amount landed and discarded at the dock.
[3]100% mortality rate
[4]from 2011-14, 'Midwater Trawl'
[5]from 2011-14, 'Shoreside Hake'
[6]Starting in 2011, this sector only includes OA CA halibut
[7]LE Bottom Trawl, IFQ Bottom Trawl, IFQ hook and line, IFQ pot, LE and OA CA Halibut, Non-Nearshore Fixed Gear
[8]IFQ Midwater Rockfish, Midwater Hake, Nearshore fixed gear, Pink Shrimp, At-sea Hake
[9]Includes P. halibut catch from IFQ electronic monitoring EFP

Table 3: Percent of legal-sized P. halibut bycatch, by weight (mt) in the IFQ Bottom Trawl fishery north of 40 °10′ N. lat. (mortality rate applied).

Year	**% legal-sized P. halibut in IFQ bottom trawl north of 40 °10′ N. lat.**
2011	67%
2012	67%
2013	64%
2014	60%
2015	68%
2016	67%

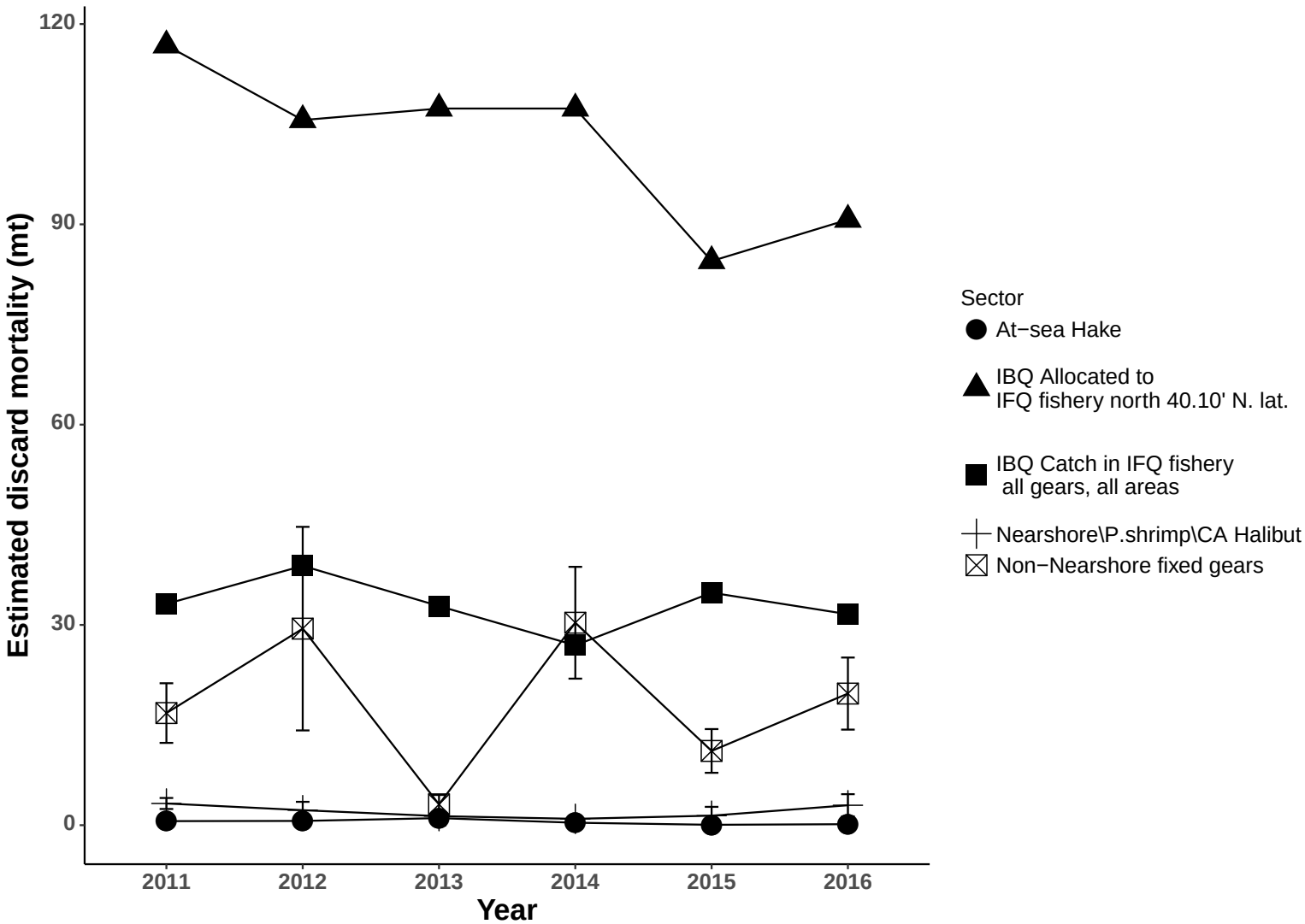

Figure 1: Total estimated P. halibut discard mortality (mt ± 1 SE, with mortality rates applied if applicable) from all sectors observed by the NWFSC Groundfish Observer Program (2011-2016). IBQ catch includes all IFQ sectors and gears except At-sea Hake which is shown separately. Values are reported in Table 2, along with historical (2002-2010) data.

2 INTRODUCTION

Pacific halibut (*Hippoglossus stenolepis*) is found in coastal waters throughout the North Pacific. Off the U.S. West Coast of the United States, it inhabits continental shelf areas (<150 fm) from Washington to central California (Clark and Hare 1998). Pacific halibut has long supported a directed commercial fishery in the U.S. and Canada, but it is also caught as bycatch in other fisheries that target demersal species inhabiting similar depths and seafloor habitat types (Chastain 2012). The objective of this report is to provide estimates of P. halibut bycatch in the U.S. West Coast groundfish fisheries from 2002-2016.

2.1 Observed West Coast Groundfish Fisheries

The U.S. 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 state (0-4.8 km) and federal (>4.8 km off-shore to the EEZ) waters. 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:

- The Limited Entry (LE) component encompasses all commercial fisheries who hold a federal limited entry permit. The total number of limited entry permits available is restricted. Vessels with an LE permit are allocated a larger portion of the total allowable catch for commercially desirable species than vessels without an LE permit.
- The Open Access (OA) component encompasses commercial fishers who do not hold a federal LE permit. Some states require fishers to carry a state issued permit for certain OA sectors.
- The Recreational component includes recreational anglers who target or incidentally catch groundfish species. Estimate of P. halibut bycatch in recreational fisheries are compiled by the IPHC and are not covered by this report.
- The Tribal component includes native tribal commercial fishers in Washington state that have treaty rights to fish groundfish. Estimates of P. halibut bycatch from tribal fisheries are compiled by the IPHC and are not included in this report, with the exception of the observed tribal at-sea Pacific hake (a.k.a. Pacific whiting, henceforth referred to as hake) sector which are included as part of the "At-sea hake" values included in Tables 2 and 47.

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

- IFQ fishery: This sector is subdivided into the following components due to differences in gear type and target strategy:
  - Bottom trawl (formerly LE bottom trawl 2002-2010): Bottom trawl nets are used to catch a variety of non-hake groundfish species. Catch is delivered to shore-based processors.
  - Midwater rockfish trawl: Midwater trawl nets are used to target mid-water non-hake species, typically rockfish, and landings of Pacific hake are less than 50% (by weight) of total trip landings. Catch is delivered to shore-based processors. From 2011-14, reported as IFQ non-hake Midwater Trawl.
  - Pot: Pot gear is used to target groundfish species, primarily sablefish. Catch is delivered to shore-based processors.
  - Hook-and-Line: Longlines are primarily used to target groundfish species, mainly sablefish. Catch is delivered to shore-based processors.
  - LE California halibut trawl: Bottom trawl nets are used to target California halibut by fishers holding a state California halibut permit and an LE federal trawl groundfish permit. Catch is delivered to shore-based processors.
  - Midwater hake trawl: Midwater trawl nets are used to catch Pacific hake and more than 50% (by weight) of the total trip landings is P. hake. Catch is delivered to shore-based processors. From 2011-14, reported as Shoreside Hake.

  - At-sea motherships: 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.
  - At-sea catcher-processors: Midwater trawl nets are used to catch and process Pacific hake at sea.
  - At-sea tribal: Midwater trawl nets are used to catch and process Pacific hake at sea by Native American tribes. The tribes must operate within defined boundaries in waters off northwest Washington.

- OA pink shrimp trawl: Trawl nets are used to target pink shrimp on vessels carrying a state pink shrimp permit. 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 based on differences in permitting and management:
  - LE sablefish endorsed: Longlines and pots are used to target sablefish. Catch is generally delivered to shore-based processors.
  - LE sablefish non-endorsed: Longlines and pots are used to target groundfish, primarily sablefish and thornyheads, by LE sablefish vessels that have caught their sablefish quota limit or are fishing outside the normal LE sablefish season. Catch is delivered to shore-based processors or sold alive.
- OA fixed gear (non-nearshore): Fixed gear, including longlines, pots, fishing poles, stick gear, etc. is used to target non-nearshore groundfish. Catch is delivered to shore-based processors.
- Nearshore fixed gear: A variety of fixed gear, including longline, 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.

2.2 NW 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 WCGOP was established in May 2001 by NOAA Fisheries (a.k.a., National Marine Fisheries Service, NMFS) in accordance with the Pacific Coast Groundfish Fishery Management Plan (50 CFR Part 660) (50 FR 20609). This regulation requires all vessels that catch groundfish in the U.S. EEZ from 4.8-322 km 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 0-4.8 km state territorial zone to carry observers.

The A-SHOP has conducted observations of the U.S. West Coast at-sea hake fishery since 2001. Prior to 2001, observer coverage of the U.S. West Coast at-sea hake fishery was conducted by the North Pacific Groundfish Observer Program. Current A-SHOP program information and documentation on data collection methods can be found in the A-SHOP observer manual (NWFSC 2016b). The at-sea hake fishery has mandatory observer coverage, with each vessel over 38 meters carrying two observers. Beginning in 2011, under IFQ/Co-op Program management, all catcher vessels that deliver catch to motherships are required to carry WCGOP observers or use electronic monitoring equipment.

The NWFSC Groundfish Observer Program's goal is to improve estimates of total catch and discard by observing groundfish fisheries along the U.S. West Coast. The WCGOP and A-SHOP observe distinct sectors of the groundfish fishery. The WCGOP observes multiple sectors of the groundfish fishery, including: IFQ shoreside delivery of groundfish and Pacific hake, at-sea mothership catcher-vessels fishing for Pacific hake, LE and 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 fishery that catches and delivers Pacific hake at-sea including non-tribal catcher-processor and mothership vessels.

2.3 Pacific Halibut Management and Fishery Interaction

The International Pacific Halibut Commission, a body founded through treaty agreement between the U.S. and Canada, sets the P. halibut annual total allowable catch (TAC) for IPHC Area 2A, the collective U.S. waters off the states of Washington, Oregon and California. The TAC is based on bycatch mortality, which takes into account potential survival after being discarded. Regulations for IPHC Area 2A are set by NOAA Fisheries West Coast Regional Office. Pacific 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 2016, the LE fixed gear sablefish endorsed sector was allowed to retain and land P. halibut north of Pt. Chehalis, WA. The IFQ midwater Pacific hake fishery is a maximized-retention fishery. Under this fishery, small amounts of incidental P. halibut take are allowed to be landed and subsequently donated to food banks or destroyed. In all other West Coast commercial groundfish fishery sectors, P. halibut must be discarded at-sea. However, small amounts of P. halibut are, on rare occasions, mixed with target species and accidentally landed. These individuals are subsequently donated or destroyed as in the IFQ Midwater hake fishery.

In 2011, the LE bottom trawl sector of the U.S. West Coast groundfish fishery began fishing under an 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 UlC 1802(23)). The implementation of the IFQ management program in 2011 resulted in changes to the method used for estimating fishing mortality, including the mandate that vessels must carry NMFS observers on all IFQ fishing trips. A full list of changes to the fishery can be found in Jannot et al. 2012.

Under the IFQ program, P. halibut is managed at the permit level, through Individual Bycatch Quota (IBQ) pounds. An IBQ accounts for bycatch mortality including any potential survivorship after capture. Currently, this is the only species managed under IBQ for the U.S. 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 by an IBQ quota but are reported here under the IFQ fishery.

Data collection and reporting for this fishery is described in section 3.2.1 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 P. 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 sablefish non-endorsed fixed gear, and OA fixed gear sectors.

3 METHODS

3.1 Data Sources

Data sources for this analysis include on-board observer data (from the WCGOP and A-SHOP), landing receipt data (referred to as fish tickets, obtained from PacFIN) and data generated from vessels carrying electronic monitoring (a.k.a. EM) equipment. Currently only vessels in the IFQ sector fishing on an exempted fishing permit (EFP) carry EM equipment. EM data are obtained from Pacific States Marine Fisheries Commission. To date, observer data is the sole source for discard estimation in the IFQ sectors, except for vessels using EM under an EFP, as stated above. All other sectors use a combination of observer and PacFIN data to estimate discard mortality. A list of fisheries, coverage priorities and data collection methods employed by WCGOP in each observed fishery can be found in the WCGOP manuals (NWFSC 2016b). A-SHOP program information, documentation and data collection methods can be found in the A-SHOP observer manual (NWFSC 2016b).

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 on the WCGOP Data Processing webpage (NWFSC 2016a) and was conducted prior to the analyses

presented in this report. All weights of P. halibut presented in this report are round weights, that is, whole fish. IPHC converts these weights to dressed weight (i.e., head and organs removed).

For data processing purposes, species and species groups were defined based on management (NWFSC 2016c). A complete listing of groundfish species is defined in the Pacific Coast 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-aggregate sales receipts for market categories that may represent single or multiple species. Fish tickets 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 PacFIN regional database. Annual fish ticket landings data were retrieved from the PacFIN database (April 2016) and subsequently divided into various sectors of the groundfish fishery as indicated in Figure 8 and in further detail online (NWFSC 2016c).

3.2 Shore-based IFQ Fishery

The methods used to report in-season IBQ estimates via the Vessel Account System (VAS) are separate from those methods used to estimate final fleet-wide P. halibut mortality. Methods for in-season IBQ estimation are discussed in Appendix B 10.2. Results obtained by methods described here resulted in fleet-wide estimates of P. halibut mortality that are very close to those reported by the VAS (Data not shown due to confidentiality).

3.2.1 Pacific Halibut Data Collection in the Shore-based IFQ Fishery

The WCGOP discard sampling methodologies ensure that 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 P. halibut mortality (also see Table 4):

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 (NWFSC 2016b). A unique key is used for each gear type (trawl, longline, pot).

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, 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 requests by the observer to ensure proper P. halibut sampling, including but not limited to: modifying P. halibut sorting procedure, assisting the observer by delivering the P. halibut to the observer, and modifying operations to ensure P. halibut sampling is completed. Table 4 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, midwater trawl, and pot vessels, but only visual length estimates are made on vessels fishing hook-&-line gear in the IFQ fishery. Visual estimates are in 10 cm increments (55-64 cm, 65-74 cm, etc.).

The crew's cooperation is vital to the observer's sampling success during 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 can 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 individual fish to the observer or slow the gear retrieval.

Viability is assessed at the point of fish 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

Table 4: Data collected from P. 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
Midwater trawl [1]	all in the sample	actual, all or subset	yes
Pot	all in sampled portion	actual, all or subset	yes
Hook & Line	all in sampled portion	visual, all or subset	no

[1]Applies only to Catcher Processors and Mothership Catcher Vessels. Shoreside midwater trawl hauls are dumped directly into the hold and any P. halibut are delivered to the dock for discard or donation.

categories for trawl and pot gear: Excellent, Poor, or Dead (NWFSC 2016; Williams and Chen 2004). Observer field estimates of viability for P. halibut discarded in the IFQ fishery by vessels fishing bottom trawl or pot gear are used to compute the total estimated mortality of discarded P. halibut. IBQ weight (or simply IBQ) refers to the estimated mortality of discarded P. halibut, with the appropriate mortality rate applied based on viability (Tables 2 & 3).

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 conservative assumptions of likely survival from pot-induced injuries (Williams and Wilderbuer 1995). Because of the difficulties of collecting P. halibut viability on hook & line vessels, we used a discard mortality rate (DMR) of 0.16, which represents an average of DMRs over all years for the Bering Sea/Aleutian region longline fishery (Williams 2008). Discard mortality was assumed to be 100% for all midwater trawl bycatch estimates.

Table 5: Mortality rates used for each of the condition categories (m_c) for IFQ bottom trawl vessels (Clark et al. 1992).

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

Table 6: Mortality rates used for each of the condition categories (m_c) for IFQ pot gear vessels (IPHC, 2011).

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

3.2.2 Shore-based IFQ fishery Bycatch Estimation

We stratified IFQ P. halibut bycatch data based on sector (shoreside non-hake groundfish, shoreside Pacific hake, at-sea Pacific hake, and LE California halibut) and gear (bottom trawl, midwater trawl, pot, hook-&-line). LE California halibut tows were separated from IFQ bottom trawl tows in 2011-12, but have been combined with IFQ bottom trawl since 2013 to maintain confidentiality. Within the shoreside non-hake groundfish sector, we further stratified using area and depth within each gear type. 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

et al. 2010, Jannot et al. 2011, 2012, 2013) because prior work demonstrated that these variables were correlated with P. halibut bycatch (Heery et al. 2010). Observations from IFQ vessels fishing midwater trawl gear targeting Pacific hake or other midwater target species were not post-stratified. In addition to the strata described above, we also provide bycatch estimates north and south of the groundfish management line (40°10′ N. lat.) for each sector and gear type.

Despite the 100% observer coverage mandate since 2011, there were some rare occasions (e.g., observer illness, trawl net ripped) when tows or sets were either only partially sampled, not sampled or data failed quality control. In these cases, we used ratio estimators to apportion unsampled weight to P. halibut, within each stratum. To obtain the estimated weight of P. halibut ($\hat{W}$) when the entire haul or set was unsampled(or data failed), the unsampled discard weight, summed across unsampled hauls within the stratum, was multiplied by the ratio of the weight of P. halibut discard (summed across fully sampled hauls within a stratum) divided by the total discard weight of all species in all fully sampled hauls within a stratum:

$$\hat{W}_{u,s} = \sum_{u} x_{u,s} \times \frac{\sum w_{f,s}}{\sum x_{f,s}} \tag{1}$$

where, for each stratum:

s = stratum, which includes sector and year and could include, area, depth, gear
u = unsampled haul
f = fully sampled haul
x = weight of discarded catch
$\hat{W}$ = estimated weight of unsampled P. halibut in the stratum
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). For the purposes of this report, we assume that unsampled P. halibut would only occur in NIFQ (south of 40°10′ N. lat. only), IFQM, or IFQFF unsampled categories. Thus, those are the only categories for which P. halibut is estimated. IFQM included all 2016 IFQ managed species (see 76 FR 27508 for a listing of IFQ species). NIFQ included all species encountered that were not designated as an IFQ managed species. IFQFF included all IFQ flatfish species managed as a complex under the groundfish FMP. North of the 40°10′ north latitude groundfish management line, P. halibut would be included in unsampled IFQFF or IFQM categories. South of the groundfish management line, P. halibut would only be included in the unsampled NIFQ category.

To obtain the estimated weight of P. halibut ($\hat{W}$) in partially sampled hauls or sets, the unsampled discard weight, summed across partially sampled hauls within the stratum, was multiplied by the ratio of the weight of P. halibut (summed across fully sampled hauls within a stratum) divided by the total discard weight of all species occurring within a category (NIFQ, IFQFF, IFQM) in all fully sampled hauls within a stratum. Estimated P. halibut weight was summed across unsampled categories.

$$\hat{W}_{p,s} = \sum_{y} \left(\sum_{p} x_{p,y,s} \times \frac{\sum w_{f,s}}{\sum x_{f,y,s}} \right) \tag{2}$$

where, for each stratum:

s = stratum, which includes year and sector, and could include, area, depth, gear
y = unsampled category (either NIFQ, IFQFF, or IFQM)
p = partially sampled haul
f = fully sampled haul
x = weight of discarded catch
$\hat{W}$ = estimated weight of unsampled P. halibut in the stratum
w = sampled weight of P. halibut

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

3.2.3 Viability Analysis

We used observer field estimates of viability for P. halibut discarded in the IFQ fishery by vessels fishing bottom or pot gear to compute the total estimated mortality of discarded P. 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 table provided in Appendix C 10.3.

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 5 and 6 above):

$$DMR_{csj} = m_c \times P_{csj} \tag{3}$$

where:

s = stratum, which could include, area, depth, gear, and sector
c = viability condition (Excellent, Poor, Dead)
j = year
m = 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 gear type separately :

$$\hat{F}_{sj} = \sum_c (B_{sj} \times DMR_{sj}) \tag{4}$$

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 = gross estimated discard weight
DMR = discard mortality rate

Viability data are collected from only a sub-sample of the P. halibut that observers encounter. Based on previous evaluations by Wallace and Hastie (2009), we expect that survivorship of P. 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. For longline gear, we used a discard morality rate of 16%, which represents an average of DMRs over all years for the Bering Sea/Aleutian region longline fishery (Williams 2008).

Final estimates of P. halibut bycatch and discard mortality are also presented in the context of the estimated mortality of legal-sized halibut. This was computed by applying the proportion of sampled P. halibut weighed 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.

3.2.4 Length Frequencies

The length frequency distribution for P. halibut in the 2011-2016 IFQ fishery is provided in Tables 18 & 19. Pacific halibut pose unique challenges for observer sampling. Observers typically measure the length of P. halibut and then convert the measurement to weight using the IPHC length-weight conversion table (Table 9 in 10.3). Occasionally, observers weigh individual fish. Sometimes crew members presort the catch by removing P. halibut and immediately return them to sea. Vessel crews presort P. halibut to increase the likelihood of survival of the discarded fish. Presorting is prevalent on vessels fishing with hook-&-line gear. Fishers have raised concerns regarding crew safety when landing large P. halibut. In addition, hook-&-line fishers are concerned that P. halibut individuals would be injured during landing because of their interaction with the vessel 'crucifier' (gear used to strip the bait and any catch off of the hook and ganglion 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 9 in Appendix C 10.3).

Tables 48 & 51 (Appendix A 10.1) provide the actual observed length frequency distributions of discarded P. 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 10.1 for further details). We have summarized the proportion of length measurements in each condition category (Excellent, Poor, and Dead) in Tables 49 and 52 (Appendix A 10.1) to inform size-specific modeling of mortality. The frequency of sampled fish within each condition category was weighed in the same manner as length frequency distributions and then summarized for each 2 cm length bin. In addition, we also provide a count of the number of dead individuals in each 2 cm length bin (Appendix A 10.1, Tables 57, 58 & 59). These values were obtained by multiplying the number of individuals in a length bin within a viability category, by the condition specific mortality rate (Tables 5 & 6; or 1.0 in the case of midwater trawl) and summed these values across viabilities to obtain the number of dead per length bin. This method assumes there is no size-specific mortality.

3.3 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 sablefish non-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 randomly chosen for observation. 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 P. 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 Pt. Chehalis, WA = $46^{\circ}53.30^{'}$ 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). Pt. Chehalis, WA was used in previous estimates of P. 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 previous stratifications for the other groundfish fixed gear sectors (Heery and Bellman 2009, Heery et al. 2010, Jannot et al. 2011, 2012, 2013).

3.3.1 Discard Estimation

A deterministic approach was used to estimate P. 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 P. halibut divided by the retained weight (Table 25). Retained weight varies by sector in this fishery and can be either sablefish or all FMP groundfish (except Pacific hake, see Table 24 for type of retained used; for list of FMP groundfish species, see: NWFSC 2016c). 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 P. 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 8). In addition, fixed gear fish tickets without recorded sablefish or nearshore species were included in the non-nearshore fixed gear sectors only if groundfish landings were greater than non-groundfish landings based on a unique vessel and landing date.

Fish tickets from the non-nearshore fixed gear sector were partitioned into the three commercial fixed-gear sectors (LE sablefish endorsed season, LE sablefish non-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 sablefish non-endorsed sector. In addition, fish tickets from non-endorsed LE vessels were also placed in the LE sablefish non-endorsed sector.

Further processing of fish tickets identified and removed the directed commercial P. halibut fishery landings from the non-nearshore fixed gear analysis. The directed P. 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 vessels north of Pt. Chehalis) this is the only time during which they are allowed to land P. halibut. Fish tickets that included P. 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. This approach may have resulted in the removal of some non-directed fishery landings north of Pt. 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.

WCGOP observer data were stratified according to sector and gear type (longline and pot/trap). As previously described, one additional latitudinal stratum at Pt. Chehalis, WA (46°53.30′ N. lat.) was used for the LE sablefish endorsed longline sector. Some retention of P. halibut was allowed in the LE sablefish endorsed season in the area north of Pt. Chehalis. The Pt. Chehalis line was the only latitudinal stratification incorporated into this portion of the analysis and was only applied to the LE sablefish endorsed sector. Discard amounts provided for the other two gear sectors represent coast-wide estimates.

The number of observed trips, sets, and vessels are summarized for each sector, gear type, and area (where applicable) (Tables 21, 22 & 23). 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 (Tables 24 & 25). Observed discard ratios were calculated by sector, gear type and area based on the following equation:

$$\hat{D}_s = \frac{\sum_t d_s}{\sum_t r} \times F_s \tag{5}$$

s = stratum, including gear, sector, gear type, and area
t = observed sets
d = observed discard (mt) of P. 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 sablefish non-endorsed longline and the OA sectors, discard ratios were calculated by dividing the stratum discard weight of P. halibut by the retained catch weight of sablefish. Retained groundfish was used as the ratio denominator for the LE sablefish non-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.

Where FMP groundfish (excluding Pacific hake) was used to compute discard ratios, 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 market category, e.g., northern unspecified scope 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.

The expansion factors for each fishery sector and gear type can be found in Table 25. The discard rate multiplied by the expansion factor yielded an expanded gross P. halibut discard estimate for each stratum (Table 30). If landings were made by a fixed gear sector for which there were zero 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. 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 24).

3.3.2 Discard Mortality Rates

Once an initial gross P. halibut discard weight was estimated, this value was multiplied by a discard mortality rate (Table 30) to generate final discard mortality estimates (Tables 30 & 31, Figure 5). Discard mortality is approximated based on viabilities in a manner similar to the approach used for IFQ bottom trawl. Observers have systematically collected viability data on hook & line vessels in the Non-Nearshore Fixed Gear sector since 2011. Current methods require observers to collect a length and viability on the first 5 P. halibut observed in each set on these vessels and to ignore any injuries incurred during landing when assessing viability. For the period 2002-2010, we used a single mortality rate for all bycatch (16%) on longline and hook & line vessels, which represents an average of DMRs over all years for the Bering Sea/Aleutian region longline fishery (Williams 2008). For the period 2011-2016, we used observer field estimates of discarded P. halibut viability on Non-Nearshore Fixed Gear vessels fishing longline or hook & line gear to estimate mortality of discarded P. halibut. (Note: Observers currently do not take viability of P. halibut caught on IFQ hook & line vessels).

Methods used to calculate discard mortality based on viability condition are almost identical to those methods currently accepted for use with IFQ bottom trawl vessels (see subsection 3.2.3). To account for the impact of fish size on survivorship, we computed an annual weighted mortality rate for P. halibut in each condition category in the LE Sablefish Endorsed fishery (Table 27). For the LE Sablefish Non-Endorsed and OA Fixed Gear sectors, sample sizes were too small to calculate an annual rate. Therefore, we calculated a five year running average of weighted mortality rate for each condition category in these two sectors (Tables 28 & 29). Length measurements associated with each viability record were converted to weight based on the IPHC length-weight table provided in Appendix C 10.3.

The proportion of P. halibut sampled weight in a viability category multiplied by the viability category-specific mortality rate (Table 7 above):

$$DMR_{csj} = m_c \times P_{csj} \tag{6}$$

where:

Table 7: Mortality rates used for each of the condition categories (m_c) for Non-Nearshore hook & line vessels: minor, mod = moderate, severe, dead (Trumble et al. 2000).

m_c	**Rate**
m_{minor}	0.035
m_{mod}	0.363
m_{severe}	0.662
m_{dead}	1.00

s = stratum, which could include, area and sector
c = viability condition (Minor, Moderate, Severe, Dead)
j = year
m = mortality rate
t = 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 sub-sector separately :

$$\hat{F}_{sj} = \sum_c (B_{sj} \times DMRsj) \tag{7}$$

where:

s = stratum, which could include, area and sector
c = viability condition ((Minor, Moderate, Severe, Dead)
j = year
F = total estimated discard mortality
B = gross estimated discard weight
DMR = discard mortality rate

Viabilities from pot gear would be appropriate to use in estimating discard mortality, however bycatch of P. halibut in pot gear is infrequent and the sample size is too small to utilize in this analysis. Consistent with past reports, we relied on discard mortality rates (DMR) computed for Alaska groundfish fisheries (Williams 2008). An 18% DMR was applied to estimates for pot gear, coinciding with the DMR used for the sablefish pot CDQ fishery in Alaska.

For additional context, we present the length frequency distribution of P. halibut from visual length estimates and physically measured lengths in non-nearshore fixed gear sectors (Tables 32, 33, 34, 35, & 36) and the proportion of sampled P. halibut discard of legal (>82 cm) and sub-legal (<82 cm) sizes in non-nearshore fixed gear sectors (Table 37). The majority of P. halibut lengths recorded in these fisheries were visual estimates of length, 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 sub-legal versus legal P. halibut from visually estimated lengths. Visual estimates were instead summarized in the manner in which they are recorded; with sub-legal and legal sized halibut falling within the 75-84 cm length bin.

3.4 Observed State Fisheries

Pacific halibut bycatch was also observed in the Oregon and California nearshore groundfish fixed gear sectors (Table 38), the Washington, Oregon, and California pink shrimp trawl fisheries (Table 39), and the OA California halibut trawl fishery (Table 40) The LE California halibut fishery is covered under the IFQ fishery. Bycatch estimates for these three fishery sectors were computed within each fishery based on the following equation:

$$\hat{B} = \frac{\sum_t b}{\sum_t r} \times F \tag{8}$$

b = observed discard (mt) of P. halibut on set/haul t
t = observed sets
r = observed retained weight (mt) of target species on set/haul t
F = weight (mt) of retained target species
$\hat{B}$ = Discard estimate of P. halibut (mt)

The nearshore fixed gear fishery targets a variety of groundfish and state managed nearshore species that inhabit areas less than 50 fathoms deep. All species included in the nearshore target group, as listed in the WCGOP data processing appendix (NWFSC 2016c), 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. Discard mortality rates are not available for California halibut and pink shrimp fisheries due to a lack of information regarding survivorship. To maintain confidentiality, the Nearshore fisheries cannot be split out by gear type (hook & line vs. pot). For these reasons, we assumed 100% mortality in the Nearshore, Pink Shrimp, and CA halibut fisheries.

3.5 Exempted Fishing Permits

Occasionally, the WCGOP observes vessels fishing under an EFP. EFPs directed toward groundfish species have been required to carry observers on 100% of trips. Thus to obtain the catch from EFPs, we sum the at-sea discards and landed P. halibut catch.

Since 2015, vessels in the IFQ fishery could elect to participate in an electronic monitoring (EM) EFP. To obtain the catch from the IFQ EM EFP, we sum the P. halibut catch from the electronic monitoring data supplied to NWFSC Observer Program by the Pacific States Marine Fisheries Commission. Unlike the normal IFQ program, IFQ vessels fishing under an EM EFP are not required to carry an observer on every fishing trip because EM is used to ensure compliance with the IFQ program. The NWFSC Observer Program targets 30% of randomly selected IFQ EM trips for observer coverage for the purposes of scientific observation (e.g., biological sampling). A comparison of the discard mortality rates between the EM and non-EM IFQ vessels is presented in Appendix E (10.5), as was requested by PFMC staff.

3.6 Non-groundfish Fisheries Not Observed by NWFSC

Pacific halibut bycatch from non-groundfish fisheries that are not observed by the NWFSC Observer Program is recorded on fish tickets. Data from these fisheries are only available to the the NWFSC Observer Program from PacFIN fish ticket records. We provide a summary of landed P. halibut from these fisheries by year.

4 RESULTS

4.1 IFQ Fishery

All participating vessels carry an observer on all fishing trips under IFQ management (100% trips observed,) except those participating in the EM EFP (see below for EM EFP results). For all 2016 strata, 98% or more of the observed IFQ tows or sets were sampled (Tables 8, 9, & 10). Unsorted catch was the only source of unsampled catch (Table 11; see NWFSC 2016b for IFQ sampling protocols). The total estimated weight of P. halibut from unsampled tows or sets in 2016 represents a small fraction (0.25 mt, or 0.7%) of the total 2016 IFQ gross discard weight of P. halibut (Tables 11, 12 & 13).

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 (Table 15). This gear-area-depth stratum accounts for 73% of the 2016 P. halibut discard mortality in the IFQ fishery. The next largest fraction (14%) of total IFQ discard mortality was 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 87% of the 2016 P. halibut discard mortality in the IFQ fishery (Table 15).

In terms of viability, the majority of individuals were classified as either excellent or dead, depending on the stratum (Table 14). The majority of individuals caught with bottom trawl were in excellent condition in the area

north of Pt. Chehalis and in shallow depths between 40°10′ N. latitude and Pt. Chehalis (Table 14). In deeper depths between 40°10′ N. latitude and Pt. Chehalis the majority of individuals were dead (Table 14). IFQ EM vessels have higher discard mortality rates than non-EM IFQ vessels; although sample sizes were very small (Appendix E 10.5).

Estimated P. halibut discard mortality from all sectors and gears of the 2016 IFQ fishery is very close to the average for the past 5 years (2011-15 mean = 34.92 mt, 2016 = 35.15 mt, including IFQ EM EFP).

The 2016 IFQ estimated P. halibut discard mortality for all gears is 81% less than the estimated discard morality from the 2010 LE bottom trawl fishery (Figure 1) and 84% less than the average mortality in the LE bottom trawl fishery over the years 2002-2010 (220 mt). The managemnt changes in the fishery could explain this decrease in P. halibut catch. First, IBQs for P. halibut might have increased fisher incentives to avoid P. halibut bycatch and thereby changed fisher behavior (i.e., changing fishing grounds or gear). Second, testing and use of gear to exclude P. halibut from the catch became general practice in much of the trawl fleet under IFQ, which enabled fishermen to increase fishing activity without additional risk to quota.

Estimated bycatch weight of P. halibut from the At-sea hake component of the 2016 IFQ fishery increased very slightly from 2015 (2015 = 0.06 mt, 2016 = 0.15; Tables 42 & 47). There was no fishing in the Tribal sector. At-sea hake P. halibut length frequencies are given in Table 43.

4.2 Non-Nearshore Fixed Gear Fishery

The 2016 estimated discard mortality of P. halibut in the longline portion of the LE sablefish endorsed sector increased from 2015 (Table 30). Compared to 2015, the 2016 observed discard ratio increased north of Pt. Chehalis (Table 25). Estimated discard of P. halibut from the pot portion of the LE sablefish endorsed sector increased compared to 2015, but remained relatively low compared to longline gears (Table 30).

Discard of P. halibut among the sablefish non-endorsed fixed gear sectors (LE and OA) during 2016 increased relative to 2013, 2014, and 2015, which were at or near historic lows for the longline/hook-&-line portion of these sectors (Table 30). Effort in the LE sablefish non-endorsed sector in 2016 was nearly equivalent to 2014 & 2015 (Table 25), but encounters jumped from 1.5% of observed trips in 2015 to 7.3% of observed trips in 2016 (Table 26) even though observer coverage slightly decreased from 2015 to 2016 (Table 22). OA hook-&-line and pot effort in 2016 also remained relatively constant compared to 2015 (Table 25). The increase in P. halibut discard mortality on OA hook-&-line vessels compared to last year (Table 30) was probably driven by increases in encounters on observed trips compared to 2015 (Table 26). The estimated discard mortality for OA pot gear vessels ticked up from 2015 (Table 30), again possibly due to an increase in observed encounters (Table 26).

Physical measurements of P. halibut length frequency from the non-nearshore fixed gear sectors can be found in Tables 32, 33, 34, & 35. Visual estimates of length frequencies in the non-nearshore fixed gear sectors can be found in Table 36.

4.3 Observed State Fisheries, EFPs and Non-Groundfish Fisheries

Very small amounts of P. halibut bycatch were recorded in state managed observed fisheries. Even assuming 100% mortality, 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 2016 total mortality estimate for P. halibut (Tables 38, 39, & 40).

Pacific halibut bycatch by year, from EFP IFQ vessels carrying electronic monitoring technologies are given in Table 44. Estimated P. halibut discard mortality from the 2016 IFQ Electronic Monitoring Exempted Fishing Permit was 2.63 mt from bottom trawl vessels, 0.8 mt from pot vessels (including discards at dock), and 0.66 mt from midwater trawl vessels (0.65 mt discarded at dock).

Pacific halibut bycatch by year, from non-EM EFP vessels has been zero since 2011 (Table 45). Pacific halibut landings from non-groundfish fisheries not observed by NWFSC Observer Program were approximately 41 mt in 2016 and have varied from about 25 mt (2011) to 106 mt (2002) (Table 46).

5 SUMMARY & CONCLUSIONS

5.1 IFQ Fishery

- Estimated P. halibut discard mortality from the 2016 IFQ non-EM vessels was 31.86 mt and from IFQ EM vessels was 3.29 mt.
- EM vessels had higher discard mortality rates than non-EM IFQ vessels; however samples sizes were very small.
- P. halibut discard from the at-sea Pacific hake fishery in 2016 (0.15 mt) increased relative to 2015 (0.06 mt), but remains on the low end of the historical average (2002-15: 1.25 mt).

5.2 Non-IFQ Fisheries

- The 2016 estimates of P. halibut discard morality (16.59 mt) in the LE sablefish endorsed sector increased relative to 2015 (10.20 mt) mt due to increased discard ratio, possibly due to increases in observed encounters, but this reason is not clear from available data. The 2016 Pacific halibut mortality estimates on LE sablefish non-endorsed (0.36 mt) and OA fixed gear hook & line (2.76 mt) and pot vessels (0.01 mt) increased relative to 2015. These increases were likely due to increases in encounters relative to 2015.
- Estimated P. halibut mortality in all other non-IFQ observed fisheries remain low relative to the IFQ and non-nearshore sectors, and are within the range observed in previous years.

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8 TABLES

Table 8: Number of vessels, trips, and tows observed and metric tons of sampled Pacific halibut discarded at-sea and the P. halibut landed and discarded at the dock (from PacFIN fish tickets) on IFQ bottom trawl vessels. All participating vessels carry an observer on all fishing trips under IFQ management (100% observed). For clarity, the number of hauls with unsampled catch categories is provided. Some tows are completely unsampled. See Table 44 for bottom trawl vessles fishing under the Electronic Monitoring EFP. (*) confidential data, (-) not applicable.

Area / Depth (fm) / Year	Bottom Trawl								Unsampled categories			Sampled Rate	
	No. of vessels	No. of trips	No. sampled tows	No. un-sampled tows	Sampled tow hours	Unsampled tow hours	Discarded at sea (mt)	Discarded at dock (mt)	IFQFF	IFQM	Non-IFQ	%tows sampled	% tow hrs. sampled
N. of Pt. Chehalis													
0-60													
2011	13	46	295	3	802.75	11.25	7.28	0.00	2	5	10	98.99%	98.62%
2012	14	66	312	5	662.80	6.80	4.35	0.00	0	1	10	98.42%	98.98%
2013	11	94	448	1	1124.53	3.05	5.35	0.00	1	0	19	99.78%	99.73%
2014	10	32	184	1	387.28	3.00	1.96	0.00	0	3	4	99.46%	99.23%
2015	8	56	278	0	577.36	0.00	3.89	0.00	0	0	0	100.00%	100.00%
2016	11	71	269	4	629.14	14.58	2.62	0.00	0	0	4	98.53%	97.74%
>60													
2011	22	145	973	5	3870.62	27.73	18.07	0.01	3	8	138	99.49%	99.29%
2012	19	167	1292	10	4933.33	39.21	28.60	0.03	0	20	58	99.23%	99.21%
2013	17	200	1657	4	6013.21	15.70	28.90	0.14	2	3	54	99.76%	99.74%
2014	13	147	1195	10	4834.45	32.22	24.45	0.08	0	3	19	99.17%	99.34%
2015	16	147	1006	1	3467.43	4.50	23.76	0.01	0	4	54	99.90%	99.87%
2016	17	137	958	1	2988.10	5.33	14.12	0.03	0	0	13	99.90%	99.82%
40°10′ to Pt. Chehalis													
0-60													
2011	21	139	1058	19	2002.93	36.72	9.71	0.00	12	2	65	98.24%	98.20%
2012	21	152	947	8	1864.09	18.51	7.33	0.00	3	6	29	99.16%	99.02%
2013	20	204	933	2	2167.95	5.25	8.31	0.00	0	8	23	99.79%	99.76%
2014	19	198	1059	9	2391.97	30.43	9.92	0.00	0	17	29	99.16%	98.74%
2015	15	190	1034	5	2241.72	17.33	10.00	0.00	0	8	30	99.52%	99.23%
2016	18	180	1029	9	2603.97	32.67	7.08	0.00	0	1	25	99.13%	98.76%
>60													
2011	56	751	4984	28	25758.16	143.25	20.16	0.01	5	14	178	99.44%	99.45%
2012	54	703	4450	26	23012.24	99.87	19.37	0.04	2	27	137	99.42%	99.57%
2013	54	743	4883	15	24709.66	72.51	19.88	0.02	1	19	165	99.69%	99.71%
2014	50	623	3783	10	19466.22	31.34	16.85	0.01	0	8	88	99.74%	99.84%
2015	49	591	3685	4	17621.28	18.34	29.32	0.04	0	11	72	99.89%	99.90%
2016	43	584	3523	2	16161.49	9.58	31.07	0.08	0	0	61	99.94%	99.94%
S. of 40°10′ N. lat.													
0-60													
2011	3	21	63	0	157.17	0.00	0.17	0.00	3	0	1	100.00%	100.00%
2012	*	*	*	*	*	*	*	*	*	*	*	*	*
2013‡	4	56	171	0	453.42	0.00	0.03	0.00	0	0	0	100.00%	100.00%
2014‡	5	16	39	1	76.54	2.08	0.00	0.00	0	0	1	97.50%	97.35%
2015‡	5	29	75	0	143.22	0.00	0.00	0.00	0	0	0	100.00%	100.00%
2016‡	*	*	*	*	*	*	*	*	*	*	*	*	*
>60													
2011	15	240	1357	3	5838.74	12.07	0.16	0.00	3	0	34	99.78%	99.79%
2012	13	255	1587	3	5881.45	4.08	0.75	0.00	1	1	69	99.81%	99.93%
2013‡	14	277	1727	2	6423.88	2.75	0.88	0.00	0	2	69	99.88%	99.96%
2014‡	14	277	1877	12	6318.95	50.11	0.56	0.00	1	0	35	99.36%	99.21%
2015‡	11	186	1231	3	4198.51	5.80	0.33	0.00	0	0	14	99.76%	99.86%
2016‡	7	91	616	0	1931.13	0.00	0.09	0.00	0	0	3	100.00%	100.00%
LE CA Halibut S. of 40°10′ N. lat.													
All depths													
2011	3	63	155	0	507.17	0.00	0.00	0.00	0	0	2	100.00%	100.00%
2012	*	*	*	*	*	*	*	*	*	*	*	*	*

‡Combined IFQ and LE CA Halibut bottom trawl.

Table 9: Number of vessels, trips, and tows observed and metric tons of sampled Pacific halibut discarded at-sea and the P. halibut landed and discarded at the dock (from PacFIN fish tickets) on IFQ midwater trawl vessels. All participating vessels carry an observer on all fishing trips under IFQ management (100% observed). For clarity the number of hauls with unsampled catch categories is provided. Some tows are completely unsampled. Note that starting in 2015, sector names have changed such that trips with P. hake comprising less than 50% of the total landings are renamed Midwater Rockfish whereas trips with P. hake greater than 50% of landings are renamed Midwater Hake. (*) confidential data, (-) not applicable.

Midwater Trawl													
Gear									**Unsampled categories**			**Sampled Rate**	
Sector-Area Year	**No. of vessels**	**No. of trips**	**No. sampled tows**	**No. un-sampled tows**	**Sampled tow hours**	**Unsampled tow hours**	**Discarded at sea (mt)**	**Discarded at dock (mt)**	**IFQFF**	**IFQM**	**Non-IFQ**	**%tows sampled**	**% tow hrs. sampled**
Non-hake Shoreside													
North of 40°10′													
2011	*	*	*	*	*	*	*	*	*	*	*	*	*
2012	4	9	35	0	72.96	0.00	0.00	0.00	0	0	0	100.00%	100.00%
2013	6	22	77	0	137.49	0.00	0.00	0.00	0	0	1	100.00%	100.00%
2014	9	34	133	0	268.46	0.00	0.00	0.00	0	0	0	100.00%	100.00%
Midwater Rockfish													
North of 40°10′													
2015	7	43	146	0	243.97	0.00	0.00	0.00	0	0	1	100.00%	100.00%
2016	3	13	42	0	84.07	0.00	0.00	0.00	0	0	0	100.00%	100.00%
Shoreside Hake													
North of 40°10′													
2011	27	914	1715	0	3971.49	0.00	0.03	0.33	0	0	2	100.00%	100.00%
2012	24	721	1598	0	5948.46	0.00	0.00	0.62	0	0	3	100.00%	100.00%
2013	24	942	1732	0	4621.83	0.00	0.05	1.28	0	0	2	100.00%	100.00%
2014	25	957	1718	1	4716.14	1.25	0.11	1.25	0	0	7	99.94%	99.97%
Midwater Hake													
North of 40°10′													
2015	5	126	286	0	1159.49	0.00	0.00	0.14	0	0	3	100.00%	100.00%
2016	4	97	207	0	652.59	0.00	0.00	0.03	0	0	0	100.00%	100.00%

Table 10: Number of vessels, trips, and sets observed and metric tons of sampled Pacific halibut discarded at-sea and the P. halibut landed and discarded at the dock (from PacFIN fish tickets) on IFQ fixed gear vessels. All participating vessels carry an observer on all fishing trips under IFQ management (100% observed). For clarity the number of hauls with unsampled catch categories is provided. Some sets are completely unsampled. Note in 2015, IFQ vessels using pot gear that fished north of Point Chehalis were all part of the Electronic Monitoring EFP (see Table 44 for summary of these vessels). (*) confidential data, (-) not applicable.

Gear / **Area** / Year							**Unsampled categories**			**Coverage Rate**
	No. of vessels	**No. of trips**	**No. sampled sets**	**No. un-sampled sets**	**discarded at sea (mt)**	**discarded at dock (mt)**	**IFQFF**	**IFQM**	**Non-IFQ**	**%sets sampled**
Hook and Line										
North of 40°10′ N. lat.										
2011	6	21	408	1	6.03	0.00	0	0	0	99.76%
South of 40°10′ N. lat.										
2011	6	71	212	0	0.00	0.00	0	0	1	100.00%
Coastwide										
2012	8	32	506	0	14.66	0.00	0	0	0	100.00%
2013	8	29	215	0	3.00	0.00	0	0	0	100.00%
2014	8	31	227	32	3.43	0.00	0	0	0	87.64%
2015	5	16	185	0	9.49	0.00	0	0	0	100.00%
2016	5	30	351	0	6.39	0.00	0	0	0	100.00%
Pot										
North of Pt. Chehalis										
2011	3	12	75	0	1.03	0.00	0	0	0	100.00%
2012	5	45	418	0	1.27	0.00	0	0	7	100.00%
2013	3	12	167	0	0.22	0.00	0	0	1	100.00%
Pt. Chehalis to 40°10′ N. lat.										
2011	8	76	719	18	2.30	0.00	0	0	1	97.56%
2012	9	60	470	0	0.62	0.00	0	0	0	100.00%
2013	5	40	504	0	0.76	0.00	0	0	2	100.00%
2015	6	39	363	0	1.31	0.01	0	0	0	100.00%
South of 40°10′ N. lat.										
2011	11	148	737	0	0.00	0.00	0	0	2	100.00%
2012	13	167	812	0	0.00	0.00	0	0	1	100.00%
2013	6	41	409	0	0.00	0.00	0	0	2	100.00%
2015	3	18	220	0	0.00	0.00	0	0	0	100.00%
Coastwide										
2014	14	113	1278	0	0.32	0.00	0	0	9	100.00%
2016	8	61	584	0	1.70	0.00	0	0	0	100.00%

Table 11: Values used to calculate the expanded weight of Pacific halibut (PHLB) from each unsampled category on U.S. West Coast groundfish IFQ bottom trawl vessels by year. Unsampled catch weight could be assigned to one of four categories: IFQ flatfish species, IFQ mixed species, non-IFQ species, or unsorted (a mix of both IFQ and non-IFQ species). The sampled weight, discard ratio, unsampled weight and estimated P. halibut gross at-sea discard are presented within each category, as a function of sector, management area, depth, and area north or south of Pt. Chehalis, WA. The sum of expanded weight is the sum of the estimated gross P. halibut discard across categories. The sampled discarded PHLB weight is the sum of sampled PHLB. The total discard (gross) is the sum of the PHLB in unsampled hauls plus the sampled PHLB. All weights are metric tons (mt). (*) confidential data. Note that adding values across columns might give slightly different results because values are rounded to two decimals for reporting.

Bottom Trawl

Area / Depth (fm) / Year	IFQ Flatfish				Mixed IFQ species				Non-IFQ Species				Unsorted				Sum of Exp. Discard Weight	Samp. Discarded PHLB	Total Discard
	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard			
N. of Pt. Chehalis																			
0-60																			
2011	60.53	0.12	0.16	0.02	80.81	0.09	5.22	0.48	55.65	0.00	2.66	0.00	136.46	0.05	2.29	0.12	0.62	7.36	7.98
2012	50.77	0.09	0.00	0.00	56.29	0.08	0.05	0.00	45.51	0.00	1.02	0.00	101.80	0.05	0.56	0.03	0.03	4.77	4.80
2013	104.68	0.05	0.07	0.00	114.61	0.05	0.00	0.00	92.99	0.00	2.00	0.00	207.60	0.03	0.91	0.02	0.03	5.43	5.46
2014	26.44	0.07	0.00	0.00	32.70	0.06	1.62	0.10	27.58	0.00	0.85	0.00	60.28	0.03	0.02	0.00	0.10	1.97	2.07
2015	32.67	0.12	0.00	0.00	38.76	0.10	0.00	0.00	32.66	0.00	0.00	0.00	71.42	0.05	0.00	0.00	0.00	3.89	3.89
2016	43.01	0.06	0.00	0.00	57.97	0.05	0.00	0.00	64.58	0.00	0.78	0.00	122.55	0.02	2.56	0.06	0.06	2.71	2.76
>60																			
2011	114.16	0.19	1.03	0.20	142.47	0.15	1.01	0.15	207.64	0.00	15.03	0.00	350.11	0.06	4.79	0.30	0.64	21.65	22.29
2012	84.84	0.36	0.00	0.00	122.87	0.25	2.42	0.59	268.93	0.00	6.84	0.00	391.80	0.08	24.85	1.90	2.49	30.18	32.67
2013	185.79	0.16	0.20	0.03	227.34	0.13	1.07	0.14	241.41	0.00	5.38	0.00	468.75	0.06	1.39	0.08	0.25	29.66	29.91
2014	192.81	0.13	0.00	0.00	233.86	0.11	0.87	0.09	293.94	0.00	1.81	0.00	527.80	0.05	29.12	0.61	0.70	24.88	25.58
2015	108.65	0.22	0.00	0.00	134.93	0.18	2.84	0.51	129.24	0.00	3.76	0.00	264.18	0.09	0.16	0.01	0.53	24.34	24.86
2016	114.43	0.12	0.00	0.00	157.47	0.09	0.00	0.00	204.62	0.00	0.94	0.00	362.08	0.04	0.45	0.00	0.00	14.14	14.14
40°10′ to Pt. Chehalis																			
0-60																			
2011	96.63	0.11	0.97	0.11	117.73	0.09	2.40	0.21	188.16	0.00	6.76	0.00	305.90	0.03	5.71	0.20	0.52	10.48	11.00
2012	72.35	0.11	0.45	0.05	86.10	0.09	2.35	0.21	142.99	0.00	2.56	0.00	229.09	0.03	1.95	0.07	0.33	7.73	8.06
2013	109.66	0.08	0.00	0.00	120.95	0.07	0.86	0.06	138.52	0.00	1.84	0.00	259.47	0.03	0.41	0.01	0.07	8.47	8.55
2014	176.72	0.06	0.00	0.00	194.45	0.05	6.19	0.32	204.11	0.00	4.48	0.00	398.56	0.03	21.62	0.17	0.48	10.05	10.54
2015	158.17	0.06	0.00	0.00	192.63	0.05	0.35	0.02	193.08	0.00	2.01	0.00	385.71	0.03	1.71	0.05	0.06	10.16	10.22
2016	203.22	0.04	0.00	0.00	258.27	0.03	0.05	0.00	217.24	0.00	3.05	0.00	475.52	0.02	6.73	0.10	0.10	7.22	7.32
>60																			
2011	190.48	0.12	0.78	0.09	352.51	0.06	4.00	0.25	753.78	0.00	18.25	0.00	1106.30	0.02	7.54	0.15	0.49	22.02	22.51
2012	180.33	0.11	0.06	0.01	369.70	0.05	6.92	0.37	641.16	0.00	12.38	0.00	1010.86	0.02	7.26	0.14	0.52	19.94	20.46
2013	229.39	0.09	0.07	0.01	401.78	0.05	9.72	0.49	709.89	0.00	11.56	0.00	1111.67	0.02	9.68	0.14	0.63	20.44	21.08
2014	335.56	0.05	0.00	0.00	501.00	0.03	3.02	0.10	506.72	0.00	4.08	0.00	1007.72	0.02	24.90	0.09	0.18	16.96	17.14
2015	323.18	0.09	0.00	0.00	466.24	0.06	0.93	0.06	548.36	0.00	4.48	0.00	1014.61	0.03	2.95	0.02	0.08	29.67	29.75
2016	289.10	0.11	0.00	0.00	531.95	0.06	0.00	0.00	471.32	0.00	8.21	0.00	1003.27	0.03	4.54	0.09	0.09	31.39	31.48
S. of 40°10′ N. lat.																			
0-60																			
2011	4.60	0.00	0.04	0.00	5.04	0.00	0.00	0.00	11.75	0.01	0.01	0.00	16.79	0.01	0.00	0.00	0.00	0.17	0.17
2012	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2013‡	4.55	0.00	0.00	0.00	6.65	0.00	0.00	0.00	66.93	0.00	0.00	0.00	73.58	0.00	0.00	0.00	0.00	0.03	0.03
2014‡	0.86	0.00	0.00	0.00	2.38	0.00	0.00	0.00	4.45	0.00	0.45	0.00	6.84	0.00	0.02	0.00	0.00	0.00	0.00
2015‡	6.11	0.00	0.00	0.00	17.97	0.00	0.00	0.00	7.47	0.00	0.00	0.00	25.44	0.00	0.00	0.00	0.00	0.00	0.00
2016‡	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
>60																			
2011	155.01	0.00	0.10	0.00	275.06	0.00	0.00	0.00	223.70	0.00	2.86	0.00	498.76	0.00	1.36	0.00	0.00	0.16	0.16
2012	80.42	0.00	0.01	0.00	266.50	0.00	0.03	0.00	222.92	0.00	7.14	0.03	489.41	0.00	1.93	0.00	0.03	0.81	0.84
2013‡	119.64	0.00	0.00	0.00	364.86	0.00	0.07	0.00	296.89	0.00	7.47	0.02	661.75	0.00	0.23	0.00	0.02	0.88	0.90
2014‡	169.03	0.00	0.03	0.00	363.29	0.00	0.00	0.00	341.56	0.00	1.22	0.00	704.84	0.00	5.64	0.00	0.01	0.56	0.57
2015‡	93.62	0.00	0.00	0.00	233.85	0.00	0.00	0.00	173.60	0.00	0.44	0.00	407.45	0.00	12.71	0.00	0.00	0.33	0.33
2016‡	48.17	0.00	0.00	0.00	99.67	0.00	0.00	0.00	88.29	0.00	0.11	0.00	187.96	0.00	0.00	0.00	0.00	0.10	0.10
LE CA Halibut S. of 40°10′ N. lat.																			
All depths																			
2011	0.73	0.00	0.00	0.00	0.74	0.00	0.00	0.00	75.42	0.00	0.01	0.00	76.16	0.00	0.00	0.00	0.00	0.00	0.00
2012	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

‡Combined IFQ and LE CA Halibut bottom trawl.

Table 12: Values used to calculate the expanded weight of Pacific halibut (PHLB) from each unsampled category on U.S. West Coast groundfish IFQ midwater trawl vessels by year. Unsampled catch weight could be assigned to one of four categories: IFQ flatfish species, IFQ mixed species, non-IFQ species, or unsorted (a mix of both IFQ and non-IFQ species). The sampled weight, discard ratio, unsampled weight and estimated P. halibut gross at-sea discard are presented within each category, as a function of sector. All midwater trawling occurs north of 40 °10' and all depths are included in the summaries. The sum of expanded weight is the sum of the estimated gross P. halibut discard across categories. The sampled discarded PHLB weight is the sum of sampled PHLB. The total discard (gross) is the sum of the PHLB in unsampled hauls plus the sampled PHLB. All weights are metric tons (mt). (*) confidential data.

Midwater Trawl

Area / Depth (fm) / Year	IFQ Flatfish				Mixed IFQ species				Non-IFQ Species				Unsorted						
	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Sum of Exp. Discard Weight	Samp. Discarded PHLB	Total Discard
Non-hake Shoreside																			
2011	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
2014	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00
Midwater Rockfish																			
2015	0.00	0.00	0.00	0.00	3.79	0.00	0.00	0.00	16.37	0.00	0.05	0.00	20.15	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.09	0.00	0.00	0.00	2.36	0.00	0.00	0.00	0.01	0.00	0.00	0.00	2.37	0.00	0.00	0.00	0.00	0.00	0.00
Shoreside Hake																			
2011	0.03	0.99	0.00	0.00	521.49	0.00	0.00	0.00	3.82	0.00	1.37	0.00	525.31	0.00	0.00	0.00	0.00	0.03	0.03
2012	0.00	0.00	0.00	0.00	128.31	0.00	0.00	0.00	8.19	0.00	0.36	0.00	136.50	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.05	1.00	0.00	0.00	460.78	0.00	0.00	0.00	7.24	0.00	0.27	0.00	468.03	0.00	0.00	0.00	0.00	0.05	0.05
2014	0.16	0.71	0.00	0.00	498.24	0.00	0.00	0.00	13.04	0.00	0.23	0.00	511.28	0.00	0.05	0.00	0.00	0.11	0.11
Midwater Hake																			
2015	0.00	0.00	0.00	0.00	43.76	0.00	0.00	0.00	4.47	0.00	0.12	0.00	48.23	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.00	0.00	0.00	0.00	59.29	0.00	0.00	0.00	1.18	0.00	0.00	0.00	60.47	0.00	0.00	0.00	0.00	0.00	0.00

Table 13: Values used to calculate the expanded weight of Pacific halibut (PHLB) from each unsampled category on U.S. West Coast groundfish IFQ fixed gear vessels by year. Unsampled catch weight could be assigned to one of four categories: IFQ flatfish species, IFQ mixed species, non-IFQ species, or unsorted (a mix of both IFQ and non-IFQ species). The sampled weight, discard ratio, unsampled weight and estimated P. halibut gross at-sea discard are presented within each category, as a function of gear, management area, and, for pot gear, by areas north and south of Point Chehalis, WA. All depths fished are included in the summaries. The sum of expanded weight is the sum of the estimated gross P. halibut discard across categories. The sampled discarded PHLB weight is the sum of sampled PHLB. The total discard (gross) is the sum of the PHLB in unsampled sets plus the sampled PHLB. All weights are metric tons (mt). (*) confidential data.

Area / Depth (fm) / Year	IFQ Flatfish				Mixed IFQ species				Non-IFQ Species				Unsorted						
	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Samp. Weight	Discard Ratio	Unsamp. Weight	Est. Discard	Sum of Exp. Discard Weight	Samp. Discarded PHLB	Total Discard
Hook and Line																			
North of 40°10′ N. lat.																			
2011	7.19	0.84	0.00	0.00	22.01	0.28	0.00	0.00	56.74	0.00	0.00	0.00	78.76	0.08	0.00	0.00	0.00	6.06	6.06
South of 40°10′ N. lat.																			
2011	0.18	0.00	0.00	0.00	3.72	0.00	0.00	0.00	21.06	0.00	0.00	0.00	24.78	0.00	0.00	0.00	0.00	0.00	0.00
Coastwide																			
2012	19.31	0.76	0.00	0.00	36.87	0.40	0.00	0.00	97.36	0.00	0.00	0.00	134.24	0.11	0.00	0.00	0.00	14.66	14.66
2013	5.10	0.59	0.00	0.00	8.29	0.36	0.00	0.00	27.60	0.00	0.00	0.00	35.88	0.08	0.00	0.00	0.00	3.00	3.00
2014	5.37	0.64	0.00	0.00	8.41	0.41	0.00	0.00	35.36	0.00	0.00	0.00	43.76	0.08	9.85	0.38	0.38	3.43	3.80
2015	10.76	0.88	0.00	0.00	16.49	0.58	0.00	0.00	38.39	0.00	0.00	0.00	54.88	0.17	0.00	0.00	0.00	9.49	9.49
2016	8.69	0.74	0.00	0.00	18.97	0.34	0.00	0.00	61.15	0.00	0.00	0.00	80.13	0.08	0.00	0.00	0.00	6.39	6.39
Pot																			
North of Pt. Chehalis																			
2011	1.05	0.98	0.00	0.00	1.56	0.66	0.00	0.00	0.26	0.00	0.00	0.00	1.82	0.57	0.00	0.00	0.00	1.03	1.03
2012	2.46	0.52	0.00	0.00	9.15	0.14	0.00	0.00	2.27	0.00	0.01	0.00	11.42	0.11	0.00	0.00	0.00	1.27	1.27
2013	0.28	0.79	0.00	0.00	1.08	0.20	0.00	0.00	0.66	0.00	0.01	0.00	1.73	0.13	0.00	0.00	0.00	0.22	0.22
Pt. Chehalis to 40°10′ N. lat.																			
2011	2.45	0.94	0.00	0.00	7.92	0.29	0.00	0.00	3.37	0.00	0.00	0.00	11.29	0.20	3.18	0.02	0.02	2.30	2.33
2012	1.22	0.51	0.00	0.00	3.86	0.16	0.00	0.00	6.03	0.00	0.00	0.00	9.88	0.06	0.00	0.00	0.00	0.62	0.62
2013	1.23	0.62	0.00	0.00	6.77	0.11	0.00	0.00	10.90	0.00	0.00	0.00	17.67	0.04	0.00	0.00	0.00	0.76	0.76
2015	1.78	0.74	0.00	0.00	7.90	0.17	0.00	0.00	7.52	0.00	0.00	0.00	15.42	0.08	0.00	0.00	0.00	1.31	1.31
South of 40°10′ N. lat.																			
2011	0.30	0.00	0.00	0.00	6.49	0.00	0.00	0.00	6.91	0.00	0.00	0.00	13.41	0.00	0.00	0.00	0.00	0.00	0.00
2012	0.52	0.00	0.00	0.00	4.21	0.00	0.00	0.00	4.59	0.00	0.00	0.00	8.80	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.03	0.00	0.00	0.00	3.01	0.00	0.00	0.00	3.62	0.00	0.00	0.00	6.64	0.00	0.00	0.00	0.00	0.00	0.00
2015	0.01	0.00	0.00	0.00	1.46	0.00	0.00	0.00	8.65	0.00	0.00	0.00	10.12	0.00	0.00	0.00	0.00	0.00	0.00
Coastwide																			
2014	0.58	0.55	0.00	0.00	11.53	0.03	0.00	0.00	16.58	0.00	0.01	0.00	28.11	0.01	0.00	0.00	0.00	0.32	0.32
2016	2.20	0.77	0.00	0.00	6.54	0.26	0.00	0.00	5.50	0.00	0.00	0.00	12.04	0.14	0.00	0.00	0.00	1.70	1.70

Table 14: Pacific halibut viabilities in the U.S. West Coast groundfish IFQ fishery by gear, management area, area north and south of Point Chehalis, WA, depth (bottom trawl only), and year. The condition of sampled P. halibut was identified as Excellent (Exc), Poor, or Dead (see Appendices in WCGOP manual), consistent with IPHC protocol. The number of fish in each category was weighted based on the length-weight relationship as described in the Methods. In addition, all years combined are also shown. (‡) combined IFQ and LE CA Halibut, (*) confidential data, (-) no estimate provided, see text for explanation.

Area Depth (fm)	**Number**				**Weighted percentages in each category**		
Year	**Exc**	**Poor**	**Dead**	**Total**	**Exc**	**Poor**	**Dead**
Bottom Trawl							
North of Pt. Chehalis							
0-60							
2011	517	137	308	962	57.34%	14.21%	28.45%
2012	314	156	299	769	45.94%	20.28%	33.78%
2013	327	114	464	905	41.06%	13.61%	45.33%
2014	252	27	26	305	85.12%	8.02%	6.86%
2015	349	51	90	490	71.79%	12.54%	15.67%
2016	242	61	89	392	66.54%	14.69%	18.76%
All	2001	546	1276	3823	57.42%	14.52%	28.07%
>60							
2011	1063	439	927	2429	46.75%	18.24%	35.01%
2012	1299	709	1368	3376	40.36%	20.82%	38.82%
2013	2100	534	984	3618	62.12%	14.22%	23.65%
2014	1669	595	1055	3319	52.59%	16.97%	30.43%
2015	1529	404	679	2612	59.53%	14.33%	26.14%
2016	837	326	630	1793	47.79%	16.90%	35.30%
All	8497	3007	5643	17147	51.70%	16.98%	31.31%
40°10′ to Pt. Chehalis							
0-60							
2011	1076	169	199	1444	80.30%	9.53%	10.17%
2012	791	175	229	1195	67.68%	13.89%	18.44%
2013	659	238	260	1157	59.12%	21.69%	19.19%
2014	1095	229	307	1631	68.69%	13.72%	17.59%
2015	778	232	426	1436	59.35%	15.05%	25.60%
2016	525	137	447	1109	49.51%	11.91%	38.58%
All	4924	1180	1868	7972	64.95%	14.17%	20.88%
>60							
2011	967	554	1188	2709	37.57%	20.22%	42.22%
2012	850	446	1201	2497	35.47%	17.55%	46.97%
2013	753	404	1100	2257	34.57%	18.55%	46.88%
2014	765	363	865	1993	42.04%	17.22%	40.74%
2015	1402	556	1513	3471	41.39%	17.07%	41.54%
2016	1319	515	1813	3647	38.09%	13.80%	48.11%
All	6056	2838	7680	16574	38.36%	17.10%	44.54%
Bottom Trawl							
South of 40°10′ N. lat.							

Continued on next page

Table 14: (IFQ viabilities continued)

Area Depth (fm) Year	Number				Weighted percentages in each category		
	Exc	Poor	Dead	Total	Exc	Poor	Dead
0-60							
2011	0	0	10	10	0.00%	0.00%	100.00%
2012	*	*	*	*	*	*	*
2013‡	2	0	0	2	100.00%	0.00%	0.00%
2014‡	0	0	0	0	0.00%	0.00%	0.00%
2015‡	0	0	0	0	0.00%	0.00%	0.00%
2016‡	*	*	*	*	*	*	*
All‡	*	*	*	*	*	*	*
>60							
2011	7	1	6	14	48.21%	6.06%	45.73%
2012	35	7	36	78	49.26%	9.18%	41.56%
2013‡	27	14	51	92	32.05%	16.05%	51.90%
2014‡	24	9	14	47	63.47%	13.76%	22.76%
2015‡	10	3	15	28	54.15%	9.94%	35.91%
2016‡	6	4	1	11	73.40%	22.25%	4.35%
All‡	109	38	123	270	48.13%	12.61%	39.25%
LE CA Halibut S. of 40°10′ N. lat.							
All depths							
2011	0	0	0	0	0.00%	0.00%	0.00%
2012	*	*	*	*	*	*	*
All	*	*	*	*	*	*	*
Midwater Trawl							
Non-hake Shoreside							
North of 40°10′ N. lat.							
All depths							
2011	*	*	*	*	*	*	*
2012	0	0	0	0	0.00%	0.00%	0.00%
2013	0	0	0	0	0.00%	0.00%	0.00%
2014	0	0	0	0	0.00%	0.00%	0.00%
All	*	*	*	*	*	*	*
Midwater Rockfish							
North of 40°10′ N. lat.							
All depths							
2015	0	0	0	0	0.00%	0.00%	0.00%
2016	0	0	0	0	0.00%	0.00%	0.00%
All	0	0	0	0	0.00%	0.00%	0.00%
Midwater Trawl							
Shoreside Hake							
North of 40°10′ N. lat.							
All depths							
2011	0	1	2	3	0.00%	46.01%	53.99%
2012	0	0	0	0	0.00%	0.00%	0.00%
2013	2	0	1	3	91.76%	0.00%	8.24%
2014	6	2	0	8	89.99%	10.01%	0.00%

Continued on next page

Table 14: (IFQ viabilities continued)

Area Depth (fm) Year	Number				Weighted percentages in each category		
	Exc	Poor	Dead	Total	Exc	Poor	Dead
All	8	3	3	14	78.15%	12.12%	9.73%
Midwater Hake							
North of 40°10′ N. lat.							
All depths							
2015	0	0	0	0	0.00%	0.00%	0.00%
2016	0	0	0	0	0.00%	0.00%	0.00%
All	0	0	0	0	0.00%	0.00%	0.00%
Hook and Line							
North of 40°10′ N. lat.							
2011	-	-	-	902	-	-	-
All	-	-	-	902	-	-	-
South of 40°10′ N. lat.							
2011	-	-	-	0	-	-	-
All	-	-	-	0	-	-	-
Coastwide							
2012	-	-	-	1271	-	-	-
2013	-	-	-	404	-	-	-
2014	-	-	-	698	-	-	-
2015	-	-	-	963	-	-	-
2016	-	-	-	672	-	-	-
All	-	-	-	4008	-	-	-
Pot							
North of Pt. Chehalis							
2011	53	3	19	75	83.58%	2.14%	14.27%
2012	103	21	24	148	66.34%	16.72%	16.94%
2013	18	1	11	30	60.78%	1.83%	37.39%
All	174	25	54	253	71.77%	10.11%	18.12%
Pt. Chehalis to 40°10′ N. lat.							
2011	149	10	65	224	69.06%	4.57%	26.37%
2012	58	4	3	65	86.97%	7.77%	5.27%
2013	76	7	8	91	83.18%	6.94%	9.88%
2015	145	7	17	169	83.65%	4.47%	11.88%
All	428	28	93	549	77.71%	5.29%	17.00%
Pot							
South of 40°10′ N. lat.							
2011	0	0	0	0	0.00%	0.00%	0.00%
2012	0	0	0	0	0.00%	0.00%	0.00%
2013	0	0	0	0	0.00%	0.00%	0.00%
2015	0	0	0	0	0.00%	0.00%	0.00%
All	0	0	0	0	0.00%	0.00%	0.00%
Coastwide							
2014	24	0	8	32	73.71%	0.00%	26.29%
2016	195	3	13	211	90.04%	1.73%	8.23%
All	219	3	21	243	87.32%	1.44%	11.24%

Table 15: Estimated Pacific halibut gross at-sea discard (mt) and at-sea discard mortality (mt) in the U.S. West Coast groundfish IFQ fishery by gear type, management area, area north or south of Pt. Chehalis, WA, depth (bottom trawl only), and year. Estimates were allocated to three condition categories based on information presented in Table 14. DMR=Discard Mortality Rate. (‡) combined IFQ and LE CA Halibut, (*) confidential data, (-) no estimate, see text for explanation.

Area / Depth (fm) / Year	Estimated Gross Discard (mt)				Estimated Discard Mortality				DMR
	Exc	Poor	Dead	Total	m(Exc)	m(Poor)	m(Dead)	m(Total)	
Bottom Trawl									
North of Pt. Chehalis									
0-60									
2011	4.58	1.13	2.27	7.98	0.92	0.62	2.04	3.58	0.45
2012	2.21	0.97	1.62	4.80	0.44	0.54	1.46	2.44	0.51
2013	2.24	0.74	2.47	5.46	0.45	0.41	2.23	3.08	0.56
2014	1.76	0.17	0.14	2.07	0.35	0.09	0.13	0.57	0.28
2015	2.79	0.49	0.61	3.89	0.56	0.27	0.55	1.37	0.35
2016	1.84	0.41	0.52	2.76	0.37	0.22	0.47	1.06	0.38
>60									
2011	10.42	4.07	7.80	22.29	2.08	2.24	7.02	11.34	0.51
2012	13.19	6.80	12.68	32.67	2.64	3.74	11.42	17.79	0.54
2013	18.58	4.25	7.07	29.91	3.72	2.34	6.37	12.42	0.42
2014	13.45	4.34	7.78	25.58	2.69	2.39	7.00	12.08	0.47
2015	14.80	3.56	6.50	24.86	2.96	1.96	5.85	10.77	0.43
2016	6.76	2.39	4.99	14.14	1.35	1.31	4.49	7.16	0.51
40°10′ to Pt. Chehalis									
0-60									
2011	8.83	1.05	1.12	11.00	1.77	0.58	1.01	3.35	0.30
2012	5.45	1.12	1.49	8.06	1.09	0.62	1.34	3.04	0.38
2013	5.05	1.85	1.64	8.55	1.01	1.02	1.48	3.51	0.41
2014	7.24	1.45	1.85	10.54	1.45	0.80	1.67	3.91	0.37
2015	6.07	1.54	2.62	10.22	1.21	0.85	2.35	4.41	0.43
2016	3.62	0.87	2.82	7.32	0.72	0.48	2.54	3.75	0.51
>60									
2011	8.46	4.55	9.50	22.51	1.69	2.50	8.55	12.75	0.57
2012	7.26	3.59	9.61	20.46	1.45	1.98	8.65	12.08	0.59
2013	7.29	3.91	9.88	21.08	1.46	2.15	8.89	12.50	0.59
2014	7.20	2.95	6.98	17.14	1.44	1.62	6.28	9.35	0.55
2015	12.31	5.08	12.36	29.75	2.46	2.79	11.12	16.38	0.55
2016	11.99	4.34	15.14	31.48	2.40	2.39	13.63	18.42	0.59
South of 40°10′ N. lat.									
0-60									
2011	0.00	0.00	0.17	0.17	0.00	0.00	0.15	0.15	0.90
2012	*	*	*	*	*	*	*	*	*
2013	0.03	0.00	0.00	0.03	0.01	0.00	0.00	0.01	0.20
2014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	*	*	*	*	*	*	*	*	*
Bottom Trawl									

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Table 15: (IFQ gross discard and DMR continued)

Area / Depth (fm) / Year	Estimated Gross Discard (mt)				Estimated Discard Mortality				DMR
	Exc	Poor	Dead	Total	m(Exc)	m(Poor)	m(Dead)	m(Total)	
>60									
2011	0.08	0.01	0.08	0.16	0.02	0.01	0.07	0.09	0.54
2012	0.41	0.08	0.35	0.84	0.08	0.04	0.31	0.44	0.52
2013	0.29	0.14	0.47	0.90	0.06	0.08	0.42	0.56	0.62
2014	0.36	0.08	0.13	0.57	0.07	0.04	0.12	0.23	0.41
2015	0.18	0.03	0.12	0.33	0.04	0.02	0.11	0.16	0.49
2016	0.07	0.02	0.00	0.10	0.01	0.01	0.00	0.03	0.31
LE CA Halibut S. of 40°10′ N. lat.									
All depths									
2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	*	*	*	*	*	*	*	*	*
Midwater Trawl									
Non-hake Shoreside									
North of 40°10′ N. lat.									
All depths									
2011	*	*	*	*	*	*	*	*	*
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Midwater Rockfish									
North of 40°10′ N. lat.									
All depths									
2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shoreside Hake									
North of 40°10′ N. lat.									
All depths									
2011	0.00	0.01	0.01	0.03	0.00	0.00	0.00	0.03	1.00
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.05	1.00
2014	0.10	0.01	0.00	0.11	0.00	0.00	0.00	0.11	1.00
Midwater Hake									
North of 40°10′ N. lat.									
All depths									
2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hook and Line									
North of 40°10′ N. lat.									
2011	-	-	-	6.06	-	-	-	0.97	0.16
South of 40°10′ N. lat.									
2011	-	-	-	0.00	-	-	-	0.00	0.00
Coastwide									
2012	-	-	-	14.66	-	-	-	2.34	0.16
2013	-	-	-	3.00	-	-	-	0.48	0.16
2014	-	-	-	3.80	-	-	-	0.61	0.16

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Table 15: (IFQ gross discard and DMR continued)

Area / Depth (fm) / Year	Estimated Gross Discard (mt)				Estimated Discard Mortality				DMR
	Exc	Poor	Dead	Total	m(Exc)	m(Poor)	m(Dead)	m(Total)	
2015	-	-	-	9.49	-	-	-	1.52	0.16
2016	-	-	-	6.39	-	-	-	1.02	0.16
Pot									
North of Pt. Chehalis									
2011	0.86	0.02	0.15	1.03	0.00	0.02	0.15	0.17	0.16
2012	0.84	0.21	0.21	1.27	0.00	0.21	0.21	0.43	0.34
2013	0.13	0.00	0.08	0.22	0.00	0.00	0.08	0.09	0.39
Pt. Chehalis to 40°10′ N. lat.									
2011	1.61	0.11	0.61	2.33	0.00	0.11	0.61	0.72	0.31
2012	0.54	0.05	0.03	0.62	0.00	0.05	0.03	0.08	0.13
2013	0.63	0.05	0.07	0.76	0.00	0.05	0.07	0.13	0.17
2015	1.10	0.06	0.16	1.31	0.00	0.06	0.16	0.21	0.16
South of 40°10′ N. lat.									
2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coastwide									
2014	0.23	0.00	0.08	0.32	0.00	0.00	0.08	0.08	0.26
2016	1.53	0.03	0.14	1.70	0.00	0.03	0.14	0.17	0.10

Table 16: Estimated Pacific halibut discard (mt), discard mortality (mt), legal-sized (82 cm) mortality (mt), and percent of legal-sized discard by weight in the U.S. West Coast groundfish IFQ fisheries by gear, management area, area north and south of Pt. Chehalis WA, depth (bottom trawl only) and year. The proportion of legal-sized P. halibut in the non-hake IFQ bottom trawl sector north of 40°10′ N. lat. is 67.26%. (‡) combined IFQ and LE CA Halibut, (*) confidential data, (-) no estimate, see text for explanation.

Area / Depth (fm) / Year	Total discard (mt)	Total discard mortality (mt)	Estimated legal-sized mortality (mt)	Estimated % legal-size discarded by weight
Bottom Trawl				
North of Pt. Chehalis				
0-60				
2011	7.98	3.58	1.96	54.66%
2012	4.80	2.44	1.14	46.94%
2013	5.46	3.08	1.23	39.75%
2014	2.07	0.57	0.27	47.56%
2015	3.89	1.37	0.95	68.79%
2016	2.76	1.06	0.64	60.15%
>60				
2011	22.29	11.34	8.00	70.52%
2012	32.67	17.79	12.31	69.19%
2013	29.91	12.42	7.96	64.07%
2014	25.58	12.08	6.46	53.50%
2015	24.86	10.77	6.96	64.63%
2016	14.14	7.16	4.30	60.06%
40°10′ to Pt. Chehalis				
0-60				
2011	11.00	3.35	2.08	62.17%
2012	8.06	3.04	1.61	53.02%
2013	8.55	3.51	2.18	62.10%
2014	10.54	3.91	1.92	49.16%
2015	10.22	4.41	2.54	57.52%
2016	7.32	3.75	2.06	55.01%
>60				
2011	22.51	12.75	8.78	68.87%
2012	20.46	12.08	8.51	70.44%
2013	21.08	12.50	8.81	70.48%
2014	17.14	9.35	6.91	73.89%
2015	29.75	16.38	11.84	72.32%
2016	31.48	18.42	13.43	72.95%
Bottom Trawl				
South of 40°10′ N. lat.				
0-60				
2011	0.17	0.15	0.15	100.00%

Continued on next page

Table 16: (IFQ legal-sized DMR continued)

Area / Depth (fm) / Year	Total discard (mt)	Total discard mortality (mt)	Estimated legal-sized mortality (mt)	Estimated % legal-size discarded by weight
2012	*	*	*	*
2013‡	0.03	0.01	0.01	100.00%
2014‡	0.00	0.00	0.00	0.00%
2015‡	0.00	0.00	0.00	0.00%
2016‡	*	*	*	*
>60				
2011	0.16	0.09	0.09	96.93%
2012	0.84	0.44	0.38	86.31%
2013‡	0.90	0.56	0.45	80.25%
2014‡	0.57	0.23	0.21	90.96%
2015‡	0.33	0.16	0.14	88.19%
2016‡	0.10	0.03	0.03	88.20%
LE CA Halibut S. of 40°10′ N. lat.				
All depths				
2011	0.00	0.00	0.00	0.00%
2012	*	*	*	*
Midwater Trawl				
Non-hake Shoreside				
North of 40°10′ N. lat.				
All depths				
2011	*	*	*	*
2012	0.00	0.00	0.00	0.00%
2013	0.00	0.00	0.00	0.00%
2014	0.00	0.00	0.00	0.00%
Midwater Rockfish				
North of 40°10′ N. lat.				
All depths				
2015	0.00	0.00	0.00	0.00%
2016	0.00	0.00	0.00	0.00%
Shoreside Hake				
North of 40°10′ N. lat.				
All depths				
2011	0.03	0.03	0.02	76.44%
2012	0.00	0.00	0.00	0.00%
2013	0.05	0.05	0.05	91.55%
2014	0.11	0.11	0.10	90.18%
Midwater Trawl				
Midwater Hake				
North of 40°10′ N. lat.				
All depths				
2015	0.00	0.00	0.00	0.00%
2016	0.00	0.00	0.00	0.00%
Hook and Line				
North of 40°10′ N. lat.				

Continued on next page

Table 16: (IFQ legal-sized DMR continued)

Area / Depth (fm) / Year	Total discard (mt)	Total discard mortality (mt)	Estimated legal-sized mortality (mt)	Estimated % legal-size discarded by weight
2011	6.06	0.97	0.43	44.66%
South of 40°10′ N. lat.				
2011	0.00	0.00	0.00	0.00%
Coastwide				
2012	14.66	2.34	1.81	76.99%
2013	3.00	0.48	0.24	49.73%
2014	3.80	0.61	0.30	49.87%
2015	9.49	1.52	0.65	42.61%
2016	6.39	1.02	0.43	42.08%
Pot				
North of Pt. Chehalis				
2011	1.03	0.17	0.13	77.00%
2012	1.27	0.43	0.34	80.73%
2013	0.22	0.09	0.07	77.82%
Pt. Chehalis to 40°10′ N. lat.				
2011	2.33	0.72	0.54	74.48%
2012	0.62	0.08	0.06	73.97%
2013	0.76	0.13	0.09	70.53%
2015	1.31	0.21	0.16	73.94%
South of 40°10′ N. lat.				
2011	0.00	0.00	0.00	0.00%
2012	0.00	0.00	0.00	0.00%
2013	0.00	0.00	0.00	0.00%
2015	0.00	0.00	0.00	0.00%
Coastwide				
2014	0.32	0.08	0.07	84.94%
2016	1.70	0.17	0.12	72.61%

Table 17: Pacific halibut bycatch by month for vessels fishing bottom trawl gear in the 2016 IFQ fishery. We present coastwide estimates across all depths to maintain confidentiality. Note that adding values across columns might give slightly different results because values are rounded to two decimals for reporting.

Month	**Expanded Discard (mt)**	**Sampled Discard (mt)**	**Total Bycatch (mt)**
Jan	0.00	4.29	4.29
Feb	0.00	4.59	4.59
Mar	0.00	4.53	4.53
Apr	0.00	9.42	9.42
May	0.00	5.99	5.99
Jun	0.01	4.26	4.27
Jul	0.15	4.39	4.54
Aug	0.00	4.06	4.06
Sep	0.00	3.44	3.44
Oct	0.00	3.40	3.40
Nov	0.09	3.50	3.58
Dec	0.00	3.69	3.69

Table 18: Physical measurements of P. halibut length (cm) in the U.S. west coast groundfish IFQ fishery (2011-2016) for vessels using bottom trawl gear. Length bins include the lower bound and exclude the upper bound.

IFQ Bottom Trawl physical lengths					
Length bin (cm)	Total No. Individuals	No. Dead Individuals	Length bin (cm)	Total No. Individuals	No. Dead Individuals
14-16	1	1	104-106	590	279
18-20	1	0	106-108	450	201
22-24	1	0	108-110	397	192
30-32	3	1	110-112	350	156
32-34	5	3	112-114	294	142
34-36	4	1	114-116	214	101
36-38	6	1	116-118	164	73
38-40	27	8	118-120	131	60
40-42	27	11	120-122	99	47
42-44	26	9	122-124	103	43
44-46	14	7	124-126	70	31
46-48	26	9	126-128	50	28
48-50	54	17	128-130	46	17
50-52	45	26	130-132	26	9
52-54	59	29	132-134	24	7
54-56	96	46	134-136	20	7
56-58	119	63	136-138	18	6
58-60	307	172	138-140	12	6
60-62	609	332	140-142	10	7
62-64	1070	570	142-144	9	5
64-66	1503	802	144-146	7	3
66-68	1873	982	146-148	9	2
68-70	2383	1225	148-150	9	3
70-72	2808	1441	150-152	3	2
72-74	3080	1618	152-154	2	0
74-76	3048	1586	154-156	2	1
76-78	2949	1567	160-162	1	1
78-80	2871	1514	162-164	2	1
80-82	2760	1400	164-166	2	0
82-84	2629	1384	168-170	3	1
84-86	2356	1209	170-172	3	1
86-88	2016	1054	172-174	6	2
88-90	1823	936	174-176	1	1
90-92	1751	893	176-178	1	0
92-94	1558	782	178-180	3	2
94-96	1212	596	180-182	2	0
96-98	1034	511	182-184	3	2
98-100	901	448	184-186	2	1
100-102	883	406	186-188	2	2
102-104	728	351	188-190	1	0
104-106	590	279	192-194	3	1
106-108	450	201	198-200	1	0
108-110	397	192	212-214	1	1

Table 19: Physical measurements of P. halibut length (cm) in the U.S. west coast groundfish IFQ fishery (2011-2016) for vessels using pot gear. Length bins include the lower bound and exclude the upper bound.

IFQ Pot physical lengths		
Length bin (cm)	Total No. Individuals	No. Dead Individuals
44-46	1	0
46-48	1	0
50-52	3	0
54-56	4	1
56-58	2	0
58-60	4	1
60-62	14	4
62-64	12	5
64-66	12	3
66-68	8	1
68-70	27	4
70-72	44	10
72-74	57	7
74-76	51	8
76-78	37	10
78-80	63	15
80-82	89	18
82-84	103	25
84-86	89	17
86-88	71	15
88-90	59	9
90-92	65	13
92-94	35	9
94-96	36	8
96-98	32	11
98-100	17	5
100-102	25	4
102-104	15	2
104-106	14	4
106-108	12	4
108-110	7	2
110-112	6	1
112-114	4	0
114-116	7	4
116-118	3	1
118-120	3	2
120-122	2	0
122-124	3	0
128-130	1	0
130-132	2	1
134-136	1	0
136-138	1	0
138-140	1	0
166-168	1	0
200-202	1	0

Table 20: Visual estimates of P. halibut lengths (cm) from the U.S. West Coast groundfish IFQ fishery (2011-2016) for vessels using bottom trawl, pot, and hook and line gear. Length bins include the lower bound and exclude the upper bound. On IFQ hook & line vessels, only visual estimates are taken on P. halibut.

IFQ visual lengths, no. of individuals			
Length bin (cm)	Bottom Trawl (no.)	Pot (no.)	Hook and Line (no.)
25-34	0	1	25
35-44	2	2	175
45-54	3	1	318
55-64	10	2	848
65-74	32	4	1275
75-84	33	13	939
85-94	39	8	578
95-104	26	7	345
105-114	7	1	198
115-124	8	2	115
125-134	6	1	29
135-144	4	0	13
145-154	4	0	2
155-164	1	0	1
165-174	0	0	2
175-184	2	0	1

Table 21: Number of observed vessels, trips, and sets by year and gear type in the LE Sablefish Endorsed fishery.

LE Sablefish Endorsed									
	Longline						Pot		
	North			South					
Year	vessels	trips	sets	vessels	trips	sets	vessels	trips	sets
2002	9	23	207	18	47	181	6	23	247
2003	8	25	191	9	26	160	6	35	362
2004	6	13	121	13	35	205	3	13	139
2005	10	31	402	18	73	276	7	39	492
2006	9	31	291	10	34	160	7	39	289
2007	9	36	381	14	40	136	4	30	154
2008	6	17	195	13	60	345	6	24	329
2009	3	12	177	6	34	110	3	27	67
2010	5	18	251	20	127	511	7	43	314
2011	7	18	284	20	84	389	3	22	227
2012	5	7	47	16	86	485	5	19	351
2013	6	12	135	14	49	218	3	14	47
2014	5	12	246	13	74	249	4	16	195
2015	6	15	174	24	87	458	9	35	299
2016	4	10	212	20	87	459	7	55	596

Table 22: Number of observed vessels, trips, and sets by year and gear type in the LE Sablefish NonEndorsed fishery. The number of observed pot vessels in this fishery is too small to meet confidentiality and thus not reported.

LE Sablefish Non-Endorsed			
	Longline		
Year	vessels	trips	sets
2002	4	11	22
2003	17	130	219
2004	14	62	130
2005	11	35	60
2006	21	121	201
2007	36	158	304
2008	32	122	221
2009	34	138	273
2010	38	226	472
2011	38	201	426
2012	26	128	252
2013	22	124	248
2014	18	77	154
2015	21	65	144
2016	16	41	70

Table 23: Number of observed vessels, trips, and sets by year and gear type in the OA Fixed Gear fishery. OA Fixed Gear fishery was not observed until 2003.

OA Fixed Gear						
	Longline			Pot		
Year	vessels	trips	sets	vessels	trips	sets
2002	–	–	–	–	–	–
2003	13	41	49	7	16	50
2004	14	42	52	17	96	185
2005	10	34	37	14	43	50
2006	7	10	11	15	38	39
2007	25	51	67	21	46	75
2008	33	58	68	20	55	75
2009	34	69	104	18	30	45
2010	37	70	105	26	40	71
2011	40	69	101	29	61	85
2012	24	34	53	19	35	70
2013	14	23	30	17	25	48
2014	21	28	39	21	41	63
2015	20	38	54	17	49	64
2016	30	55	78	28	56	74

Table 24: Expansion factors and WCGOP observed discard rate by gear type for limited entry (LE) and open access (OA) non-nearshore fixed gear sectors used to expand discard estimates of *Pacific halibut* to the entire fleet.

Sector	**Gear**	**Expansion Factor**	**Sector and Gear Type Rate Applied**
LE Sablefish Endorsed	Longline	Sablefish	LE Sablefish Endorsed Longline
LE Sablefish Endorsed	Longline	Sablefish	LE Sablefish Endorsed Pot
LE Sablefish Non-Endorsed	Longline	Groundfish	LE Sablefish Non-Endorsed Longline
LE Sablefish Non-Endorsed	Pot	Sablefish	OA Fixed Gear[1] Pot
OA Fixed Gear	Hook and Line	Groundfish	OA Fixed Gear[1] Hook and Line
OA Fixed Gear	Pot	Groundfish	OA Fixed Gear[1] Pot

[1] A coast-wide discard ratio and coast-wide discard estimate could not be computed in the OA fixed gear sector for 2002-06 because the WCGOP only covered OA vessels in California during this time

Table 25: Total sablefish or groundfish landings (mt) and observed discard ratios (1SE) for each sector and gear type in the non-nearshore fixed gear fishery. Sablefish landings were used as the expansion factor in all cases except for the LE Sablefish Non-Endorsed and the OA Fixed Gear sectors, where target species include a variety of groundfish species.

Year	LE Sablefish Endorsed			LE Sablefish Non-Endorsed		OA Fixed Gear	
	Longline		Pot	Longline	Pot	Hook-and-Line	Pot
	North of Pt. Chehalis	South of Pt. Chehalis					
Expansion Factors							
2002	382	407	352	622	7	387	109
2003	464	571	604	542	7	545	187
2004	657	653	620	399	11	475	186
2005	619	674	615	548	3	626	379
2006	660	717	582	467	30	487	443
2007	472	609	428	515	2	264	258
2008	394	701	433	651	3	402	241
2009	435	1012	489	759	7	647	373
2010	266	1039	504	1006	17	757	318
2011	223	930	372	1245	24	435	256
2012	202	873	286	810	9	323	126
2013	217	535	283	813	15	193	72
2014	181	564	338	724	4	219	148
2015	232	707	358	729	4	364	234
2016	290	735	359	726	12	309	206
Discard Ratios							
2002	0.3297 (0.05)	0.0283 (0.01)	0.0114 (0.00)	- -	- -	- -	- -
2003	0.3532 (0.05)	0.0467 (0.01)	0.0005 (0.00)	0.0003 (0.00)	- -	- -	- -
2004	0.2369 (0.07)	0.0741 (0.01)	0.0526 (0.01)	- -	- -	- -	- -
2005	0.3318 (0.07)	0.0203 (0.00)	0.0043 (0.00)	- -	- -	- -	- -
2006	0.7827 (0.11)	0.1636 (0.05)	0.0271 (0.00)	- -	- -	- -	- -
2007	0.2184 (0.03)	0.0333 (0.01)	0.0092 (0.00)	0.0033 (0.00)	- -	0.0789 (0.02)	0.0034 (0.00)
2008	0.3715 (0.07)	0.1473 (0.03)	0.0153 (0.00)	0.0046 (0.00)	- -	0.0994 (0.04)	0.0010 (0.00)
2009	0.6497 (0.10)	0.0413 (0.01)	0.0017 (0.00)	0.0003 (0.00)	- -	0.0534 (0.02)	0.0007 (0.00)
2010	0.2522 (0.06)	0.0631 (0.01)	0.0100 (0.00)	0.0004 (0.00)	- -	0.0424 (0.03)	0.0016 (0.00)
2011	0.4780 (0.06)	0.0281 (0.00)	0.0110 (0.00)	0.0171 (0.01)	- -	0.0299 (0.01)	0.0003 (0.00)
2012	0.4534 (0.16)	0.0594 (0.01)	0.0209 (0.00)	0.0204 (0.01)	- -	0.0719 (0.03)	0.0032 (0.00)
2013	0.0871 (0.02)	0.0063 (0.00)	0.0000 (0.00)	- -	- -	0.0089 (0.00)	0.0008 (0.00)
2014	0.8892 (0.13)	0.0177 (0.00)	0.0060 (0.00)	- -	- -	0.0152 (0.00)	0.0011 (0.00)
2015	0.3685 (0.07)	0.0562 (0.01)	0.0045 (0.00)	0.0006 (0.00)	- -	0.0279 (0.01)	0.0000 (0.00)
2016	0.4211 (0.06)	0.0597 (0.01)	0.0159 (0.00)	0.0069 (0.00)	- -	0.1466 (0.03)	0.0003 (0.00)

Table 26: Percent of observed trips that caught Pacific halibut by sector, gear, and area (where applicable). Observed average, minimum and maximum annual catch and discard weights and the percent of P. halibut catch weight discarded by year. n.o.c. No observed catch of P. halibut and thus a % discard calculation is not possible. – No WCGOP observers were deployed for the sector-year-gear type combination.

Year	LE Sablefish Endorsed			LE Sablefish Non-Endorsed		OA Fixed Gear	
	Longline		Pot	Longline	Pot	Hook-and-Line	Pot
	North of Pt. Chehalis	South of Pt. Chehalis					
% of observed trips that caught P. halibut							
2002	95.7%	46.8%	17.4%	0.0%	–	0.0%	0.0%
2003	100.0%	50.0%	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%	–	10.0%	0.0%
2007	94.4%	47.5%	33.3%	1.9%	–	25.5%	6.5%
2008	100.0%	78.3%	83.3%	3.3%	–	34.5%	5.5%
2009	91.7%	35.3%	33.3%	0.7%	–	37.7%	10.0%
2010	83.3%	47.2%	51.2%	1.3%	–	21.4%	2.5%
2011	88.9%	42.9%	45.5%	6.0%	–	30.4%	6.6%
2012	71.4%	58.1%	31.6%	7.0%	–	32.4%	8.6%
2013	83.3%	26.5%	21.4%	0.0%	–	13.0%	4.0%
2014	100.0%	24.3%	56.2%	0.0%	–	25.0%	9.8%
2015	100.0%	49.4%	60.0%	1.5%	–	34.2%	4.1%
2016	100.0%	60.9%	61.8%	7.3%	–	58.2%	7.1%
Observed annaul catch (mt) of Pacific haibut							
Mean	40.1	11.1	2.0	0.3	–	0.8	0.0
Min	8.0	0.7	0.1	0.0	–	0.0	0.0
Max	118.4	36.6	5.4	1.4	–	2.3	0.0
Observed annaul discard (mt) of Pacific haibut							
Mean	35.3	11.0	2.0	0.3	–	0.8	0.0
Min	5.5	0.7	0.1	0.0	–	0.0	0.0
Max	109.6	36.6	5.4	1.4	–	2.3	0.0
% of Pacific haibut catch that was discarded							
2002	77.7%	95.5%	100.0%	n.o.c.	–	n.o.c.	n.o.c.
2003	80.1%	99.4%	100.0%	0.0%	–	n.o.c.	n.o.c.
2004	76.3%	97.3%	100.0%	n.o.c.	–	n.o.c.	n.o.c.
2005	82.7%	100.0%	100.0%	n.o.c.	–	n.o.c.	n.o.c.
2006	92.6%	97.5%	100.0%	n.o.c.	–	100.0%	n.o.c.
2007	78.0%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2008	87.4%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2009	100.0%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2010	100.0%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2011	100.0%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2012	96.6%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2013	69.0%	100.0%	0.0%	0.0%	–	100.0%	100.0%
2014	95.7%	100.0%	100.0%	0.0%	–	100.0%	100.0%
2015	95.5%	100.0%	100.0%	0.0%	–	100.0%	0.0%
2016	84.5%	100.0%	100.0%	0.0%	–	100.0%	100.0%

Table 27: Pacific halibut viabilities caught by longline vessels in the U.S. west coast Limited Entry Sablefish Endorsed fishery by year and area north and south of Point Chehalis, WA. The condition of sampled P. halibut was identified as Minor (Mi), Moderate (Mo), Serious (Ser) or Dead (see Appendix in WCGOP manual), consistent with IPHC protocol. Sample sizes allowed for annual weighted percentages as described in the Methods.

	Limited Entry Sablefish																							
	no. of fish												weighted %											
Year	North of Pt. Chehalis				South of Pt. Chehalis				Coastwide				North of Pt. Chehalis				South of Pt. Chehalis				Coastwide			
	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead
2011	4839	103	62	92	1869	197	36	255	6708	300	98	347	96.3%	1.4%	1.0%	1.2%	78.8%	7.7%	1.1%	12.4%	91.4%	3.2%	1.1%	4.3%
2012	810	37	0	124	5982	764	166	417	6792	801	166	541	83.3%	3.7%	0.0%	13.0%	79.1%	11.1%	2.8%	7.0%	79.6%	10.2%	2.4%	7.8%
2013	2774	314	0	209	518	9	16	49	3292	323	16	258	83.4%	9.5%	0.0%	7.1%	89.8%	0.4%	4.2%	5.6%	84.6%	7.7%	0.8%	6.8%
2014	7453	301	153	953	1569	258	60	238	9022	559	213	1191	83.2%	3.3%	1.9%	11.6%	71.1%	12.2%	3.3%	13.4%	80.5%	5.3%	2.2%	12.0%
2015	7180	169	121	141	9381	653	286	239	16561	822	407	380	94.3%	2.1%	1.7%	1.9%	88.5%	6.2%	2.8%	2.5%	91.0%	4.4%	2.3%	2.2%
2016	7385	460	28	112	8720	1718	103	654	16105	2178	131	766	92.9%	5.5%	0.4%	1.2%	74.4%	17.0%	1.6%	7.0%	80.9%	12.9%	1.2%	4.9%

Table 28: Pacific halibut viabilities caught by longline vessels in the U.S. west coast Limited Entry Sablefish Non-Endorsed fishery, coastwide by year. The condition of sampled P. halibut was identified as Minor (Mi), Moderate (Mo), Serious (Ser) or Dead (see Appendix in WCGOP manual), consistent with IPHC protocol. Sample sizes necessitated the use of a five year rolling avearge to calculate weighted percentages, as described in the Methods.

	Limited Entry Sablefish Non-Endorsed							
Year	no. of fish				weighted %			
	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead
2011	407	186	0	0	63.6%	36.4%	0.0%	0.0%
2012	368	14	0	0	97.6%	2.4%	0.0%	0.0%
2013	0	0	0	0	0.0%	0.0%	0.0%	0.0%
2014	0	0	0	0	0.0%	0.0%	0.0%	0.0%
2015	24	0	0	0	100.0%	0.0%	0.0%	0.0%
2016	58	36	0	0	56.1%	43.9%	0.0%	0.0%

Table 29: Pacific halibut viabilities caught by hook-&-line vessels in the U.S. west coast Open Access fixed gear fishery, coastwide by year. The condition of sampled P. halibut was identified as Minor (Mi), Moderate (Mo), Serious (Ser) or Dead (see Appendix in WCGOP manual), consistent with IPHC protocol. Sample sizes necessitated the use of a five year rolling avearge to calculate weighted percentages, as described in the Methods.

Year	Open Access Fixed Gear							
	no. of fish				weighted %			
	Mi	Mo	Ser	Dead	Mi	Mo	Ser	Dead
2011	284	74	30	6	72.4%	17.3%	9.8%	0.5%
2012	466	36	0	17	91.3%	8.4%	0.0%	0.3%
2013	53	0	0	0	100.0%	0.0%	0.0%	0.0%
2014	104	15	0	0	80.7%	19.3%	0.0%	0.0%
2015	472	23	0	0	97.2%	2.8%	0.0%	0.0%
2016	1793	87	0	0	92.4%	7.6%	0.0%	0.0%

Table 30: Estimated gross discard (mt) and discard mortality (mt) in the limited entry (LE) sablefish endorsed, LE sablefish non-endorsed, and open access (OA) fixed gear sectors. Estimated discard mortality (mt) on longline and hook-&-line vessels was computed by two methods. For the 2002-2010 period, a 16 % discard mortality rate was applied to gross discard estimates because viability data was not available. Since 2011, mortality rates on longline vessels are based on the viability categories assigned to individuals. For all years, an 18% discard mortality rate was applied to gross discard estimates from pot vessels.

Year	LE Sablefish Endorsed				LE Sablefish Non-Endorsed		OA Fixed Gear	
	Longline			Pot	Longline	Pot	Hook-and-Line	Pot
	North of Pt. Chehalis	South of Pt. Chehalis	Coastwide					
Gross Discard Estimates								
2002	125.90	11.50	137.40	4.03	0.00	[0.02] *	[35.40] *	[0.23] *
2003	163.92	26.66	190.58	0.30	0.17	[0.01] *	[49.79] *	[0.39] *
2004	155.55	48.35	203.90	32.60	0.00	[0.02] *	[43.44] *	[0.39] *
2005	205.46	13.68	219.13	2.62	0.00	[0.01] *	[57.23] *	[0.79] *
2006	516.79	117.32	634.10	15.79	0.00	[0.06] *	[44.47] *	[0.92] *
2007	102.98	20.27	123.25	3.94	1.72	0.01	20.79	0.89
2008	146.34	103.24	249.58	6.62	2.99	0.00	39.94	0.23
2009	282.86	41.84	324.70	0.85	0.24	0.01	34.58	0.27
2010	66.99	65.58	132.56	5.04	0.37	0.03	32.06	0.50
2011	106.73	26.12	132.85	4.08	21.29	0.01	12.99	0.06
2012	91.52	51.87	143.39	5.99	16.54	0.03	23.24	0.41
2013	18.86	3.39	22.25	0.00	0.00	0.01	1.72	0.06
2014	161.09	9.98	171.07	2.03	0.00	0.00	3.33	0.16
2015	85.43	39.70	125.13	1.61	0.46	0.00	10.14	0.00
2016	122.01	43.87	165.89	5.72	4.98	0.00	45.34	0.05
Estimated Discard Mortality								
2002	20.14	1.84	21.98	0.73	0.00	– *	– *	– *
2003	26.23	4.27	30.49	0.05	0.03	– *	– *	– *
2004	24.89	7.74	32.62	5.87	0.00	– *	– *	– *
2005	32.87	2.19	35.06	0.47	0.00	– *	– *	– *
2006	82.69	18.77	101.46	2.84	0.00	– *	– *	– *
2007	16.48	3.24	19.72	0.71	0.28	0.00	3.33	0.16
2008	23.41	16.52	39.93	1.19	0.48	0.00	6.39	0.04
2009	45.26	6.69	51.95	0.15	0.04	0.00	5.53	0.05
2010	10.72	10.49	21.21	0.91	0.06	0.00	5.13	0.09
2011	6.20	4.87	11.07	0.73	3.29	0.00	2.05	0.01
2012	15.77	8.12	23.89	1.08	0.71	0.00	1.52	0.07
2013	2.54	0.40	2.94	0.00	0.00	0.00	0.06	0.01
2014	27.33	2.25	29.58	0.37	0.00	0.00	0.33	0.03
2015	6.07	3.84	9.91	0.29	0.02	0.00	0.45	0.00
2016	8.17	7.38	15.56	1.03	0.89	0.00	2.72	0.01

*The LE sablefish non-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. OA fixed gear vessels were not observed coastwide until 2007 and thus 2002-06 estimates are based on the 2007-08 coastwide discard rate, shown in brackets.

Table 31: Estimated P. halibut discard mortality (mt, mortality rate applied, see text for description) from each sector of the non-nearshore fixed gear fishery by year.

	Estimated discard mortality (mt)			
	LE Sablefish Endorsed	**LE Sablefish Non-Endorsed**	**OA Fixed Gear**	**All Sectors**
2002	22.71	0.00	0.00	22.71
2003	30.55	0.03	0.00	30.57
2004	38.49	0.00	0.00	38.49
2005	35.53	0.00	0.00	35.53
2006	104.30	0.00	0.00	104.30
2007	20.43	0.28	3.49	24.19
2008	41.12	0.48	6.43	48.04
2009	52.10	0.04	5.58	57.72
2010	22.12	0.06	5.22	27.40
2011	11.80	3.29	2.07	17.15
2012	24.97	0.71	1.59	27.27
2013	2.94	0.00	0.07	3.01
2014	29.95	0.00	0.36	30.30
2015	10.20	0.02	0.45	10.66
2016	16.59	0.89	2.73	20.21

Table 32: Physical measurements of P. halibut length (cm) from the U.S. west coast LE Sablefish Endorsed fishery (2002-2016) for vessels using hook & line gear. Length bins include the lower bound and exclude the upper bound.

LE Sablefish Endorsed Hook & Line, physical lengths						
Length bin (cm)	Total No.	Dead No.		Length bin (cm)	Total No.	Dead No.
38-40	1	0		88-90	234	32
40-42	1	0		90-92	232	26
42-44	2	0		92-94	233	25
44-46	3	0		94-96	188	26
46-48	1	0		96-98	168	16
48-50	4	0		98-100	127	16
50-52	8	0		100-102	106	15
52-54	8	0		102-104	100	18
54-56	7	0		104-106	84	16
56-58	21	2		106-108	67	10
58-60	20	2		108-110	64	14
60-62	28	2		110-112	42	5
62-64	48	4		112-114	40	9
64-66	75	7		114-116	34	3
66-68	82	11		116-118	29	6
68-70	151	19		118-120	16	2
70-72	206	23		120-122	16	2
72-74	256	27		122-124	8	1
74-76	294	34		124-126	12	1
76-78	345	37		126-128	9	2
78-80	353	41		128-130	6	1
80-82	312	41		130-132	2	1
82-84	318	39		132-134	4	0
84-86	312	38		134-136	2	1
86-88	292	42		136-138	2	0
88-90	234	32		140-142	3	0
90-92	232	26		146-148	0	0
92-94	233	25		158-160	1	0

Table 33: Physical measurements of P. halibut length (cm) from the U.S. west coast LE Sablefish Endorsed fishery (2002-2016) for vessels using pot gear. Length bins include the lower bound and exclude the upper bound.

LE Sablefish Endorsed Pot, physical lengths						
Length bin (cm)	Total No.	Dead No.		Length bin (cm)	Total No.	Dead No.
38-40	0	0		88-90	63	10
40-42	0	0		90-92	50	9
42-44	0	0		92-94	34	6
44-46	0	0		94-96	38	6
46-48	0	0		96-98	30	4
48-50	0	0		98-100	23	8
50-52	0	0		100-102	14	3
52-54	0	0		102-104	12	2
54-56	0	0		104-106	7	2
56-58	0	0		106-108	6	0
58-60	1	0		108-110	9	1
60-62	5	1		110-112	7	2
62-64	3	1		112-114	0	0
64-66	10	1		114-116	1	0
66-68	8	1		116-118	3	1
68-70	16	2		118-120	2	0
70-72	36	6		120-122	0	0
72-74	41	8		122-124	6	2
74-76	67	8		124-126	0	0
76-78	67	12		126-128	0	0
78-80	72	13		128-130	0	0
80-82	76	16		130-132	1	0
82-84	77	18		132-134	0	0
84-86	81	12		134-136	0	0
86-88	76	17		136-138	0	0
88-90	63	10		140-142	0	0
90-92	50	9		146-148	1	0
92-94	34	6				

Table 34: Physical measurements of P. halibut length (cm) from the U.S. west coast LE Sablefish Non-Endorsed fishery (2002-2016) for vessels using hook and line gear. The WCGOP does not cover vessels fishing pot gear in this fishery. Length bins include the lower bound and exclude the upper bound.

LE Sablefish Non-Endorsed Hook & Line, physical lengths		
Length bin (cm)	Total No.	Dead No.
66-68	1	0
68-70	3	0
72-74	5	1
74-76	4	0
76-78	6	0
78-80	4	0
80-82	3	0
82-84	3	0
84-86	3	0
86-88	5	1
88-90	6	0
90-92	5	1
92-94	4	0
94-96	2	0
96-98	3	0
98-100	6	1
100-102	1	0
102-104	2	0
104-106	3	0
106-108	2	0
110-112	1	0
112-114	4	1
118-120	2	0
122-124	1	0
134-136	1	0

Table 35: Physical measurements of P. halibut length (cm) from the U.S. west coast OA Fixed Gear fishery (2002-2016) for vessels using hook and line or pot gear.

OA Fixed Gear physical lengths				
	Hook & Line		Pot	
Length bin (cm)	Total (no.)	Dead (no.)	Total (no.)	Dead (no.)
34-36	1	0	0	0
44-46	3	1	0	0
48-50	1	0	0	0
50-52	2	0	0	0
52-54	1	0	0	0
54-56	1	0	0	0
56-58	1	0	0	0
58-60	4	0	0	0
60-62	3	0	0	0
62-64	6	0	0	0
64-66	9	2	0	0
66-68	8	0	1	1
68-70	14	1	0	0
70-72	13	0	3	0
72-74	23	2	0	0
74-76	23	1	1	0
76-78	21	1	1	0
78-80	21	1	1	0
80-82	21	1	1	1
82-84	23	2	0	0
84-86	30	1	1	0
86-88	21	2	2	0
88-90	7	0	0	0
90-92	15	1	0	0
92-94	15	2	0	0
94-96	9	0	0	0
96-98	10	0	0	0
98-100	4	0	0	0
100-102	5	0	0	0
102-104	2	0	0	0
104-106	5	1	0	0
106-108	4	0	0	0
108-110	5	1	1	0
110-112	3	0	0	0
112-114	2	0	0	0
114-116	5	1	0	0
116-118	1	0	0	0
118-120	2	0	0	0
120-122	1	0	0	0
122-124	2	0	0	0

Table 36: Visual estimates of P. halibut lengths (cm) from the U.S. West Coast groundfish Non-Nearshore fixed gear fisheries (2002-2016) for vessels using hook and line gear and pot gear. Numbers are the numbers of individuals caught with each gear type. The WCGOP does not observe LE Non-Endorsed Sablefish vessels fishing with pot gear. Length bins include the lower bound and exclude the upper bound.

	LE Sablefish Endorsed		**LE Sablefish Non-Endorsed**	**OA Fixed Gear**	
Length bin (cm)	No. Hook and Line	No. Pot	No. Hook and Line	No. Hook and Line	No. Pot
15-24	0	0	0	0	0
25-34	33	0	0	0	0
35-44	109	1	0	4	0
45-54	537	5	2	15	0
55-64	4043	47	11	36	0
65-74	8296	107	28	75	0
75-84	9319	88	37	103	2
85-94	6994	75	26	49	0
95-104	4025	38	15	27	0
105-114	1377	16	8	11	0
115-124	477	9	9	6	0
125-134	127	2	4	1	0
135-144	28	2	0	0	0
145-154	6	0	0	0	0
155-164	2	0	0	1	0
165-174	0	0	0	0	0

Table 37: Pacific halibut physically measured lengths and visual estimates of lengths approximating legal (82 cm>) versus sublegal defintions (IPHC), collected by the WCGOP in the IFQ fishery (2011-2016), Non-Nearshore fixed gear fisheries (LE sablefish endorsed, LE non-endorsed, OA fixed gear; 2002-2016), and the At-sea Hake sectors (2002-2016). Note that visual length estimates are not taken in the At-sea Hake sectors.

Fishery	Type of Measurement	Length bin (cm)	No. of individuals	Percentage of Total
Non-Nearshore Fixed Gear	actual	0-82.0	2838	44.6%
Non-Nearshore Fixed Gear	actual	82.0>	3521	55.4%
Non-Nearshore Fixed Gear	visual	0-74.0	14970	37.8%
Non-Nearshore Fixed Gear	visual	75.0-84.0	10243	25.8%
Non-Nearshore Fixed Gear	visual	84.0>	14434	36.4%
Catch Shares	actual	0-82.0	26204	55.9%
Catch Shares	actual	82.0>	20653	44.1%
Catch Shares	visual	0-74.0	2698	53.1%
Catch Shares	visual	75.0-84.0	985	19.4%
Catch Shares	visual	84.0>	1400	27.5%
At-sea Hake	actual	0-82.0	195	27.9%
At-sea Hake	actual	82.0>	503	72.1%

Table 38: Coverage information, bycatch rates, and bycatch estimates for Pacific halibut in the Oregon and California nearshore fixed gear groundfish fisheries by state and year. The WCGOP began observing the California nearshore fishery in 2003 and the Oregon nearshore fishery in 2004. Gear specific mortality rates cannot be applied to P. halibut bycatch in this fishery because of confidentiality issues. Coverage rate in the state nearshore fisheries is defined as the proportion of nearshore target species landings that were observed. Nearshore target species are listed in the WCGOP Data Processing Appendix. Washington does not allow a state nearshore fishery.

Nearshore fixed gear groundfish fishery

State	**Observed**								**Estimated**		
Year	Fleet observer coverage rate	Number of observed sets	% of sets with P. halibut	P. halibut bycatch (mt)	Nearshore species retained (mt)	P. halibut bycatch rate	SE bycatch rate	Total fleet catch of nearshore species (mt)	P. halibut bycatch (mt)	Bycatch lower 95% CI (mt)	Bycatch upper 95% CI (mt)
Oregon											
2002	*not observed*	–	–	–	–	–	–	278.68	–	–	–
2003	*not observed*	–	–	–	–	–	–	207.78	–	–	–
2004	4.94%	210	1.90%	0.05	10.28	0.00	0.00	207.84	0.989	0.434	1.544
2005	6.70%	170	0.59%	0.03	11.85	0.00	0.00	176.82	0.485	0.390	0.581
2006	12.02%	385	1.30%	0.06	19.63	0.00	0.00	163.37	0.523	0.271	0.775
2007	9.01%	248	0.40%	0.01	16.23	0.00	0.00	180.13	0.086	0.072	0.100
2008	7.78%	185	0.54%	0.03	14.64	0.00	0.00	188.07	0.350	0.287	0.412
2009	6.26%	225	2.22%	0.08	13.95	0.01	0.00	222.82	1.280	0.745	1.815
2010	7.88%	213	0.47%	0.01	13.46	0.00	0.00	170.91	0.078	0.064	0.091
2011	8.19%	244	2.05%	0.09	15.88	0.01	0.00	193.93	1.094	0.400	1.788
2012	10.58%	290	1.38%	0.11	20.70	0.01	0.00	195.60	1.062	0.322	1.803
2013	7.80%	264	0.76%	0.02	16.08	0.00	0.00	206.05	0.289	0.196	0.383
2014	8.26%	197	2.03%	0.08	16.64	0.00	0.00	201.39	0.954	0.547	1.360
2015	8.63%	237	1.69%	0.12	18.43	0.01	0.00	213.46	1.419	0.097	2.740
2016	12.36%	268	4.48%	0.37	22.13	0.02	0.00	179.00	2.986	1.324	4.648
California											
2002	*not observed*	–	–	–	–	–	–	381.40	–	–	–
2003	3.17%	208	0.00%	0.00	8.11	0.00	0.00	256.15	0.000	0.000	0.000
2004	8.01%	434	0.00%	0.00	23.27	0.00	0.00	290.62	0.000	0.000	0.000
2005	4.66%	219	0.91%	0.08	13.02	0.01	0.00	279.51	1.706	0.003	3.564
2006	3.25%	161	0.00%	0.00	8.36	0.00	0.00	257.52	0.000	0.000	0.000
2007	4.33%	227	0.00%	0.00	11.84	0.00	0.00	273.58	0.000	0.000	0.000
2008	2.28%	89	0.00%	0.00	6.69	0.00	0.00	293.75	0.000	0.000	0.000
2009	2.59%	123	0.00%	0.00	6.72	0.00	0.00	259.67	0.000	0.000	0.000
2010	3.23%	117	0.00%	0.00	7.07	0.00	0.00	218.85	0.000	0.000	0.000
2011	3.92%	214	0.47%	0.08	8.47	0.01	0.00	215.99	1.970	1.535	2.405
2012	5.95%	239	1.26%	0.07	11.92	0.01	0.00	200.19	1.186	0.174	2.199
2013	5.32%	194	1.55%	0.06	11.67	0.00	0.00	219.23	1.070	0.560	1.579
2014	4.69%	183	0.00%	0.00	11.46	0.00	0.00	244.51	0.000	0.000	0.000
2015	6.90%	277	0.00%	0.00	22.86	0.00	0.00	331.03	0.000	0.000	0.000
2016	5.39%	156	0.00%	0.00	13.33	0.00	0.00	247.13	0.000	0.000	0.000

Table 39: Coverage information, bycatch rates, and bycatch estimates for Pacific halibut in the state pink shrimp fisheries by state and year. The WCGOP began observing the OR and CA state pink shrimp fisheries in 2004, but was unable to observe these fisheries in 2006. The WA state pink shrimp fishery was added for observation in 2010. Mortality rates are not applied to P. halibut bycatch in these fisheries because mortality rates for pink shrimp trawl gear have not been estimated. Coverage rate in the pink shrimp fisheries is defined as the proportion of pink shrimp landings that were observed. (*) = Confidential data; (–) = not observed.

Pink shrimp trawl fishery

State	Observed								Estimated		
Year	Fleet observer coverage rate	Number of observed sets	% of sets with P. halibut	P. halibut bycatch (kg)	Pink shrimp retained (kg)	P. halibut bycatch rate	SE bycatch rate	Total fleet catch of pink shrimp (mt)	P. halibut bycatch (mt)	Bycatch lower 95% CI (mt)	Bycatch upper 95% CI (mt)
Washington											
2010	9.30%	341	0.00%	0.00	399484	0.00000	0.00000	4296	0.00	0.00	0.00
2011	16.17%	578	0.17%	7.66	697238	0.00001	0.00000	4312	0.05	0.04	0.05
2012	14.77%	522	0.00%	0.00	625952	0.00000	0.00000	4239	0.00	0.00	0.00
2013	10.18%	386	0.00%	0.00	626823	0.00000	0.00000	6158	0.00	0.00	0.00
2014	7.07%	402	0.00%	0.00	980854	0.00000	0.00000	13876	0.00	0.00	0.00
2015	11.43%	1458	0.00%	0.00	2151088	0.00000	0.00000	18814	0.00	0.00	0.00
2016	17.32%	974	0.00%	0.00	1107926	0.00000	0.00000	6396	0.00	0.00	0.00
Oregon											
2002	*not observed*	–	–	–	–	–	–	18896	–	–	–
2003	*not observed*	–	–	–	–	–	–	9322	–	–	–
2004	7.72%	765	0.00%	0.00	427212	0.00000	0.00000	5537	0.00	0.00	0.00
2005	5.63%	533	0.19%	2.27	402886	0.00001	0.00000	7159	0.04	0.04	0.05
2006	*not observed*	–	–	–	–	–	–	5532	–	–	–
2007	7.12%	929	0.22%	15.26	649983	0.00002	0.00001	9129	0.21	0.03	0.39
2008	5.81%	785	0.00%	0.00	672491	0.00000	0.00000	11576	0.00	0.00	0.00
2009	7.48%	672	0.00%	0.00	751198	0.00000	0.00000	10049	0.00	0.00	0.00
2010	11.94%	1233	0.00%	0.00	1706840	0.00000	0.00000	14290	0.00	0.00	0.00
2011	13.63%	1892	0.11%	19.33	2985964	0.00001	0.00000	21915	0.14	0.05	0.24
2012	13.52%	2122	0.00%	0.00	3014219	0.00000	0.00000	22292	0.00	0.00	0.00
2013	10.71%	1403	0.00%	0.00	2313243	0.00000	0.00000	21604	0.00	0.00	0.00
2014	9.72%	1463	0.00%	0.00	2291345	0.00000	0.00000	23573	0.00	0.00	0.00
2015	9.40%	1991	0.00%	0.00	2282089	0.00000	0.00000	24274	0.00	0.00	0.00
2016	14.33%	2468	0.00%	0.00	2309357	0.00000	0.00000	16116	0.00	0.00	0.00
California											
2002	*not observed*	–	–	–	–	–	–	1849	–	–	–
2003	*not observed*	–	–	–	–	–	–	974	–	–	–
2004	*	*	*	*	*	*	*	992	*	*	*
2005	*	*	*	*	*	*	*	859	*	*	*
2006	*not observed*	–	–	–	–	–	–	63	–	–	–
2007	*	*	*	*	*	*	*	289	*	*	*
2008	*	*	*	*	*	*	*	945	*	*	*
2009	*	*	*	*	*	*	*	1183	*	*	*
2010	14.99%	134	0.00%	0.00	265531	0.00000	0.00000	1771	0.00	0.00	0.00
2011	12.62%	203	0.00%	0.00	420595	0.00000	0.00000	3333	0.00	0.00	0.00
2012	12.46%	175	0.00%	0.00	347598	0.00000	0.00000	2791	0.00	0.00	0.00
2013	9.19%	188	0.00%	0.00	359770	0.00000	0.00000	3915	0.00	0.00	0.00
2014	15.54%	337	0.00%	0.00	597530	0.00000	0.00000	3845	0.00	0.00	0.00
2015	9.69%	335	0.30%	0.91	334660	0.00000	0.00000	3453	0.01	0.01	0.01
2016	23.44%	406	0.00%	0.00	313379	0.00000	0.00000	1337	0.00	0.00	0.00

Table 40: Coverage information, bycatch rates, and bycatch estimates for Pacific halibut in the state California halibut trawl fishery by sector and year. The WCGOP recognizes two sectors; a limited entry sector and an open access sector. In 2010, the LE and OA sectors are combined to maintain confidentiality. Beginning in 2011, the limited entry sector is observed under the IFQ groundfish fishery and estimates for this sector are included in the IFQ tables (above). Mortality rates are not applied to P. halibut bycatch in these fisheries because mortality rates for CA halibut trawl gear have not been estimated. Coverage rate in the CA halibut fishery is defined as the proportion of CA halibut landings that were observed.

California halibut trawl fishery

Sector	**Observed**								**Estimated**		
Year	Fleet observer coverage rate	Number of observed tows	% of tows with P. halibut	P. halibut bycatch (kg)	CA halibut retained (kg)	P. halibut bycatch rate	SE bycatch rate	Total fleet catch of CA halibut (mt)	P. halibut bycatch (mt)	Bycatch lower 95% CI (mt)	Bycatch upper 95% CI (mt)
Limited Entry Sector											
2002	3.32%	52	0.00%	0.000	3590	0.00000	0.00000	108	0.000	0.000	0.000
2003	18.09%	207	0.00%	0.000	19093	0.00000	0.00000	106	0.000	0.000	0.000
2004	23.08%	171	0.58%	3.493	31488	0.00011	0.00001	136	0.015	0.012	0.018
2005	16.16%	235	0.43%	4.717	30514	0.00015	0.00001	189	0.029	0.024	0.034
2006	11.95%	224	0.89%	2.903	14286	0.00020	0.00007	120	0.024	0.007	0.042
2007	29.29%	81	1.23%	8.119	5447	0.00149	0.00023	19	0.028	0.019	0.036
2008	26.48%	118	8.47%	82.605	9637	0.00857	0.00162	36	0.312	0.196	0.428
2009	6.14%	29	0.00%	0.000	2898	0.00000	0.00000	47	0.000	0.000	0.000
LE & OA Sectors combined											
2010	7.12%	153	0.00%	0.000	8798	0.00000	0.00000	124	0.000	0.000	0.000
2011-2016	Observed under IFQ fisheries, see Table 15										
Open Access Sector											
2002	*not observed*	–	–	–	–	–	–	36	–	–	–
2003	7.68%	110	0.00%	0.000	1977	0.00000	0.00000	26	0.000	0.000	0.000
2004	7.20%	244	1.64%	49.351	5102	0.00967	0.00334	71	0.686	0.222	1.150
2005	11.52%	362	0.00%	0.000	7431	0.00000	0.00000	65	0.000	0.000	0.000
2006	*not observed*	–	–	–	–	–	–	55	–	–	–
2007	7.00%	227	0.00%	0.000	2745	0.00000	0.00000	39	0.000	0.000	0.000
2008	5.14%	199	0.00%	0.000	2666	0.00000	0.00000	52	0.000	0.000	0.000
2009	0.77%	30	0.00%	0.000	634	0.00000	0.00000	82	0.000	0.000	0.000
2011	15.57%	204	0.00%	0.000	12446	0.00000	0.00000	80	0.000	0.000	0.000
2012	6.35%	78	0.00%	0.000	3541	0.00000	0.00000	56	0.000	0.000	0.000
2013	6.25%	81	0.00%	0.000	4305	0.00000	0.00000	69	0.000	0.000	0.000
2014	22.27%	145	0.00%	0.000	18139	0.00000	0.00000	81	0.000	0.000	0.000
2015	33.26%	339	0.00%	0.000	30615	0.00000	0.00000	92	0.000	0.000	0.000
2016	30.49%	500	0.00%	0.000	27327	0.00000	0.00000	90	0.000	0.000	0.000

Table 41: Coverage information and Pacific halibut bycatch in the At-sea Pacific hake fisheries by sector and year. Gear specific mortality rates cannot be applied to P. halibut bycatch in this fishery because mortality rates have not been determined for midwater trawl gear. (*) confidential

At-sea Pacific hake fishery

Sector **Year**	**Fleet observer coverage**	**Number of observed sets**	**% of sets with P. halibut**	**P. halibut bycatch (mt)**
Catcher-Processor				
2002	100%	559	3.22%	1.013
2003	100%	768	4.04%	2.619
2004	100%	1501	1.07%	0.806
2005	100%	1337	1.72%	1.217
2006	100%	1497	0.27%	0.111
2007	100%	1577	1.65%	0.504
2008	100%	1886	5.51%	2.070
2009	100%	868	0.12%	0.014
2010	100%	1068	0.47%	0.143
2011	100%	1549	1.48%	0.488
2012	100%	1107	2.35%	0.542
2013	100%	1459	1.30%	0.667
2014	100%	1696	0.06%	0.039
2015	100%	1519	0.07%	0.012
2016	100%	2205	0.05%	0.028
Mothership Catcher Vessels				
2002	100%	574	0.17%	0.048
2003	100%	536	0.37%	0.035
2004	100%	571	1.23%	0.323
2005	100%	1040	1.25%	0.567
2006	100%	1283	1.95%	0.532
2007	100%	1147	2.01%	0.621
2008	100%	1349	2.82%	0.629
2009	100%	600	3.50%	0.255
2010	100%	908	3.41%	1.080
2011	100%	1248	0.48%	0.085
2012	100%	949	0.63%	0.099
2013	100%	1256	2.15%	0.397
2014	100%	1308	1.22%	0.332
2015	100%	640	0.31%	0.049
2016	100%	1565	0.51%	0.123

Table 42: Coverage information and Pacific halibut bycatch in the Tribal At-sea Pacific hake fishery by year. Tribal At-sea P. hake fishery has not operated since 2012. Gear specific mortality rates cannot be applied to P. halibut bycatch in this fishery because mortality rates have not been determined for midwater trawl gear. (*) confidential

At-sea Pacific hake fishery

Sector **Year**	**Fleet observer coverage**	**Number of observed sets**	**% of sets with P. halibut**	**P. halibut bycatch (mt)**
Tribal Sector				
2002	100%	633	0.32%	0.079
2003	100%	540	0.00%	0.000
2004	100%	632	0.00%	0.000
2005	100%	633	0.79%	0.182
2006	100%	160	3.12%	0.192
2007	100%	156	0.64%	0.053
2008	100%	382	7.33%	1.280
2009	100%	404	0.99%	0.064
2010	100%	516	3.49%	0.349
2011	100%	228	0.88%	0.034
2012	100%	*	*	*

Table 43: Physical P. halibut length frequencies (cm) collected by A-SHOP observers in the At-sea hake fishery (2002-2016). Length bins include the lower bound and exclude the upper bound.

At-sea Hake				
Length bin (cm)	**No. of Excellent**	**No. of Poor**	**No. of Dead**	**No. of Unknown**
58-60	0	0	2	0
60-62	0	1	3	0
62-64	0	0	2	0
64-66	0	2	6	0
66-68	0	0	9	0
68-70	1	0	10	0
70-72	0	1	20	0
72-74	1	0	21	0
74-76	0	1	19	0
76-78	1	1	20	1
78-80	0	0	26	0
80-82	1	0	45	1
82-84	2	0	21	0
84-86	0	0	29	0
86-88	0	2	27	0
88-90	2	0	39	2
90-92	0	0	35	1
92-94	0	0	30	0
94-96	1	2	38	0
96-98	0	0	21	0
98-100	0	0	30	0
100-102	0	4	32	0
102-104	1	1	20	0
104-106	0	1	22	0
106-108	0	0	23	0
108-110	2	1	22	1
110-112	1	0	17	0
112-114	1	0	8	0
114-116	0	0	8	0
116-118	0	1	10	1
118-120	0	0	7	0
120-122	0	0	6	0
122-124	0	0	7	0
124-126	0	0	4	0
126-128	0	1	1	0
128-130	0	0	4	0
130-132	0	0	5	0
132-134	0	0	2	0
136-138	0	0	2	0
138-140	0	0	1	0
140-142	0	0	2	0
142-144	0	0	1	0
154-156	0	0	1	0

Table 44: Number of vessels, trips, and tows (or sets) and gross metric tons of Pacific halibut discarded at-sea, P. halibut discarded at sea with mortality rate applied (bottom trawl = 0.90; pot = 0.18) and the P. halibut landed and discarded at the dock (mortality rate = 1.0) under the IFQ Electronic Monitoring Exempted Fishing Permit (EFP). All participating vessels carry electronic monitoring equipment on all fishing trips. Data are summarized from the EM program administered by Pacific States Marine Fisheries Commission

Area	**Electronic Monitoring EFP (IFQ)**					
Depth (fm)						
Year	**No. of vessels**	**No. of trips**	**No. of sets**	**discarded at sea (gross, mt)**	**discard mortality (mt)**	**discarded at dock (mt)**
Bottom Trawl						
North of Pt. Chehalis						
All depths						
2015	0	0	0	0.00	0.00	0.00
2016	0	0	0	0.00	0.00	0.00
South of Pt. Chehalis						
All depths						
2015	5	23	139	0.18	0.16	0.00
2016	7	98	574	2.93	2.63	0.00
Pot						
North of 40°10′ N. lat.						
All depths						
2015	3	32	302	0.89	0.16	0.00
2016	5	44	417	0.07	0.01	0.00
South of 40°10′ N. lat.						
All depths						
2015	5	26	398	0.00	0.00	0.00
2016	4	27	603	0.00	0.00	0.00
Midwater Hake Trawl						
North of 40°10′ N. lat.						
2015	17	454	1178	0.00	0.00	0.56
2016	20	648	1411	0.01	0.01	0.65
Midwater Rockfish Trawl						
North of 40°10′ N. lat.						
2015	8	26	81	0.00	0.00	0.00
2016	6	30	74	0.00	0.00	0.00

Table 45: Metric tons of Pacific halibut discarded at sea and landed and discarded at the dock on observed Exempted Fishing Permit (EFP) vessels. Note: This does not contain the Catch Shares Electronic Monitoring EFP data, see Table 44 for those data.

		Observed					
Year	**Gear**	**Sector**	**No. vessels**	**No. trips**	**No. hauls**	**P. halibut discarded (mt)**	**P. halibut landed (mt)**
2002	EFP	Bottom & Midwater Trawl	7	38	279	53.36	0.10
2003	EFP	Bottom & Midwater Trawl	12	156	1491	50.79	0.20
2004	EFP	Bottom & Midwater Trawl	6	59	427	30.68	0.55
2005	EFP	–	0	0	0	0.00	0.00
2006	EFP	Bottom & Midwater Trawl	9	48	80	0.00	0.69
2007	EFP	–	0	0	0	0.00	0.00
2008	EFP	Fixed Gears	3	29	162	0.00	0.00
2009	EFP	Fixed Gears	5	83	141	0.00	0.00
2010	EFP	Fixed Gears	6	136	389	0.00	0.00
2011	EFP	–	0	0	0	0.00	0.00
2013	EFP	Fixed Gears	2	5	166	0.00	0.00
2014	EFP	Fixed Gears	3	11	21	0.00	0.00
2015	EFP	Fixed Gears	1	3	4	0.00	0.00
2016	EFP	Fixed Gears	1	3	3	0.00	0.00

Table 46: Metric tons of Pacific halibut landed in non-groundfish fisheries that are not observed by the NWFSC Observer Program. Data are summarized from the PacFIN fish tickets and do not include any P. halibut landed under the IPHC P. halibut directed fishery.

Year	**Sector**	**P. halibut landings (mt)**
2002	Other Fisheries	105.93
2003	Other Fisheries	74.37
2004	Other Fisheries	49.49
2005	Other Fisheries	43.69
2006	Other Fisheries	33.87
2007	Other Fisheries	29.42
2008	Other Fisheries	27.21
2009	Other Fisheries	26.50
2010	Other Fisheries	45.88
2011	Other Fisheries	25.30
2012	Other Fisheries	49.29
2013	Other Fisheries	37.28
2014	Other Fisheries	49.20
2015	Other Fisheries	50.94
2016	Other Fisheries	41.05

Table 47: Discard estimates for all fishery sectors observed by the NWFSC Groundfish Observer Program, 2002-2016. Total discard mortality estimates are also provided where discard mortality rates were applied. Estimates include individuals discarded at the dock (100% mortality).

Year	LE bottom trawl 2002-10	IFQ Fishery [7]						Non-Nearshore fixed gear			Nearshore Fixed Gear [3]	Pink Shrimp [3]	CA Halibut [3,6]	At-sea Hake [3]	Total
		Bottom Trawl [1,2,7]	LE CA Halibut [1,3]	Hook and Line	Pot[7]	Midwater Rockfish [3,4,7]	Midwater Hake [2,3,5,7]	LE Endorsed	LE Non-Endorsed	OA					
Gross Discard Estimates (mt)															
2002	524.41							141.43	0.00	-	-	-	0.00	1.14	666.98
2003	186.65							190.88	0.17	-	0.00	-	0.00	2.65	380.35
2004	212.43							236.50	0.00	-	0.99	0.00	0.70	1.13	451.75
2005	460.35							221.75	0.00	-	2.19	0.04	0.03	1.97	686.33
2006	390.91							649.89	0.00	-	0.52	-	0.02	0.83	1042.17
2007	294.38							127.19	1.73	21.67	0.09	0.21	0.03	1.18	446.48
2008	305.21							256.20	3.00	40.17	0.35	0.00	0.31	3.98	609.22
2009	385.24							325.55	0.25	34.84	1.28	0.00	0.00	0.33	747.49
2010	265.08							137.60	0.40	32.56	0.08	0.00	0.00	1.57	437.29
2011		64.14	0	6.06	3.36	*	0.35	136.93	21.30	13.05	3.06	0.19	0.00	0.61	249.05
2012		67.13	*	14.66	1.89	0.0	0.62	149.38	16.57	23.65	2.25	0.00	0.00	0.64	276.79
2013		66.08	see[1]	3.00	0.98	0.0	1.34	22.25	0.01	1.78	1.36	0.00	0.00	1.06	97.86
2014		55.97	see[1]	3.80	0.32	0.0	1.36	173.11	0.00	3.49	0.95	0.00	0.00	0.37	239.37
2015		69.27	see[1]	9.49	2.21	0.0	0.70	126.74	0.46	10.14	1.42	0.01	0.00	0.06	220.50
2016		58.84	see[1]	6.39	1.77	0.0	0.68	171.60	4.98	45.40	2.99	0.00	0.00	0.15	292.80
Total Discard Mortality (mt)															
2002	344.82							22.71	0.00	-	-	-	0.00	1.14	368.67
2003	124.43							30.55	0.03	-	0.00	-	0.00	2.65	157.66
2004	133.12							38.49	0.00	-	0.99	0.00	0.70	1.13	174.43
2005	286.52							35.53	0.00	-	2.19	0.04	0.03	1.97	326.28
2006	242.47							104.30	0.00	-	0.52	-	0.02	0.83	348.14
2007	208.81							20.43	0.28	3.49	0.09	0.21	0.03	1.18	234.52
2008	207.81							41.12	0.48	6.43	0.35	0.00	0.31	3.98	260.48
2009	251.1							52.10	0.04	5.58	1.28	0.00	0.00	0.33	310.43
2010	180.97							22.12	0.06	5.22	0.08	0.00	0.00	1.57	210.02
2011		31.30	0	0.97	0.89	*	0.35	11.80	3.18	1.82	3.06	0.19	0.00	0.61	54.17
2012		36.13	*	2.34	0.51	0.0	0.62	24.97	1.79	2.68	2.25	0.00	0.00	0.64	71.93
2013		32.41	see[1]	0.48	0.21	0.0	1.34	2.94	0.00	0.18	1.36	0.00	0.00	1.06	39.98
2014		26.32	see[1]	0.61	0.08	0.0	1.36	29.95	0.00	0.38	0.95	0.00	0.00	0.37	60.02
2015		33.36	see[1]	1.52	0.38	0.0	0.70	10.20	0.05	0.87	1.42	0.01	0.00	0.06	48.57
2016		33.27	see[1]	1.02	0.18	0.0	0.68	16.59	0.36	2.77	2.99	0.00	0.00	0.15	58.01

[1]Starting in 2013, LE CA Halibut estimates are combined with IFQ Bottom Trawl estimates.

[2]Includes a small amount landed and discarded at the dock.

[3]100% mortality rate

[4]from 2011-14, 'Midwater Trawl'

[5]from 2011-14, 'Shoreside Hake'

[6]Starting in 2011, this sector only includes OA CA halibut

[7]Includes P. halibut catch from IFQ electronic monitoring EFP

9 FIGURES

Figure 2: Number of vessels by month for IFQ bottom trawl vessels in 2016 (solid line) and averaged over the 2011–16 period (dotted line). Grey ribbon represents the monthly maximum and minimum across 2011-2016.

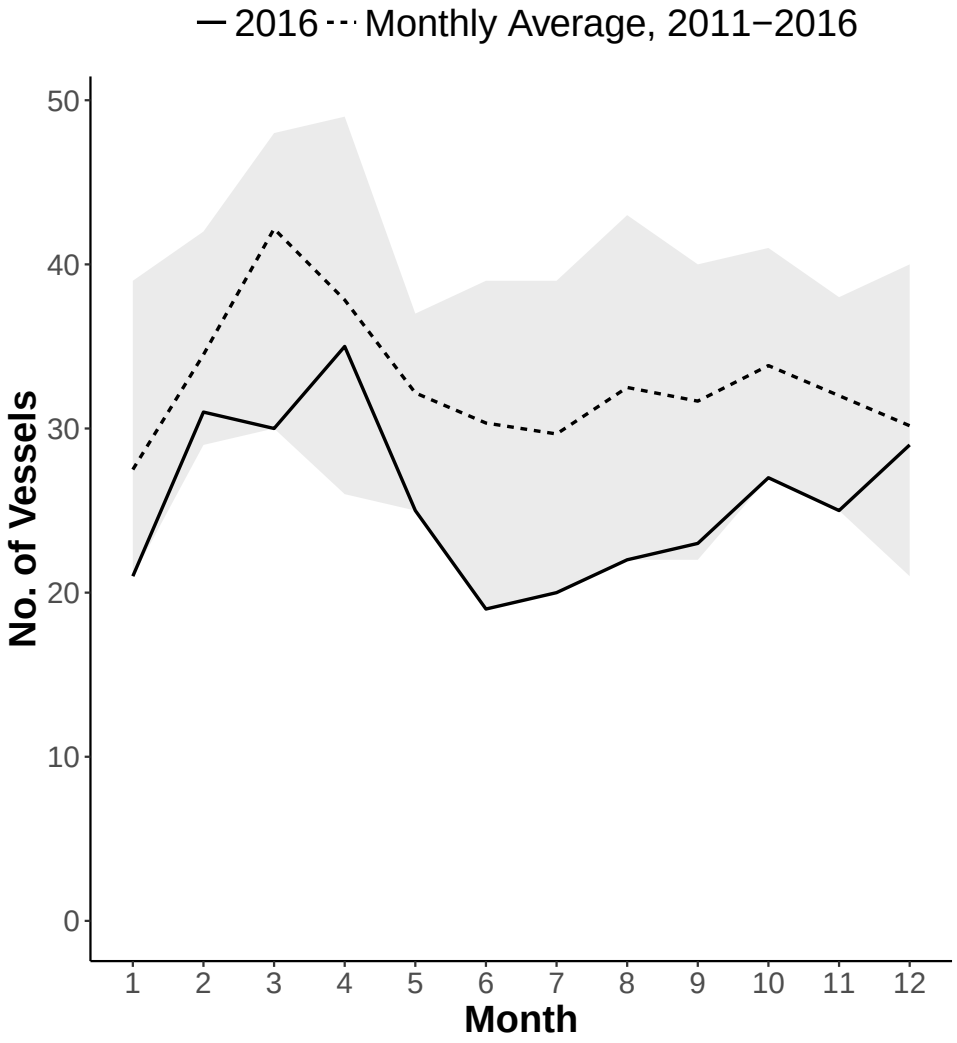


Figure 3: Number of tows by month for IFQ bottom trawl vessels in 2016 (solid line) and averaged over the 2011–16 period (dotted line). Grey ribbon represents the monthly maximum and minimum across 2011-2016.

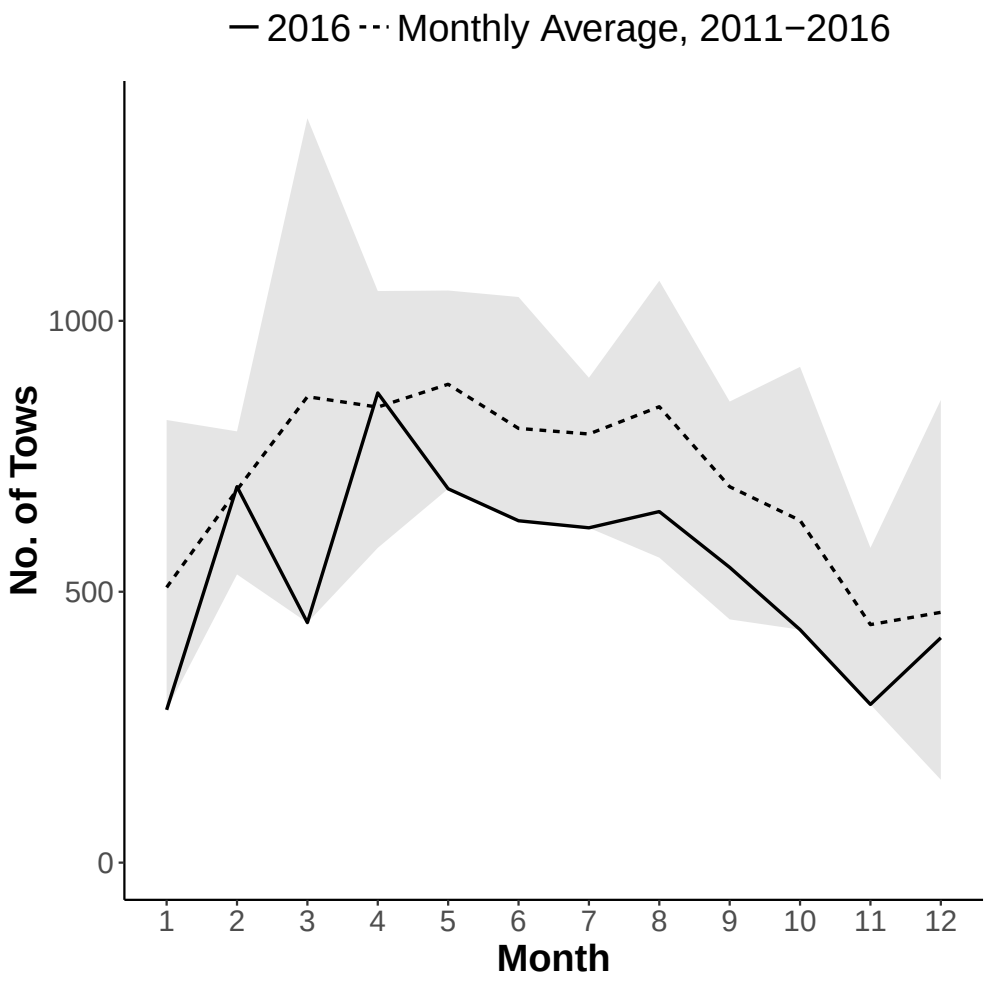


Figure 4: Tow hours by month for IFQ bottom trawl vessels in 2016 (solid line) and averaged over the 2011–16 period (dotted line). Grey ribbon represents the monthly maximum and minimum across 2011-2016.

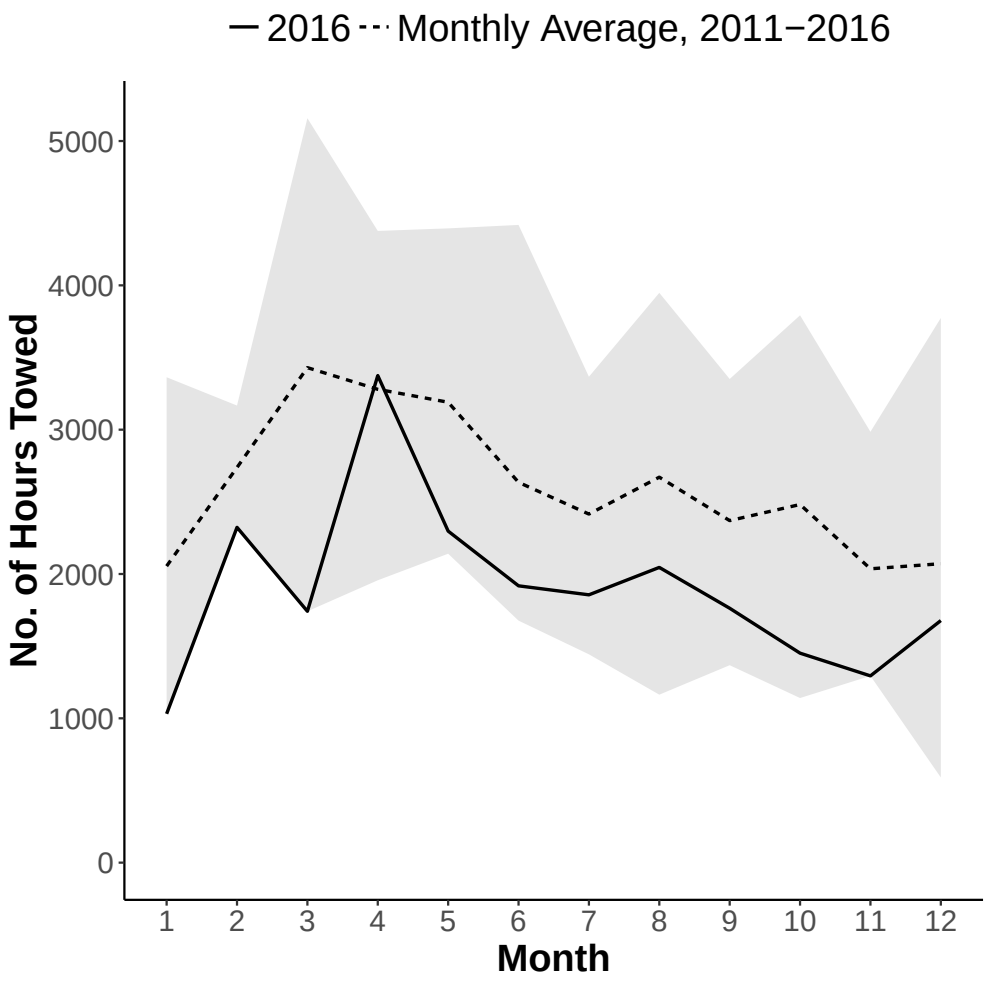


Figure 5: Estimated discard mortality of P. halibut in the non-nearshore fixed gear fishery by sector and year. The Open Access (OA) fixed gear fishery was only observed from 2003-06 in California and was not observed at all in 2002. Therefore, we apply a fixed average discard rate from 2007-08 data to generate 2002-06 discard estimates for the OA sector. The 'Other fixed gear sectors' includes LE sablefish non-endorsed and OA fixed gear vessels fishing with pot gear. The inset is an expanded view of each of the sectors, except LE sablefish endorsed longline (LL) gear, during years with very small bycatch.

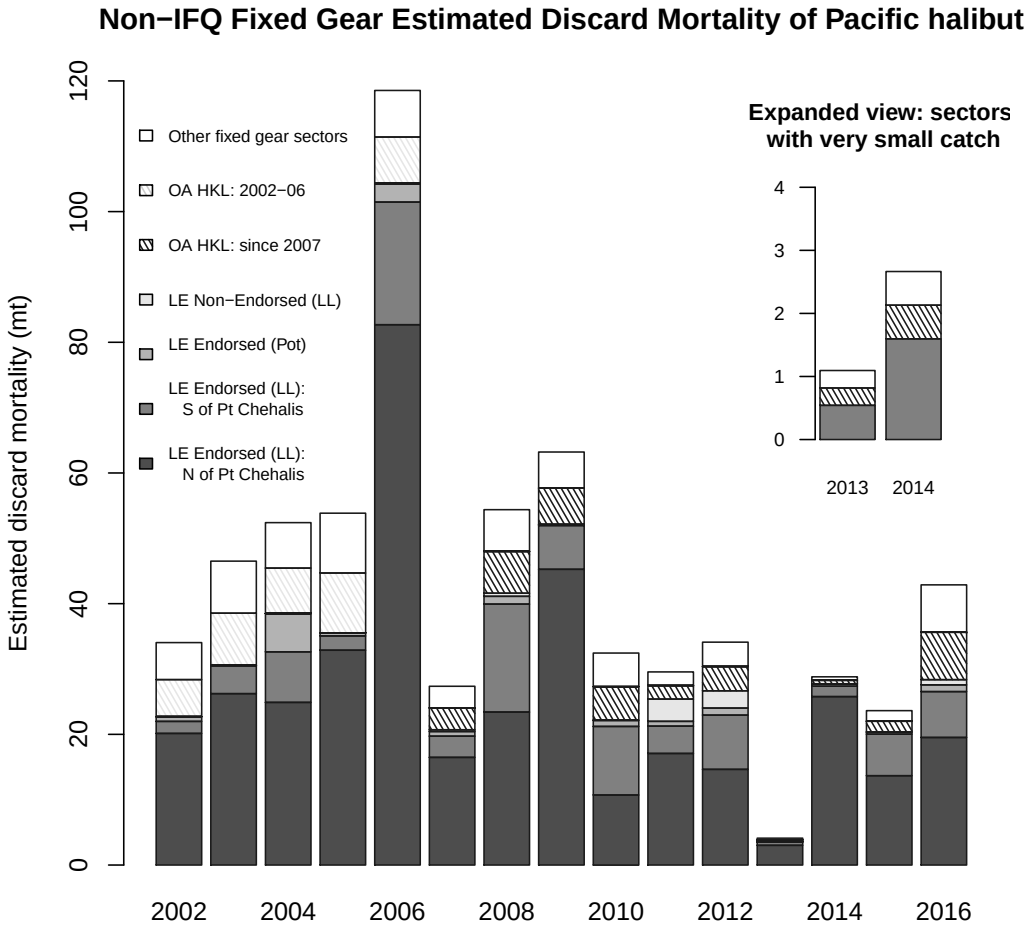


Figure 6: Length frequency distribution of discarded Pacific halibut on WCGOP observed Non-Nearshore Fixed Gear limited entry (LE) and open access (OA) groundfish vessels from September 2003 through December 2016. The majority of P. halibut lengths collected in this fishery were visual estimates (grey bars) which are only estimated in 10 cm bins. The sublegal-legal size cut-off (82 cm) is indicated by a vertical dashed line.

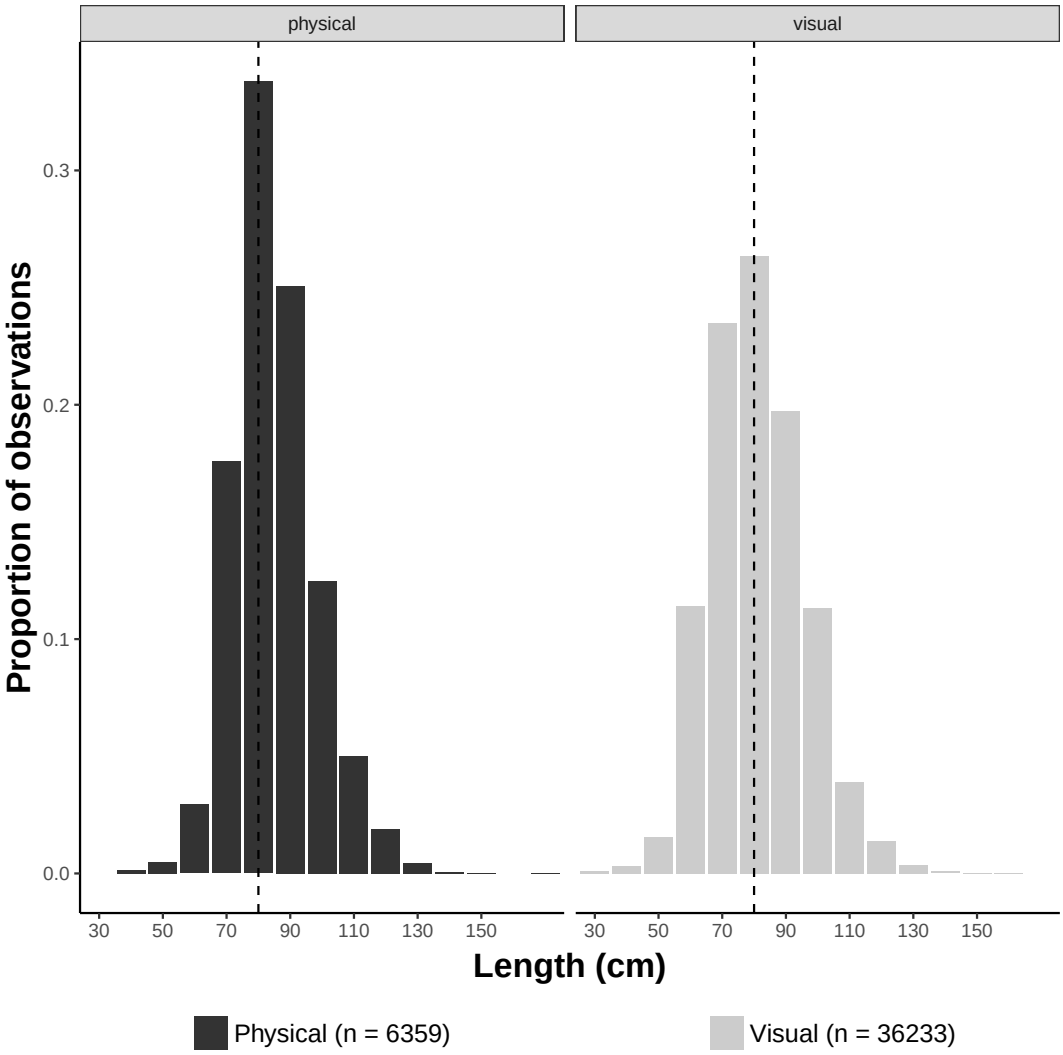


Figure 7: Spatial distribution of Pacific halibut bycatch (mt/km^2) observed by West Coast Groundfish Observer Program (2002-2016), off the U.S. West Coast. Gear types observed by the WCGOP include bottom trawl, midwater trawl, shrimp trawl, fixed gear hook-&-line and pot gear. The five catch classifications were defined by excluding any 0 values and then applying the Jenks natural breaks classification method. Cells (200 sq. km) with less than 3 vessels were omitted from the map to maintain confidentiality.

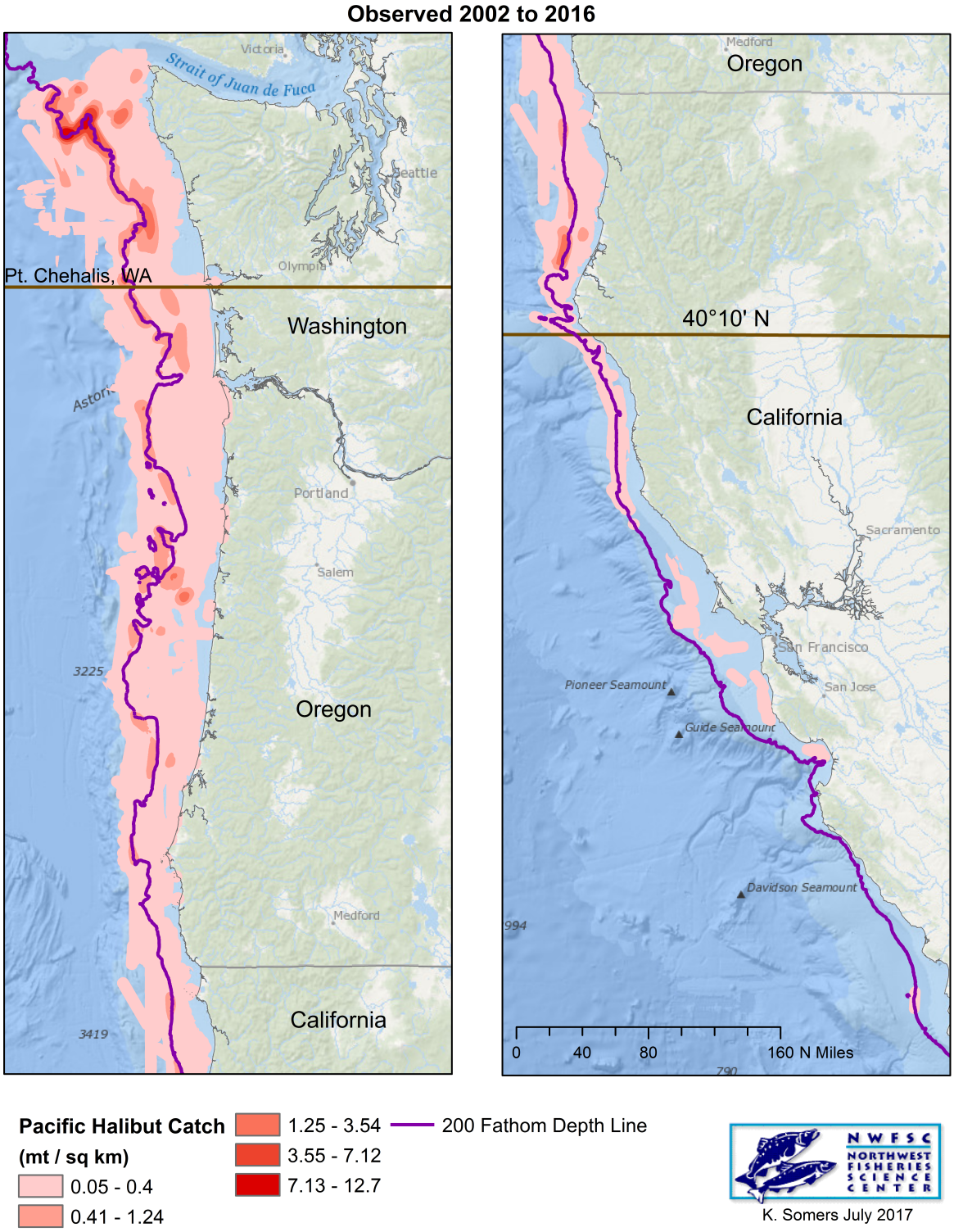
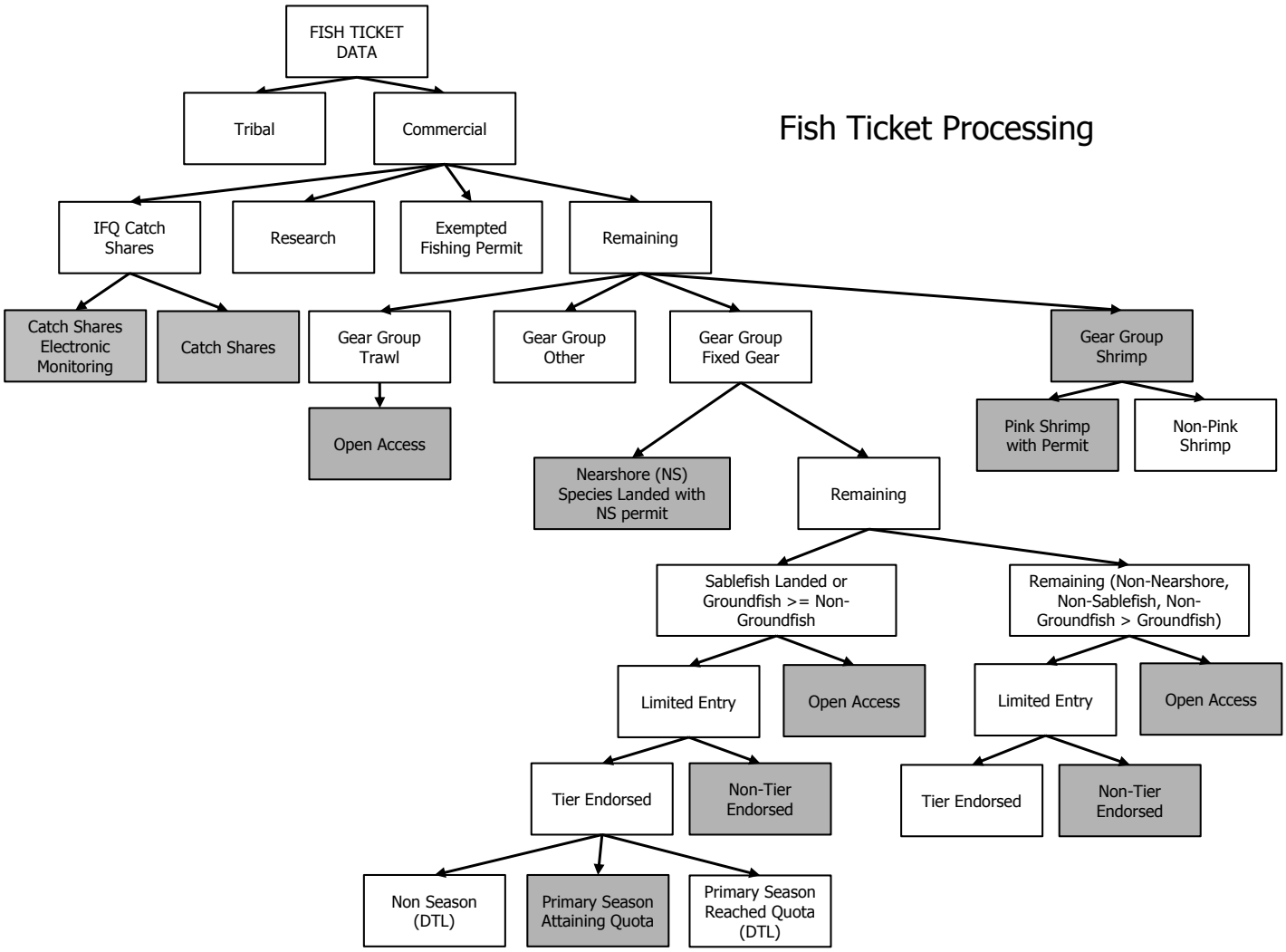


Figure 8: Fish ticket data processing for division into 2016 groundfish fishery sectors after retrieval from the Pacific Fisheries Information Network (PacFIN) database. Grey boxes indicate sectors for which federal observer data is available. Fish ticket processing methods are updated annually, thus, this figure might differ from similar figures in previous reports.



10 APPENDICES

10.1 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:

$$n_{wghtd_l} = n_l \times \frac{W_{st}}{\sum_l w_{stl}} \times \frac{\sum_t W_{st}}{W_{st}} \times \frac{\hat{W}_s}{\sum_t W_{st}} = n_l \times \frac{\hat{W}_s}{\sum_l w_{stl}} \tag{9}$$

where:
s = stratum
t = tow
l = length bin
n = number of measured fish
w = total weight of fish, as determined through the IPHC length-weight relationship (Table 9 in Appendix C 10.3)
W = total observed discard weight of Pacific halibut
$\hat{W}$ = estimated total discard weight of P. halibut

Table 48: Weighted length frequency distributions for Pacific halibut in the IFQ fishery for vessels using bottom trawl gears, by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. Since 2013, IFQ bottom trawl lengths could also include lengths taken on both IFQ and LE California halibut bottom trawl fisheries.

	Bottom Trawl							Bottom Trawl					
Length bin (cm)	2011	2012	2013	2014	2015	2016	**Length bin (cm)**	2011	2012	2013	2014	2015	2016
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	102	0.0070	0.0075	0.0067	0.0047	0.0072	0.0077
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	104	0.0054	0.0043	0.0051	0.0119	0.0062	0.0049
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	106	0.0039	0.0036	0.0036	0.0025	0.0043	0.0043
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	108	0.0030	0.0034	0.0089	0.0020	0.0168	0.0038
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	110	0.0025	0.0033	0.0041	0.0293	0.0158	0.0025
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	112	0.0021	0.0021	0.0158	0.0091	0.0024	0.0024
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	114	0.0017	0.0015	0.0112	0.0009	0.0015	0.0010
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0370	116	0.0011	0.0012	0.0035	0.0005	0.0137	0.0013
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	118	0.0009	0.0007	0.0007	0.0004	0.0009	0.0008
18	0.0065	0.0000	0.0000	0.0000	0.0000	0.0000	120	0.0005	0.0008	0.0062	0.0003	0.0243	0.0006
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	122	0.0005	0.0005	0.0005	0.0004	0.0006	0.0006
22	0.0000	0.0108	0.0000	0.0000	0.0000	0.0000	124	0.0006	0.0003	0.0002	0.0002	0.0111	0.0003
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	126	0.0003	0.0004	0.0001	0.0062	0.0002	0.0003
26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	128	0.0003	0.0000	0.0001	0.0002	0.0003	0.0002
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	130	0.0001	0.0000	0.0000	0.0001	0.0002	0.0001
30	0.0000	0.0076	0.0037	0.0000	0.0000	0.0000	132	0.0002	0.0001	0.0000	0.0001	0.0001	0.0001
32	0.0000	0.0061	0.0030	0.0028	0.0000	0.0016	134	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001
34	0.0000	0.0101	0.0000	0.0000	0.0000	0.0000	136	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
36	0.0000	0.0043	0.0000	0.0000	0.0009	0.0008	138	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
38	0.0000	0.0109	0.0000	0.0000	0.0027	0.0099	140	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
40	0.0014	0.0053	0.0019	0.0014	0.0091	0.3193	142	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000
42	0.0023	0.0110	0.0000	0.0000	0.0057	0.0068	144	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
44	0.0000	0.0024	0.0000	0.0000	0.0061	0.0022	146	0.0000	0.0000	0.0000	0.0039	0.0000	0.0000
46	0.0003	0.0073	0.0006	0.0004	0.0023	0.0028	148	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
48	0.0029	0.0064	0.0028	0.0011	0.0044	0.0101	150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50	0.0034	0.0071	0.0032	0.0000	0.0030	0.0044	152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
52	0.0046	0.0072	0.0048	0.0021	0.0010	0.0035	154	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
54	0.0079	0.0057	0.0424	0.0044	0.0052	0.0082	156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
56	0.0074	0.0062	0.0074	0.0050	0.0069	0.1074	158	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
58	0.0194	0.0148	0.0155	0.0141	0.0120	0.0119	160	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60	0.0324	0.0294	0.0275	0.0305	0.0186	0.0151	162	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
62	0.0441	0.0428	0.0553	0.0551	0.0334	0.0272	164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	0.0565	0.0529	0.0615	0.0740	0.0472	0.0273	166	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0589	0.0542	0.0710	0.0777	0.1666	0.0427	168	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
68	0.0571	0.0623	0.0979	0.0910	0.0770	0.0734	170	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70	0.0762	0.0711	0.0770	0.0897	0.0817	0.0712	172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
72	0.0737	0.0708	0.0830	0.0848	0.0841	0.0929	174	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
74	0.0858	0.0678	0.0720	0.0756	0.1153	0.0680	176	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
76	0.0669	0.0629	0.0672	0.0666	0.0541	0.0659	178	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
78	0.0561	0.0536	0.0586	0.0591	0.0476	0.0687	180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80	0.0571	0.0486	0.0522	0.0492	0.0538	0.0587	182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
82	0.0478	0.0469	0.0462	0.1270	0.0528	0.0528	184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
84	0.0460	0.0376	0.0301	0.0344	0.0379	0.0415	186	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
86	0.0309	0.0302	0.0279	0.1097	0.0337	0.0374	188	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
88	0.0284	0.0255	0.0259	0.0608	0.0648	0.0315	190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90	0.0258	0.0237	0.0241	0.0743	0.0267	0.0265	192	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
92	0.0213	0.0214	0.0208	0.0162	0.0205	0.0215	194	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
94	0.0167	0.0160	0.0152	0.0117	0.0140	0.0194	196	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
96	0.0134	0.0110	0.0114	0.0304	0.0116	0.0131	198	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
98	0.0096	0.0097	0.0095	0.0077	0.0109	0.0101	200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100	0.0086	0.0084	0.0080	0.0075	0.0096	0.0164							

Table 49: Percentage of weighted length measurements in each viability category, for IFQ bottom trawl vessels by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. Since 2013, IFQ bottom trawl lengths could also include lengths taken on both IFQ and LE California halibut bottom trawl fisheries.

	Bottom Trawl																	
	Excellent						Poor						Dead					
Length bin (cm)	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
14	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
22	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	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%	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%	0.0%	0.0%	0.0%	0.0%	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%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
30	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
32	0.0%	50.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	50.0%	100.0%	0.0%	0.0%	0.0%
34	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
36	0.0%	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
38	0.0%	82.7%	0.0%	0.0%	92.7%	100.0%	0.0%	15.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	7.3%	0.0%
40	0.0%	82.2%	22.2%	0.0%	32.3%	88.3%	100.0%	0.0%	0.0%	0.0%	38.4%	0.0%	0.0%	17.8%	77.8%	100.0%	29.3%	11.7%
42	47.9%	68.0%	0.0%	0.0%	56.6%	100.0%	52.1%	23.6%	0.0%	0.0%	19.7%	0.0%	0.0%	8.5%	0.0%	0.0%	23.7%	0.0%
44	0.0%	46.8%	0.0%	0.0%	50.6%	100.0%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	0.0%	53.2%	0.0%	0.0%	35.1%	0.0%
46	0.0%	83.4%	0.0%	0.0%	83.1%	82.9%	0.0%	16.6%	0.0%	0.0%	16.9%	0.0%	100.0%	0.0%	100.0%	100.0%	0.0%	17.1%
48	24.9%	96.4%	34.3%	100.0%	78.4%	86.2%	24.9%	0.0%	29.0%	0.0%	21.6%	13.8%	50.1%	3.6%	36.7%	0.0%	0.0%	0.0%
50	29.9%	66.0%	20.7%	0.0%	2.8%	54.5%	0.0%	10.4%	22.1%	0.0%	0.0%	8.5%	70.1%	23.6%	57.2%	0.0%	97.2%	37.1%
52	23.1%	52.4%	29.7%	30.1%	100.0%	80.9%	42.3%	15.3%	22.4%	11.6%	0.0%	14.0%	34.6%	32.3%	48.0%	58.3%	0.0%	5.1%
54	15.6%	59.9%	40.3%	50.8%	55.2%	67.9%	43.2%	29.4%	18.2%	0.0%	34.6%	5.6%	41.2%	10.7%	41.5%	49.2%	10.3%	26.5%
56	21.0%	44.2%	54.8%	35.4%	38.1%	60.6%	45.5%	13.9%	1.9%	0.8%	17.6%	17.0%	33.5%	41.9%	43.2%	63.7%	44.3%	22.4%
58	19.8%	41.0%	36.5%	32.9%	38.4%	57.2%	31.2%	10.0%	23.0%	31.2%	23.4%	10.8%	48.9%	49.0%	40.5%	35.8%	38.2%	32.0%
60	32.8%	36.8%	39.5%	38.7%	52.4%	40.6%	24.3%	21.8%	8.3%	23.6%	9.5%	14.3%	42.9%	41.4%	52.1%	37.7%	38.1%	45.1%
62	37.8%	39.9%	43.4%	43.4%	52.1%	34.2%	22.7%	21.0%	18.7%	20.1%	13.4%	20.7%	39.6%	39.1%	37.9%	36.5%	34.6%	45.1%
64	39.6%	32.2%	46.1%	45.0%	47.9%	41.8%	18.7%	20.9%	17.6%	19.7%	12.4%	14.8%	41.7%	46.9%	36.3%	35.3%	39.7%	43.4%
66	36.7%	35.9%	45.1%	48.9%	44.1%	32.5%	21.0%	22.3%	14.3%	23.7%	20.3%	18.0%	42.3%	41.9%	40.6%	27.5%	35.6%	49.5%
68	42.6%	35.1%	50.5%	46.7%	47.7%	46.3%	12.0%	21.5%	12.3%	20.8%	16.3%	12.9%	45.3%	43.4%	37.2%	32.5%	35.9%	40.8%
70	41.6%	39.6%	45.2%	53.6%	46.1%	37.6%	20.8%	19.5%	17.1%	17.8%	16.5%	13.9%	37.7%	40.9%	37.7%	28.6%	37.4%	48.5%
72	38.6%	32.2%	48.6%	50.8%	49.3%	35.2%	20.9%	18.8%	16.9%	18.4%	14.0%	17.7%	40.5%	49.0%	34.5%	30.8%	36.7%	47.1%
74	40.0%	32.5%	47.4%	53.7%	52.4%	36.3%	17.4%	21.9%	19.1%	14.8%	14.2%	15.4%	42.6%	45.7%	33.5%	31.6%	33.5%	48.3%
76	45.5%	36.9%	45.0%	44.0%	47.1%	35.9%	17.0%	17.2%	17.8%	18.2%	13.2%	17.4%	37.5%	45.9%	37.2%	37.7%	39.7%	46.7%
78	41.1%	33.3%	44.6%	52.3%	47.0%	35.8%	19.0%	24.6%	16.0%	17.9%	17.0%	12.2%	39.9%	42.1%	39.5%	29.8%	35.9%	52.0%
80	45.7%	38.8%	53.9%	50.1%	47.4%	39.9%	16.0%	18.5%	13.1%	16.6%	16.7%	14.3%	38.3%	42.7%	33.0%	33.3%	35.9%	45.8%
82	45.8%	36.6%	45.4%	50.6%	46.3%	34.6%	19.9%	20.9%	18.3%	11.3%	13.5%	15.8%	34.3%	42.5%	36.3%	38.1%	40.3%	49.6%
84	50.1%	38.5%	50.6%	45.6%	45.4%	39.5%	14.8%	18.9%	14.5%	13.3%	14.3%	14.3%	35.1%	42.6%	34.9%	41.1%	40.3%	46.2%
86	44.6%	36.4%	55.6%	48.8%	42.0%	35.2%	14.6%	21.7%	15.5%	18.1%	20.1%	12.3%	40.8%	41.8%	28.9%	33.2%	37.8%	52.5%
88	41.7%	39.2%	52.9%	43.5%	51.2%	36.8%	16.1%	21.5%	15.2%	22.0%	14.8%	14.4%	42.2%	39.3%	31.9%	34.5%	34.0%	48.8%
90	48.3%	40.9%	57.9%	43.1%	46.9%	35.1%	17.0%	18.9%	13.8%	18.7%	16.6%	15.0%	34.7%	40.1%	28.4%	38.2%	36.6%	49.9%
92	46.6%	41.0%	58.4%	50.6%	49.1%	32.1%	17.3%	20.2%	14.7%	14.0%	19.5%	18.7%	36.1%	38.9%	26.9%	35.4%	31.3%	49.1%
94	51.2%	46.4%	54.6%	49.4%	44.5%	42.2%	20.1%	14.3%	15.6%	17.6%	17.3%	15.4%	28.7%	39.3%	29.8%	33.1%	38.2%	42.4%
96	49.4%	40.5%	58.5%	57.5%	50.5%	36.7%	14.6%	16.9%	12.5%	14.7%	12.4%	15.2%	36.0%	42.6%	29.0%	27.9%	37.1%	48.1%
98	50.0%	39.7%	52.5%	43.5%	50.5%	41.8%	18.2%	17.8%	19.6%	23.2%	16.8%	14.7%	31.8%	42.4%	27.9%	33.3%	32.7%	43.5%
100	53.8%	43.8%	60.9%	57.2%	60.4%	41.7%	18.2%	21.0%	14.8%	5.6%	13.0%	12.9%	28.0%	35.2%	24.3%	37.2%	26.6%	45.3%
102	47.3%	51.1%	58.6%	52.1%	46.7%	48.0%	16.1%	16.5%	14.3%	13.3%	16.9%	14.3%	36.7%	32.4%	27.1%	34.5%	36.4%	37.8%
104	53.0%	44.5%	55.6%	60.8%	54.6%	43.0%	18.9%	10.3%	14.3%	17.8%	12.1%	12.7%	28.1%	45.2%	30.1%	21.4%	33.3%	44.3%

Table 50: Table 49 continued for IFQ bottom trawl vessels. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

	Bottom Trawl																	
	Excellent						Poor						Dead					
Length bin (cm)	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
106	54.2%	39.6%	71.7%	66.2%	50.6%	54.9%	18.4%	26.6%	12.7%	9.1%	19.4%	7.1%	27.3%	33.8%	15.6%	24.6%	30.0%	38.0%
108	53.4%	44.3%	58.5%	62.6%	45.3%	35.7%	20.3%	16.4%	14.1%	23.2%	18.9%	20.1%	26.3%	39.3%	27.4%	14.2%	35.8%	44.2%
110	56.5%	51.4%	56.2%	60.9%	62.0%	33.2%	11.2%	14.2%	26.9%	16.0%	12.9%	19.3%	32.3%	34.4%	16.9%	23.1%	25.1%	47.5%
112	56.6%	54.4%	58.0%	53.5%	30.3%	40.5%	22.5%	22.4%	20.7%	14.9%	26.9%	8.0%	20.9%	23.2%	21.3%	31.6%	42.8%	51.5%
114	49.8%	43.9%	68.4%	64.8%	52.7%	23.2%	25.2%	22.7%	12.7%	12.9%	12.0%	17.6%	25.0%	33.4%	18.9%	22.3%	35.3%	59.3%
116	60.6%	42.8%	59.7%	42.6%	57.3%	52.7%	13.5%	20.0%	20.0%	37.1%	15.2%	11.0%	25.9%	37.1%	20.2%	20.3%	27.5%	36.3%
118	55.8%	58.4%	62.9%	62.3%	54.5%	25.4%	9.6%	6.4%	17.3%	29.2%	21.4%	35.9%	34.5%	35.2%	19.8%	8.5%	24.2%	38.7%
120	47.6%	20.3%	79.4%	81.7%	58.1%	42.3%	28.1%	16.5%	18.8%	0.0%	16.4%	0.8%	24.3%	63.2%	1.8%	18.3%	25.4%	57.0%
122	54.3%	58.9%	59.0%	80.1%	56.7%	52.0%	8.0%	31.2%	14.5%	0.0%	7.6%	16.1%	37.7%	9.9%	26.5%	19.9%	35.7%	31.9%
124	39.8%	39.0%	47.7%	73.5%	29.7%	82.7%	21.8%	48.5%	16.1%	16.0%	35.1%	0.0%	38.4%	12.5%	36.1%	10.5%	35.1%	17.3%
126	42.1%	29.4%	100.0%	0.0%	34.9%	31.2%	19.0%	30.6%	0.0%	37.8%	0.0%	0.0%	38.9%	40.1%	0.0%	62.2%	65.1%	68.8%
128	52.6%	96.4%	49.5%	85.0%	84.6%	67.9%	35.7%	0.0%	50.5%	0.0%	3.9%	20.7%	11.7%	3.6%	0.0%	15.0%	11.5%	11.4%
130	75.4%	0.0%	77.8%	100.0%	82.5%	79.0%	24.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	22.2%	0.0%	17.5%	21.0%
132	45.2%	100.0%	22.2%	100.0%	100.0%	100.0%	18.6%	0.0%	0.0%	0.0%	0.0%	0.0%	36.2%	0.0%	77.8%	0.0%	0.0%	0.0%
134	79.3%	100.0%	67.0%	100.0%	25.6%	61.6%	20.7%	0.0%	33.0%	0.0%	0.0%	26.5%	0.0%	0.0%	0.0%	0.0%	74.4%	11.9%
136	25.2%	100.0%	100.0%	100.0%	100.0%	74.7%	49.5%	0.0%	0.0%	0.0%	0.0%	0.0%	25.2%	0.0%	0.0%	0.0%	0.0%	25.3%
138	0.0%	8.2%	0.0%	0.0%	0.0%	90.3%	100.0%	55.9%	100.0%	0.0%	0.0%	0.0%	0.0%	35.9%	0.0%	0.0%	100.0%	9.7%
140	49.7%	0.0%	0.0%	0.0%	4.4%	0.0%	50.3%	0.0%	0.0%	0.0%	46.5%	0.0%	0.0%	0.0%	0.0%	0.0%	49.0%	100.0%
142	25.1%	0.0%	0.0%	0.0%	10.3%	0.0%	24.8%	100.0%	0.0%	0.0%	59.5%	0.0%	50.1%	0.0%	0.0%	0.0%	30.1%	0.0%
144	59.4%	0.0%	0.0%	59.9%	0.0%	50.6%	40.6%	0.0%	0.0%	40.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	49.4%
146	100.0%	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
148	50.2%	0.0%	0.0%	0.0%	100.0%	69.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	49.8%	0.0%	0.0%	0.0%	0.0%	31.0%
150	0.0%	0.0%	0.0%	0.0%	45.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	54.5%	0.0%
152	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
154	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	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%	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%	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%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
162	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
164	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
166	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
168	0.0%	0.0%	0.0%	0.0%	91.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
170	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
172	0.0%	0.0%	0.0%	0.0%	91.8%	100.0%	0.0%	0.0%	0.0%	0.0%	8.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
174	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
176	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
178	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	100.0%	50.0%
180	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
182	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
184	0.0%	0.0%	0.0%	0.0%	45.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	54.9%	0.0%
186	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
188	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
190	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
192	0.0%	0.0%	0.0%	0.0%	100.0%	31.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	69.0%
194	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
196	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
198	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
200	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
202	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 51: Weighted length frequency distributions for Pacific halibut in the IFQ fishery for vessels using pot gears, by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

	Pot							Pot					
Length bin (cm)	2011	2012	2013	2014	2015	2016	**Length bin (cm)**	2011	2012	2013	2014	2015	2016
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	102	0.0025	0.0085	0.0103	0.0519	0.0027	0.0062
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	104	0.0024	0.0054	0.0043	0.0000	0.0100	0.0096
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	106	0.0000	0.0137	0.0170	0.0000	0.0023	0.0000
6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	108	0.0035	0.0012	0.0000	0.0000	0.0045	0.0017
8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	110	0.0014	0.0011	0.0045	0.0138	0.0021	0.0000
10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	112	0.0013	0.0010	0.0000	0.0000	0.0000	0.0030
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	114	0.0028	0.0020	0.0000	0.0123	0.0000	0.0015
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	116	0.0005	0.0000	0.0000	0.0233	0.0000	0.0000
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	118	0.0011	0.0009	0.0028	0.0000	0.0000	0.0000
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	120	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	122	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	124	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	126	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	128	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	130	0.0004	0.0000	0.0000	0.0000	0.0012	0.0000
30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	132	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	134	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	136	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	138	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
38	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	140	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	144	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
44	0.0248	0.0000	0.0000	0.0000	0.0000	0.0000	146	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
46	0.0000	0.0000	0.0556	0.0000	0.0000	0.0000	148	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
48	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0255	0.0419	152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
52	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	154	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
54	0.0129	0.0000	0.0441	0.0000	0.0212	0.0000	156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
56	0.0054	0.0000	0.0000	0.0000	0.0000	0.0137	158	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
58	0.0151	0.0000	0.0000	0.0000	0.0337	0.0000	160	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60	0.0672	0.0000	0.0074	0.0934	0.0151	0.0459	162	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
62	0.0538	0.0000	0.0000	0.0000	0.0264	0.0203	164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
64	0.0217	0.0377	0.0000	0.0000	0.0238	0.0184	166	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0136	0.0113	0.0052	0.0000	0.0221	0.0162	168	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
68	0.0215	0.0308	0.0266	0.0000	0.0584	0.0609	170	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70	0.0745	0.0239	0.0396	0.0000	0.0628	0.1038	172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
72	0.0908	0.0608	0.1317	0.0546	0.0490	0.0693	174	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
74	0.0541	0.0595	0.1028	0.1001	0.0299	0.0750	176	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
76	0.0183	0.0295	0.0699	0.0459	0.0482	0.0477	178	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
78	0.0744	0.0907	0.0737	0.0421	0.0631	0.0391	180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80	0.1017	0.0891	0.0643	0.1135	0.1052	0.0675	182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
82	0.0631	0.1473	0.1080	0.0703	0.0862	0.0911	184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
84	0.0543	0.1230	0.0470	0.0995	0.0745	0.0690	186	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
86	0.0411	0.0636	0.0379	0.1218	0.0556	0.0572	188	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
88	0.0372	0.0659	0.0496	0.0275	0.0514	0.0199	190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90	0.0473	0.0399	0.0358	0.0000	0.0476	0.0488	192	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
92	0.0217	0.0337	0.0189	0.0238	0.0295	0.0142	194	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
94	0.0187	0.0260	0.0150	0.0461	0.0172	0.0215	196	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
96	0.0153	0.0259	0.0235	0.0208	0.0161	0.0074	198	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
98	0.0123	0.0016	0.0000	0.0201	0.0091	0.0093	200	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
100	0.0163	0.0062	0.0047	0.0188	0.0056	0.0198							

Table 52: Percentage of weighted length measurements in each viability category, for IFQ pot vessels by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. Since 2013, IFQ bottom trawl lengths could also include lengths taken on both IFQ and LE California halibut bottom trawl fisheries.

	Pot																	
	Excellent						Poor						Dead					
Length bin (cm)	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
14	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
20	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	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%	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%	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%	0.0%	0.0%	0.0%	0.0%	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%	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%	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%	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%	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%	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%	0.0%	0.0%	0.0%	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%	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%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
44	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
46	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
50	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
52	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
54	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
56	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
58	68.0%	0.0%	0.0%	0.0%	100.0%	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%
60	57.3%	0.0%	100.0%	100.0%	100.0%	76.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	42.7%	0.0%	0.0%	0.0%	0.0%	24.0%
62	38.1%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	61.9%	0.0%	0.0%	0.0%	0.0%	0.0%
64	34.6%	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	65.4%	0.0%	0.0%	0.0%	0.0%	0.0%
66	50.0%	100.0%	100.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%
68	69.8%	100.0%	36.2%	0.0%	66.4%	100.0%	0.0%	0.0%	63.8%	0.0%	33.6%	0.0%	30.2%	0.0%	0.0%	0.0%	0.0%	0.0%
70	62.3%	100.0%	77.9%	0.0%	86.1%	100.0%	3.4%	0.0%	10.8%	0.0%	0.0%	0.0%	34.3%	0.0%	11.3%	0.0%	13.9%	0.0%
72	77.3%	85.9%	96.9%	100.0%	100.0%	100.0%	0.0%	14.1%	0.0%	0.0%	0.0%	0.0%	22.7%	0.0%	3.1%	0.0%	0.0%	0.0%
74	69.2%	93.6%	64.1%	100.0%	100.0%	100.0%	9.1%	6.4%	12.0%	0.0%	0.0%	0.0%	21.7%	0.0%	23.9%	0.0%	0.0%	0.0%
76	43.1%	49.7%	50.0%	100.0%	100.0%	100.0%	0.0%	37.8%	33.1%	0.0%	0.0%	0.0%	56.9%	12.4%	16.9%	0.0%	0.0%	0.0%
78	59.1%	63.3%	100.0%	100.0%	90.2%	87.3%	7.8%	14.6%	0.0%	0.0%	0.0%	0.0%	33.1%	22.2%	0.0%	0.0%	9.8%	12.7%
80	57.6%	100.0%	95.5%	65.8%	88.7%	86.5%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	40.7%	0.0%	4.5%	34.2%	11.3%	13.5%
82	86.4%	54.9%	61.6%	100.0%	87.5%	90.9%	5.6%	9.6%	16.8%	0.0%	0.0%	4.6%	8.0%	35.5%	21.6%	0.0%	12.5%	4.5%
84	59.3%	73.6%	100.0%	100.0%	79.8%	100.0%	6.0%	13.2%	0.0%	0.0%	6.8%	0.0%	34.7%	13.2%	0.0%	0.0%	13.4%	0.0%
86	85.3%	76.6%	87.9%	25.2%	75.0%	87.6%	7.4%	7.6%	0.0%	0.0%	8.4%	6.3%	7.4%	15.8%	12.1%	74.8%	16.6%	6.1%
88	92.4%	79.3%	91.4%	100.0%	75.5%	100.0%	0.0%	6.8%	0.0%	0.0%	8.2%	0.0%	7.6%	13.9%	8.6%	0.0%	16.4%	0.0%
90	70.5%	68.2%	100.0%	0.0%	75.4%	93.8%	0.0%	21.4%	0.0%	0.0%	0.0%	0.0%	29.5%	10.5%	0.0%	0.0%	24.6%	6.2%
92	55.8%	59.0%	100.0%	0.0%	100.0%	100.0%	22.1%	23.5%	0.0%	0.0%	0.0%	0.0%	22.1%	17.4%	0.0%	100.0%	0.0%	0.0%
94	52.1%	100.0%	88.9%	50.0%	79.6%	87.4%	23.9%	0.0%	0.0%	0.0%	0.0%	0.0%	23.9%	0.0%	11.1%	50.0%	20.4%	12.6%
96	45.5%	80.2%	47.1%	0.0%	80.3%	100.0%	13.4%	13.2%	0.0%	0.0%	19.7%	0.0%	41.1%	6.7%	52.9%	100.0%	0.0%	0.0%
98	53.1%	100.0%	0.0%	100.0%	100.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	24.6%	46.9%	0.0%	0.0%	0.0%	0.0%	25.4%
100	77.6%	100.0%	100.0%	100.0%	100.0%	78.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22.4%	0.0%	0.0%	0.0%	0.0%	22.0%
102	100.0%	34.1%	100.0%	100.0%	100.0%	100.0%	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%
104	100.0%	0.0%	100.0%	0.0%	74.6%	79.8%	0.0%	50.0%	0.0%	0.0%	25.4%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	20.2%

Table 53: Table 52 continued for IFQ pot vessels. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

	Pot																	
	Excellent						Poor						Dead					
Length bin (cm)	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
106	0.0%	45.4%	76.4%	0.0%	100.0%	0.0%	0.0%	54.6%	23.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
108	18.4%	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	81.6%	0.0%	0.0%	0.0%	0.0%	0.0%
110	100.0%	100.0%	23.1%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	76.9%	0.0%	0.0%	0.0%
112	100.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
114	57.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	42.6%	100.0%	0.0%	100.0%	0.0%	100.0%
116	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
118	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
120	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
122	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
124	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
126	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
128	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
130	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
132	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
134	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
136	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
138	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
140	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	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%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
144	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
146	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
148	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
150	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	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%	0.0%	0.0%	0.0%	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%	0.0%	0.0%	0.0%	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%	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%	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%	0.0%	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%	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%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
166	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
168	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
170	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
172	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
174	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
176	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
178	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
180	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
182	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
184	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
186	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
188	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
190	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
192	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
194	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
196	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
198	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
200	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
202	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 54: Weighted length frequency distributions for Pacific halibut in the limited entry bottom trawl fishery, 2002-10. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

	Weighted length frequency distribution						
Length bin (cm)	2004	2005	2006	2007	2008	2009	2010
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0125	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
36	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	0.0000	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000
44	0.0025	0.0012	0.0057	0.0000	0.0000	0.0010	0.0000
46	0.0037	0.0000	0.0094	0.0000	0.0000	0.0009	0.0000
48	0.0000	0.0034	0.0046	0.0000	0.0000	0.0000	0.0000
50	0.0027	0.0068	0.0092	0.0000	0.0007	0.0010	0.0000
52	0.0021	0.0069	0.0080	0.0041	0.0001	0.0053	0.0000
54	0.0156	0.0076	0.0164	0.0042	0.0025	0.0004	0.0000
56	0.0138	0.0211	0.0242	0.0071	0.0022	0.0019	0.0000
58	0.0187	0.0331	0.0322	0.0293	0.0027	0.0091	0.0022
60	0.0400	0.0431	0.0670	0.0593	0.0169	0.0175	0.0056
62	0.0329	0.0719	0.0751	0.0638	0.0285	0.0275	0.0121
64	0.0428	0.0783	0.1001	0.0932	0.0614	0.0545	0.0155
66	0.0532	0.0807	0.0979	0.1150	0.0705	0.0606	0.0185
68	0.0757	0.0845	0.0870	0.0000	0.0599	0.0835	0.0256
70	0.0672	0.0851	0.0986	0.1022	0.0871	0.0971	0.0154
72	0.0774	0.0882	0.0478	0.1029	0.0973	0.0972	0.0314
74	0.0998	0.0746	0.0588	0.0840	0.1023	0.0941	0.0383
76	0.0890	0.0538	0.0461	0.0710	0.0743	0.0697	0.0284
78	0.0658	0.0506	0.0423	0.0539	0.0688	0.0744	0.0349
80	0.0586	0.0427	0.0372	0.0460	0.0599	0.0527	0.0298
82	0.0486	0.0320	0.0258	0.0325	0.0443	0.0434	0.0239
84	0.0337	0.0255	0.0186	0.0316	0.0428	0.0335	0.0227
86	0.0221	0.0166	0.0130	0.0000	0.0300	0.0290	0.0141
88	0.0235	0.0115	0.0120	0.0154	0.0263	0.0290	0.0122
90	0.0193	0.0127	0.0115	0.0168	0.0225	0.0263	0.0100
92	0.0157	0.0092	0.0101	0.0122	0.0179	0.0204	0.0094

	Weighted length frequency distribution						
Length bin (cm)	2004	2005	2006	2007	2008	2009	2010
94	0.0169	0.0108	0.0099	0.0148	0.0164	0.0151	0.0053
96	0.0062	0.0052	0.0066	0.0089	0.0143	0.0087	0.0066
98	0.0034	0.0058	0.0066	0.0091	0.0110	0.0103	0.0067
100	0.0089	0.0045	0.0025	0.0053	0.0080	0.0088	0.0023
102	0.0060	0.0034	0.0029	0.0036	0.0061	0.0069	0.0018
104	0.0065	0.0023	0.0027	0.0041	0.0083	0.0062	0.0021
106	0.0043	0.0029	0.0032	0.0031	0.0059	0.0028	0.0013
108	0.0016	0.0014	0.0019	0.0018	0.0027	0.0025	0.0014
110	0.0048	0.0015	0.0004	0.0017	0.0018	0.0021	0.0009
112	0.0015	0.0007	0.0020	0.0010	0.0016	0.0024	0.0013
114	0.0020	0.0010	0.0007	0.0007	0.0020	0.0017	0.0001
116	0.0026	0.0006	0.0002	0.0000	0.0010	0.0005	0.0005
118	0.0007	0.0004	0.0003	0.0002	0.0004	0.0002	0.0002
120	0.0013	0.0005	0.0002	0.0002	0.0005	0.0003	0.0002
122	0.0008	0.0003	0.0000	0.0004	0.0003	0.0003	0.0002
124	0.0010	0.0002	0.0001	0.0000	0.0003	0.0002	0.0003
126	0.0000	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002
128	0.0002	0.0000	0.0002	0.0000	0.0000	0.0002	0.0000
130	0.0003	0.0002	0.0001	0.0002	0.0000	0.0002	0.0000
132	0.0005	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
134	0.0006	0.0000	0.0001	0.0000	0.0001	0.0001	0.0000
136	0.0001	0.0001	0.0002	0.0000	0.0000	0.0001	0.0000
138	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000
140	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
142	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
144	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
146	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
148	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
152	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
154	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
158	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
162	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 55: Percentage of weighted length measurements in each condition category for the limited entry bottom trawl fishery, 2002-10. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

Length	2004			2005			2006		
bin (cm)	Exc	Poor	Dead	Exc	Poor	Dead	Exc	Poor	Dead
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%
26	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	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%
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%
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%
40	0.0%	0.0%	100.0%	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%
44	0.0%	0.0%	100.0%	0.0%	70.8%	29.2%	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%
48	0.0%	0.0%	0.0%	22.4%	0.0%	77.6%	0.0%	0.0%	100.0%
50	0.0%	0.0%	100.0%	61.1%	9.9%	29.0%	0.0%	0.0%	100.0%
52	100.0%	0.0%	0.0%	23.6%	31.3%	45.2%	0.0%	0.0%	100.0%
54	75.5%	11.9%	12.6%	10.0%	20.8%	69.2%	16.9%	0.0%	83.1%
56	12.6%	37.9%	49.5%	25.1%	12.7%	62.2%	22.0%	15.2%	62.8%
58	21.4%	25.6%	53.0%	15.1%	29.5%	55.4%	4.1%	20.2%	75.7%
60	58.6%	14.4%	27.0%	18.2%	21.0%	60.8%	12.9%	25.5%	61.6%
62	40.0%	21.6%	38.4%	18.5%	23.7%	57.8%	27.3%	22.3%	50.4%
64	33.4%	18.4%	48.2%	25.2%	28.4%	46.4%	31.5%	21.0%	47.5%
66	23.9%	24.7%	51.4%	20.9%	26.7%	52.3%	29.6%	17.3%	53.0%
68	38.2%	21.9%	39.9%	17.0%	27.5%	55.5%	35.5%	18.8%	45.7%
70	29.5%	18.9%	51.6%	20.1%	30.3%	49.5%	30.2%	16.6%	53.2%
72	22.9%	17.9%	59.2%	20.3%	27.1%	52.6%	37.2%	21.1%	41.8%
74	23.8%	25.5%	50.7%	24.5%	23.4%	52.1%	39.6%	13.9%	46.5%
76	24.0%	23.2%	52.8%	26.8%	29.1%	44.1%	31.2%	19.2%	49.6%
78	18.8%	18.4%	62.9%	18.1%	23.5%	58.4%	35.0%	21.2%	43.8%
80	19.1%	19.6%	61.3%	23.1%	27.9%	49.0%	34.3%	15.4%	50.2%
82	14.4%	26.1%	59.5%	30.4%	25.1%	44.6%	31.7%	27.8%	40.5%
84	21.7%	9.5%	68.9%	27.0%	18.9%	54.0%	30.1%	13.2%	56.7%
86	32.4%	24.0%	43.6%	35.5%	24.7%	39.8%	31.3%	15.0%	53.7%
88	27.8%	14.8%	57.5%	31.2%	27.8%	41.0%	22.9%	12.4%	64.7%
90	30.2%	34.6%	35.2%	28.0%	16.6%	55.4%	23.8%	18.7%	57.5%
92	40.2%	28.1%	31.7%	42.5%	21.7%	35.9%	43.7%	10.7%	45.6%
94	26.1%	33.3%	40.6%	33.4%	16.3%	50.3%	35.3%	7.1%	57.6%
96	19.9%	30.0%	50.1%	34.6%	19.2%	46.2%	16.5%	13.9%	69.6%
98	33.8%	28.4%	37.8%	32.3%	22.8%	44.9%	16.8%	13.0%	70.2%
100	14.6%	26.9%	58.5%	28.1%	17.4%	54.5%	48.5%	9.6%	41.9%
102	16.0%	49.3%	34.7%	43.1%	6.9%	50.0%	13.7%	0.0%	86.3%
104	19.0%	47.5%	33.5%	36.4%	16.2%	47.4%	49.6%	6.4%	44.0%
106	23.6%	22.6%	53.9%	58.4%	11.9%	29.7%	10.4%	22.8%	66.8%
108	27.6%	3.0%	69.4%	28.6%	22.6%	48.8%	42.2%	15.1%	42.6%
110	25.4%	12.6%	62.0%	22.7%	28.1%	49.2%	32.0%	3.1%	64.9%
112	95.8%	1.2%	3.0%	16.2%	0.0%	83.8%	7.2%	14.1%	78.7%
114	0.0%	26.2%	73.8%	24.4%	4.9%	70.7%	38.9%	0.0%	61.1%
116	58.7%	6.9%	34.4%	69.4%	0.0%	30.6%	77.8%	0.0%	22.2%
118	2.7%	7.5%	89.9%	44.9%	35.0%	20.1%	33.8%	31.5%	34.7%
120	5.7%	26.2%	68.0%	9.5%	28.7%	61.8%	0.0%	0.0%	100.0%
122	40.8%	40.3%	18.9%	1.5%	15.2%	83.4%	50.0%	50.0%	0.0%
124	70.3%	14.8%	14.8%	79.9%	0.0%	20.1%	15.6%	0.0%	84.4%
126	0.0%	100.0%	0.0%	89.0%	11.0%	0.0%	47.1%	0.0%	52.9%
128	82.0%	9.0%	9.0%	18.7%	0.0%	81.3%	89.8%	0.0%	10.2%
130	13.5%	0.0%	86.5%	4.9%	47.6%	47.6%	0.0%	0.0%	100.0%
132	100.0%	0.0%	0.0%	20.2%	63.3%	16.5%	0.0%	100.0%	0.0%
134	80.0%	0.0%	20.0%	100.0%	0.0%	0.0%	22.2%	0.0%	77.8%
136	0.0%	0.0%	100.0%	10.5%	16.1%	73.4%	0.0%	0.0%	100.0%
138	0.0%	0.0%	0.0%	15.2%	0.0%	84.8%	0.0%	0.0%	0.0%
140	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	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%
144	0.0%	100.0%	0.0%	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%
148	0.0%	100.0%	0.0%	0.0%	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%
152	100.0%	0.0%	0.0%	0.0%	100.0%	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%
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%
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%
164	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Length	2007			2008			2009		
bin (cm)	Exc	Poor	Dead	Exc	Poor	Dead	Exc	Poor	Dead
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%
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%
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%
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%
38	0.0%	0.0%	0.0%	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%	0.0%	0.0%	0.0%	0.0%	0.0%
44	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
46	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
48	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
50	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%
52	33.4%	0.0%	66.6%	100.0%	0.0%	0.0%	99.5%	0.5%	0.0%
54	35.6%	0.0%	64.4%	0.0%	4.4%	95.6%	42.3%	57.7%	0.0%
56	33.9%	0.0%	66.1%	0.0%	0.0%	100.0%	15.7%	65.3%	19.0%
58	9.4%	6.8%	83.8%	3.3%	3.3%	93.3%	51.0%	4.4%	44.6%
60	5.3%	7.4%	87.2%	9.0%	14.3%	76.8%	28.7%	21.9%	49.4%
62	20.8%	9.5%	69.7%	6.1%	15.7%	78.2%	19.3%	19.5%	61.2%
64	18.9%	5.3%	75.8%	17.3%	7.5%	75.2%	38.0%	9.4%	52.6%
66	9.1%	12.5%	78.4%	25.8%	8.9%	65.4%	26.7%	19.7%	53.6%
68	54.5%	45.5%	0.0%	17.4%	13.2%	69.4%	30.1%	17.5%	52.4%
70	16.0%	7.6%	76.4%	13.1%	14.0%	73.0%	27.4%	17.5%	55.1%
72	14.8%	9.1%	76.0%	19.1%	13.7%	67.2%	22.9%	18.3%	58.8%
74	17.6%	16.9%	65.5%	24.8%	13.8%	61.3%	27.7%	14.8%	57.5%
76	14.0%	9.9%	76.1%	21.9%	11.5%	66.6%	26.2%	16.6%	57.2%
78	15.5%	13.4%	71.2%	24.7%	10.4%	64.9%	18.5%	12.1%	69.4%
80	14.7%	11.6%	73.6%	21.2%	11.4%	67.4%	20.5%	14.1%	65.3%
82	14.6%	3.0%	82.4%	21.5%	16.1%	62.4%	16.3%	18.5%	65.2%
84	17.9%	7.0%	75.1%	15.9%	22.8%	61.3%	17.0%	12.0%	71.0%
86	56.6%	43.4%	0.0%	17.6%	22.5%	59.8%	18.6%	15.5%	65.9%
88	12.3%	10.5%	77.1%	18.1%	18.8%	63.1%	20.1%	17.2%	62.8%
90	6.3%	3.7%	90.0%	23.9%	17.1%	59.0%	18.6%	13.6%	67.8%
92	20.7%	8.4%	70.9%	20.9%	25.1%	54.0%	25.3%	11.8%	62.9%
94	17.0%	18.4%	64.6%	18.8%	13.3%	67.9%	15.2%	18.4%	66.4%
96	16.7%	3.6%	79.7%	15.4%	21.3%	63.4%	27.6%	19.6%	52.8%
98	10.4%	8.2%	81.4%	28.4%	29.4%	42.3%	20.2%	16.9%	62.9%
100	15.4%	23.2%	61.4%	15.0%	19.4%	65.6%	13.4%	25.5%	61.1%
102	40.3%	9.2%	50.6%	27.6%	28.4%	44.1%	24.8%	23.8%	51.4%
104	16.7%	15.8%	67.5%	36.6%	11.7%	51.7%	28.0%	8.4%	63.7%
106	30.7%	20.1%	49.2%	34.8%	7.7%	57.6%	24.0%	13.5%	62.5%
108	29.0%	2.3%	68.7%	19.4%	14.2%	66.4%	18.2%	27.7%	54.1%
110	11.7%	45.1%	43.2%	40.2%	8.0%	51.9%	29.6%	10.4%	60.0%
112	26.9%	23.3%	49.8%	25.1%	9.2%	65.7%	14.7%	17.4%	67.9%
114	20.1%	0.0%	79.9%	22.4%	22.7%	54.9%	31.2%	7.4%	61.5%
116	0.0%	0.0%	100.0%	41.6%	4.8%	53.6%	79.5%	0.5%	20.0%
118	0.0%	0.0%	100.0%	25.5%	38.6%	35.9%	40.9%	4.4%	54.6%
120	85.1%	0.0%	14.9%	65.5%	34.5%	0.0%	48.0%	0.7%	51.2%
122	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	34.7%	0.0%	65.3%
124	0.0%	0.0%	0.0%	0.0%	70.9%	29.1%	26.1%	37.0%	37.0%
126	49.4%	0.0%	50.6%	0.0%	0.0%	100.0%	59.2%	40.8%	0.0%
128	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.7%	1.0%	43.3%
130	13.8%	0.0%	86.2%	0.0%	0.0%	0.0%	35.0%	65.0%	0.0%
132	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
134	0.0%	0.0%	0.0%	94.7%	0.0%	5.3%	100.0%	0.0%	0.0%
136	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%
138	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
140	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%	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
144	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
146	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	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%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	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%	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%
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%
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%

Table 56: Continuation of Table 55. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm.

Length	2010			Length	2010			Length	2010		
bin (cm)	Exc	Poor	Dead	bin	Exc	Poor	Dead	bin	Exc	Poor	Dead
10	0.0%	100.0%	0.0%	58	100.0%	0.0%	0.0%	106	2.4%	0.0%	97.6%
12	0.0%	0.0%	0.0%	60	33.4%	0.0%	66.6%	108	0.0%	20.1%	79.9%
14	0.0%	0.0%	0.0%	62	15.7%	29.4%	54.9%	110	14.2%	58.8%	27.0%
16	0.0%	0.0%	0.0%	64	30.1%	21.2%	48.7%	112	39.9%	0.0%	60.1%
18	0.0%	0.0%	0.0%	66	17.8%	15.4%	66.8%	114	0.0%	0.0%	100.0%
20	0.0%	0.0%	0.0%	68	15.0%	10.3%	74.8%	116	50.0%	0.0%	50.0%
22	0.0%	0.0%	0.0%	70	22.2%	7.4%	70.4%	118	0.0%	100.0%	0.0%
24	0.0%	0.0%	0.0%	72	23.6%	17.4%	59.0%	120	0.0%	0.0%	100.0%
26	0.0%	0.0%	0.0%	74	13.5%	24.8%	61.7%	122	0.0%	0.0%	100.0%
28	0.0%	0.0%	0.0%	76	20.1%	16.9%	63.0%	124	100.0%	0.0%	0.0%
30	0.0%	0.0%	0.0%	78	17.0%	17.4%	65.7%	126	0.0%	100.0%	0.0%
32	0.0%	0.0%	0.0%	80	10.6%	22.8%	66.6%	128	0.0%	0.0%	0.0%
34	0.0%	0.0%	0.0%	82	18.9%	19.9%	61.2%	130	0.0%	0.0%	0.0%
36	0.0%	0.0%	0.0%	84	21.9%	25.3%	52.8%	132	0.0%	0.0%	0.0%
38	0.0%	0.0%	0.0%	86	14.9%	16.4%	68.7%	134	0.0%	0.0%	0.0%
40	0.0%	0.0%	0.0%	88	24.8%	17.8%	57.4%	136	100.0%	0.0%	0.0%
42	0.0%	0.0%	0.0%	90	25.8%	24.2%	50.1%	138	0.0%	0.0%	0.0%
44	0.0%	0.0%	0.0%	92	5.0%	9.9%	85.1%	140	0.0%	0.0%	0.0%
46	0.0%	0.0%	0.0%	94	26.1%	29.2%	44.7%	142	0.0%	0.0%	0.0%
48	0.0%	0.0%	0.0%	96	17.4%	39.9%	42.7%	144	0.0%	0.0%	0.0%
50	0.0%	0.0%	0.0%	98	14.3%	23.3%	62.4%	146	0.0%	0.0%	0.0%
52	0.0%	0.0%	0.0%	100	2.2%	31.0%	66.8%	148	0.0%	0.0%	0.0%
54	0.0%	0.0%	0.0%	102	21.7%	20.6%	57.8%	150	0.0%	0.0%	0.0%
56	0.0%	0.0%	0.0%	104	18.3%	37.2%	44.6%	152	0.0%	100.0%	0.0%
								154	0.0%	0.0%	0.0%

Table 57: Number of dead P. halibut in each length bin, summed across viability categories, for IFQ bottom trawl vessels by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. Since 2013, IFQ bottom trawl lengths could also include lengths taken on both IFQ and LE California halibut bottom trawl fisheries. This analysis assumes that there is no size-dependent mortality within viability categories.

	Bottom Trawl												
Length (cm)	2011	2012	2013	2014	2015	2016	Length (cm)	2011	2012	2013	2014	2015	2016
10	0	0	0	0	0	0	110	101	57	132	114	134	1
12	0	0	0	0	0	0	112	135	152	5	2	70	44
14	0	0	0	0	0	1	114	112	22	90	110	21	3
16	0	0	0	0	0	0	116	81	96	5	3	100	82
18	1	0	0	0	0	0	118	51	4	64	17	69	22
20	0	0	0	0	0	0	120	1	15	54	92	1	4
22	0	1	0	0	0	0	122	74	1	1	95	36	1
24	0	0	0	0	0	0	124	68	1	85	2	1	1
26	0	0	0	0	0	0	126	46	15	63	32	1	70
28	0	0	0	0	0	0	128	1	1	34	74	23	63
30	0	1	1	0	0	0	130	79	70	1	66	71	1
32	0	2	1	1	0	1	132	17	48	28	59	1	39
34	0	1	0	0	0	0	134	32	41	47	1	1	60
36	0	1	0	0	1	1	136	1	51	2	55	1	52
38	0	3	0	0	2	4	138	44	1	31	0	39	1
40	1	2	2	1	5	2	140	2	0	0	0	58	44
42	1	5	0	0	4	2	142	2	45	0	0	37	0
44	0	1	0	0	3	5	144	3	0	0	44	0	2
46	1	1	3	1	1	1	146	24	13	0	28	17	14
48	3	2	3	4	3	1	148	3	0	0	0	19	8
50	4	5	6	0	7	5	150	0	25	0	0	1	0
52	1	7	1	6	7	9	152	0	1	0	0	0	44
54	8	3	1	1	12	11	154	0	0	0	0	35	3
56	1	9	4	5	1	5	156	0	0	0	0	0	0
58	1	13	14	10	12	1	158	0	0	0	0	0	0
60	8	7	2	39	12	37	160	0	0	0	0	31	0
62	26	1	23	18	4	70	162	0	0	0	0	1	46
64	77	1	69	1	57	1	164	0	0	0	0	26	24
66	44	2	36	6	103	136	166	0	0	0	0	0	0
68	109	1	83	146	151	160	168	0	0	0	0	19	0
70	1	129	1	176	1	131	170	0	0	0	0	31	20
72	2	173	1	185	233	2	172	0	0	0	0	1	34
74	9	240	1	2	232	234	174	0	0	0	0	41	0
76	90	275	239	3	3	8	176	0	0	0	0	0	1
78	262	2	310	211	4	55	178	0	0	0	0	38	1
80	311	104	1	294	3	262	180	0	0	0	0	29	1
82	51	297	86	1	91	3	182	0	0	0	0	41	2
84	259	5	256	306	1	91	184	0	0	0	0	25	0
86	2	274	10	7	232	3	186	0	0	0	0	19	0
88	311	15	255	3	246	221	188	0	0	0	0	0	1
90	174	1	6	7	201	3	190	0	0	0	0	0	0
92	161	86	244	70	212	146	192	0	0	0	0	15	21
94	171	5	264	81	222	164	194	0	0	0	0	0	0
96	199	138	5	5	204	3	196	0	0	0	0	0	0
98	77	185	4	123	4	94	198	0	0	0	0	1	0
100	60	150	31	168	71	4	200	0	0	0	0	0	0
102	6	187	4	58	136	111	202	0	0	0	0	0	0
104	5	170	66	186	155	177	204	0	0	0	0	0	0
106	2	37	129	103	46	122	206	0	0	0	0	0	0
108	5	171	4	5	167	26	208	0	0	0	0	0	0
110	101	57	132	114	134	1	210	0	0	0	0	0	0
							212	0	0	0	0	0	1

Table 58: Number of dead P. halibut in each length bin, summed across viability categories, for IFQ pot vessels by year. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. This analysis assumes that there is no size-dependent mortality within viability categories.

	Pot												
Length (cm)	2011	2012	2013	2014	2015	2016	Length (cm)	2011	2012	2013	2014	2015	2016
40	0	0	0	0	0	0	118	269	220	83	0	0	0
42	0	0	0	0	0	0	120	220	0	0	0	0	0
44	1	0	0	0	0	0	122	83	0	0	0	0	0
46	0	0	0	0	0	0	124	0	0	0	0	0	0
48	0	0	0	0	0	0	126	0	0	0	0	0	0
50	0	0	0	0	0	0	128	1	0	0	0	0	0
52	0	0	0	0	0	0	130	259	0	0	0	0	0
54	1	0	1	0	1	0	132	0	0	0	0	0	0
56	0	0	0	0	0	1	134	234	0	0	0	0	0
58	0	0	0	0	0	0	136	5	0	0	0	0	0
60	0	0	0	2	1	1	138	263	0	0	0	0	0
62	1	0	0	0	1	1	140	0	0	0	0	0	0
64	1	5	0	0	1	1	142	0	0	0	0	0	0
66	1	4	3	0	0	0	144	0	0	0	0	0	0
68	2	4	0	0	1	2	146	0	0	0	0	0	0
70	0	1	1	0	2	1	148	0	0	0	0	0	0
72	3	2	3	0	3	2	150	0	0	0	0	0	0
74	5	6	5	0	6	0	152	0	0	0	0	0	0
76	4	8	8	8	3	0	154	0	0	0	0	0	0
78	3	1	14	11	0	8	156	0	0	0	0	0	0
80	3	4	0	5	6	0	158	0	0	0	0	0	0
82	15	14	11	9	11	0	160	0	0	0	0	0	0
84	6	5	1	49	38	13	162	0	0	0	0	0	0
86	38	28	0	23	13	3	164	0	0	0	0	0	0
88	72	78	0	61	71	0	166	1	0	0	0	0	0
90	57	0	38	0	1	34	168	0	0	0	0	0	0
92	5	104	117	135	107	0	170	0	0	0	0	0	0
94	76	0	68	3	143	0	172	0	0	0	0	0	0
96	178	172	126	155	0	119	174	0	0	0	0	0	0
98	0	75	0	1	176	0	176	0	0	0	0	0	0
100	191	0	200	172	0	174	178	0	0	0	0	0	0
102	69	0	130	1	162	0	180	0	0	0	0	0	0
104	240	1	197	0	51	197	182	0	0	0	0	0	0
106	0	51	227	0	140	0	184	0	0	0	0	0	0
108	227	140	0	0	2	227	186	0	0	0	0	0	0
110	0	204	7	236	0	0	188	0	0	0	0	0	0
112	266	2	0	0	0	6	190	0	0	0	0	0	0
114	191	6	0	191	0	84	192	0	0	0	0	0	0
116	269	0	0	84	0	0	194	0	0	0	0	0	0
118	269	220	83	0	0	0	196	0	0	0	0	0	0
							198	0	0	0	0	0	0

Table 59: Number of dead P. halibut in each length bin for Shoreside Hake vessels 2011-14. Length bins are inclusive of the bin value (lower) and exclude the upper value, e.g., 10 = lengths 10.0 to 11.99 cm. This analysis assumes 100% mortality of all individuals because viability has not been determined for P. halibut caught with midwater trawl nets. Starting in 2015, Shoreside Hake trips were sorted into Midwater Hake or Midwater Rockfish depending on landing amount of P. hake.

	Shoreside Hake								
Length (cm)	2011	2012	2013	2014	Length (cm)	2011	2012	2013	2014
68	0	0	0	0	99	0	0	0	0
69	0	0	0	0	100	0	0	0	1
70	0	0	0	0	101	0	0	0	0
71	0	0	0	0	102	0	0	0	0
72	0	0	1	0	103	0	0	0	0
73	0	0	0	0	104	0	0	1	4
74	0	0	0	1	105	0	0	0	0
75	0	0	0	0	106	0	0	0	2
76	0	0	0	0	107	0	0	0	0
77	0	0	0	0	108	0	0	0	0
78	0	0	0	0	109	0	0	0	0
79	0	0	0	0	110	0	0	0	2
80	1	0	0	2	111	0	0	0	0
81	0	0	0	0	112	0	0	0	0
82	0	0	0	0	113	0	0	0	0
83	0	0	0	0	114	0	0	0	0
84	0	0	0	0	115	0	0	0	0
85	0	0	0	0	116	0	0	0	0
86	1	0	0	0	117	0	0	0	0
87	0	0	0	0	118	0	0	0	0
88	0	0	0	0	119	0	0	0	0
89	0	0	0	0	120	0	0	0	0
90	0	0	0	0	121	0	0	0	0
91	0	0	0	0	122	0	0	0	0
92	0	0	0	0	123	0	0	0	0
93	0	0	0	0	124	0	0	0	0
94	0	0	0	2	125	0	0	0	0
95	0	0	0	0	126	0	0	0	0
96	0	0	0	0	127	0	0	0	0
97	0	0	0	0	128	0	0	0	2
98	1	0	0	0	129	0	0	0	0
99	0	0	0	0	130	0	0	0	0
					131	0	0	0	0

10.2 Appendix B: Pacific Halibut IBQ Expansions for In-Season Management, Special Cases

10.2.1 In season reporting to the Vessel Account System

The Vessel Account System (VAS) is a NOAA, West Coast Region database that allows fishers to manage their IFQ quota pounds. On a weekly basis, the WCGOP provides trip-level estimates of discarded P. halibut IBQ to the Pacific States Marine Fisheries Commission (PSMFC). The PSMFC then uploads the data to the VAS. Occasionally, special circumstances required alternative calculations of P. halibut IBQ. Alternative calculations of P. halibut IBQ were identified by observer program staff and incorporated into the VAS. Scenarios triggering an alternative calculation and the equations used for those calculations are given in Table 61 below.

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

10.2.2 In season IBQ Weight Calculations for Bottom Trawl Gear

The sampled P. halibut lengths are converted to weight using the IPHC length-weight conversion table (Table 9 in Appendix C 10.3). The total weight of P. halibut in the haul is calculated as:

$$W = \frac{w}{n} \times N \tag{10}$$

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:

$$W_{IBQ} = \sum_c \left(\frac{w_c}{\sum_c w_c} \times W \times m_c \right) \tag{11}$$

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 5)

10.2.3 In season IBQ Weight Calculations for Pot Gear

The sampled P. halibut lengths are converted to weight using the IPHC length-weight conversion table (Table 9 in Appendix C 10.3). 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:

$$W = \left(\frac{w}{n} \times N \right) \times \left(\frac{P}{p} \right) \tag{12}$$

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 haul is then calculated as:

$$W_{IBQ} = \sum_c \left(\frac{w_c}{\sum_c w_c} \times W \times m_c \right) \tag{13}$$

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 6)

10.2.4 In season 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 (Table 9 in Appendix C 10.3). 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:

$$W_{IBQ} = \left(\frac{H}{h} \times w \right) \times 0.16 \tag{14}$$

where, for each set:

W_{IBQ} = IBQ weight (mortality rate applied) of P. halibut

w= sampled weight of P. halibut
H= total number or hooks fished
h= sampled number of hooks
0.16 = IPHC mortality rate applied to hook-&-line gear

10.2.5 In season IBQ Weight Alternative Calculation Scenarios

The most prevalent causes for alternative IBQ calculations were due to 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 calculate IBQ weight, the observer program data management team consulted with the IPHC. For bottom trawl and pot gear, the IPHC preferred the use of manually 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 tow duration of the unsampled haul.

$$W_{IBQ} = \left(\frac{\sum_t w_{IBQ}}{\sum_t d} \right) \times D \tag{15}$$

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 prom 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.

$$W_{IBQ} = \left(\frac{\sum_t w}{\sum_t d} \right) \times D \times 0.90 \tag{16}$$

where, for each tow with lost gear:
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 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.

$$W_{IBQ} = \left(\frac{\sum_t w_{IBQ}}{\sum_t g} \right) \times G \tag{17}$$

where, for each set:

t = tow
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.

$$W_{IBQ} = \left(\frac{\sum_t w_{IBQ}}{\sum_t g} \right) \times G \times 1.0 \tag{18}$$

where, for each set with lost gear:

t = tow
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

Table 60: The number of vessels and trips that required alternative expansions of P. halibut IBQ weight in the 2013 U.S. West Coast groundfish IFQ fishery. All values are counts unless otherwise stated. *Note that "Total" represents vessels or trips with at least one instance of an alternative expansion. Multiple instances within a vessel or trip are ignored. Counts reported here might differ from previous reports due to data editing to ensure the documentation of lost and unsampled consistent across all years.

				Lost Gear				
Unit	**Year**	**P. halibut Scenarios**	**Unsampled trawl tows**	**Trawl**	**Fixed**	**Total***	**IFQ Total**	**% of Total**
Vessels	2011	13	7	8	16	30	113	22.6[‡]
	2012	9	8	5	22	31	109	28.4
	2013[2]	8	7	6	9	20	108	18.5
	2014	6	2	3	12	14	107	13.1
	2015	8	8	2	7	16	77	20.8
	2016	1	9	4	11	21	65	32.3
Trips	2011	19	8	9	35	52	2492	2.1
	2012	10	13	5	63[1]	78	2220	3.5
	2013[2]	16	16	6	22	44	2382	1.9
	2014	7	2	3	38	41	2267	1.8
	2015	9	13	2	20	35	1161	3.0
	2016	1	15	4	25	44	1002	4.4

[‡]Percentage of vessels with manually calculated discard may be included in one or more categories.
[1]Partial gear loss for fixed gear trips was not reported in 2012.
[2]Manual calculations due to unsampled or lost gear were performed in 2013. All discard for these events were reported via the automated load process.

Scenario 1: *Total count of P. halibut exists with no length or viability data.*
Resolution: Determine an average mortality weight per individual P. halibut in the trip from all sampled hauls. Multiply that average by the total count of P. halibut to determine an IBQ.

Scenario 2: *Total count of P. halibut exists with actual lengths and no viability data.*
Resolution: Determine catch weight for P. halibut 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 P. halibut exists with visual estimates of P. halibut 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 P. halibut in the trip from all sampled hauls. Multiply that average by the total count of P. halibut to determine an IBQ.

Scenario 4: *Total count of P. halibut exists with visual estimates of P. halibut 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 P. halibut in the trip from all sampled hauls. Multiply that average by the total count of P. halibut to determine an IBQ.

Scenario 5: *P. halibut not sampled or only visual estimates of length are available.*
Resolution: Confirm P. halibut 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, to date, has never occurred.

Scenario 6: *Total count of P. halibut does not exist with length and no viability data.*
Resolution: Catch weight of the haul will be determined by taking the measured P. halibut sample, converted to weight, divided by the number of fish sampled, multiplied by the average number of P. halibut for all sampled hauls in the trip. Then the average mortality rates from the sampled hauls are applied to the calculated P. halibut weight and, to date, has never occurred.

Scenario 7: *Total count of P. halibut does not exist with length and viability data.*
Resolution: P. halibut catch weight for the haul will be determined by taking the length of the P. halibut sample, converted to weight, divided by the number of fish sampled, multiplied by the average number of P. halibut for all sampled hauls in the trip. Because viabilities and lengths exist, IBQ can be determined using normal protocols and the calculated catch weight and, to date, has never occurred.

Scenario 8: *Total count of P. halibut does not exist with visual length and viability data.*
Resolution: Determine an average IBQ per haul for all sampled hauls in the trip and apply to the unsampled haul(s).

Scenario 9: *Observer encounters predated fish that are dead and badly damaged so that accurate biological data cannot be collected.*
Resolution: If properly sampled P. halibut 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 P. halibut 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 P. halibut catch weight attributed to the predated fish multiplied by the mortality rate for "dead" from the IPHC viability tables for that gear.

If all P. halibut 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 P. halibut in the haul times an average catch weight (not IBQ estimates) per P. halibut from other hauls in the trip (or like "sets" if P. halibut 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 two instances where a P. halibut IBQ was manually calculated due to sand flea predation.

Table 61: Calculations used by the Vessel Account System (VAS) to determine Pacific halibut IBQ weight for unsampled or partially sampled fishing events in the U.S. West Coast groundfish IFQ fishery. The calculated values, $\hat{w}_{IBQ_{u,p}}$, are added to the sampled P. halibut to obtain total IBQ weight. Note that these calculations differ slightly from the methods used in this report.

Scenario(s)	**Calculation**
1,3,4	$\hat{w}_{IBQ_u} = \left(\frac{\sum_{h,v}(l_{h,v} \times r_v)}{\sum_h c_h}\right) \times c_u$
2	$\hat{w}_{IBQ_u} = \left(\frac{\sum_{h,v} l_{h,v}}{\sum_h l_h} \times r_v\right) \times \left(\frac{\sum_f l_f}{\sum_f c_f}\right)$
6,7	$\hat{w}_{IBQ_u} = \left[\left(\frac{\sum_f l_f}{\sum_f c_f} \times r_v\right) \times \frac{\sum_h c_h}{h}\right] \times \left(\frac{\sum_{h,v} l_{h,v}}{\sum_h l_h}\right)$
5,8	$\hat{w}_{IBQ_u} = \frac{\sum_h w_{IBQ_h}}{\sum_h t_h} \times \sum_u t_u$
9	$\hat{w}_{IBQ_p} = \frac{\sum_h l_h}{\sum_h c_h} \times c_p$

where:
c = count of P. halibut
w = weight of P. halibut
l = length of P. halibut, converted to weight via IPHC length-weight table
v = viability of P. halibut, Excellent, Poor, or Dead
r = mortality rate applied for a given viability and gear combination, see Tables 5 & 6
h = sampled hauls
u = unsampled hauls
f = individual sampled P. halibut
t = tow time
p = predated fish

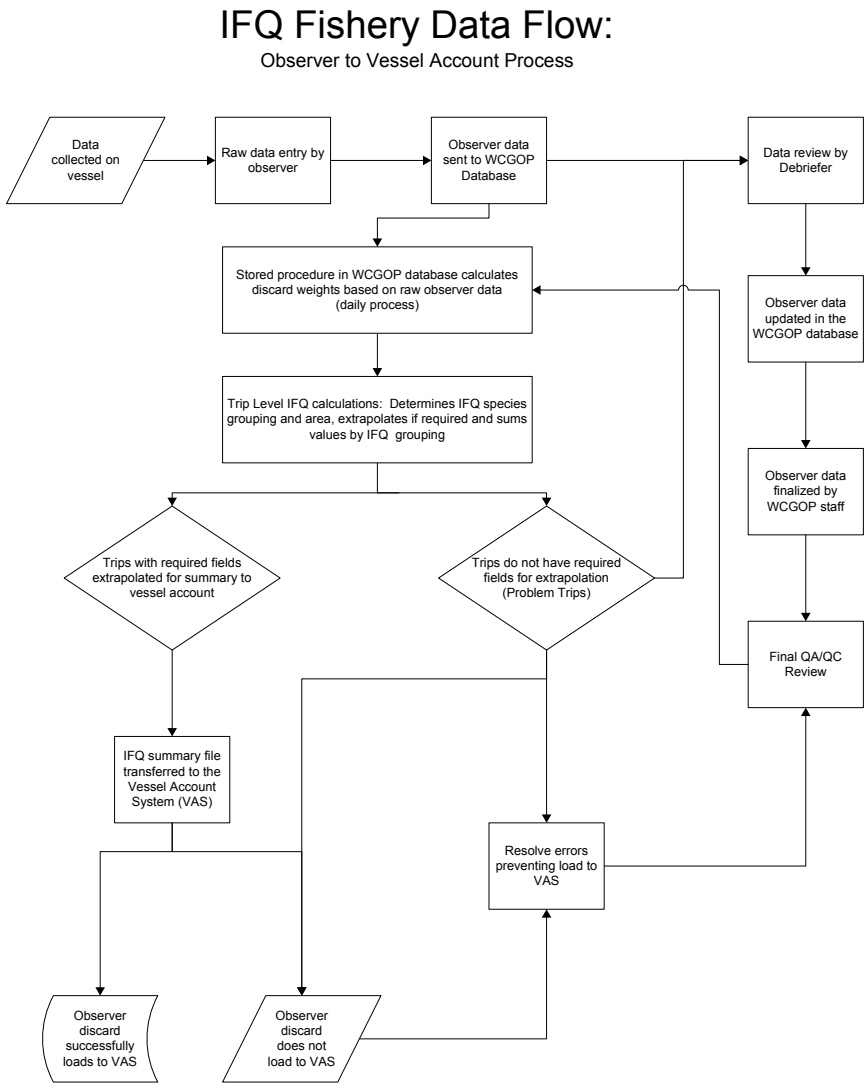
10.3 Appendix C: IPHC Length-Weight Table

Figure 9: 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									

10.4 Appendix D: Data flow

Figure 10: IFQ groundfish fishery data flow from the Northwest Fisheries Science Center Observer Program to the Vessel Account System (VAS) of the NMFS Western Regional Office.



10.5 Appendix E: IFQ Electronic Monitoring DMR comparison

In 2017, PFMC staff and the NOAA Western Regional Office requested a comparison of discard mortality rates (DMR) for bottom trawl and pot vessels in the IFQ program that carry electronic monitoring (EM) equipment versus those that carry observers on 100% of the fishing trips. When notified, EM vessels are required to carry observers for scientific observation, including collection of Pacific halibut viabilities. The WCGOP aims to observe approximately 30% of EM fishing trips. DMRs for EM vessels were calculated using data from these observers on EM vessels. EM observer data was stratified to match, as closely as possible, the current stratification used in the IFQ fishery while meeting confidentiality requirements. Confidentiality of EM data required combining strata across years, depths and areas for both the EM and non-EM IFQ vessels for comparison purposes. Otherwise, methods are identical those described in Section 3.2.1.

These data are for informational purposes only. Due to low sample sizes the NWFSC Observer Program cautions against using these estimates for management purposes. Data from EM vessels were obtained in 2015 and 2016 on pot vessels, but only in 2016 on bottom trawl EM vessels. The corresponding non-EM data (i.e., 2015, 2016 pot; 2016 only bottom trawl) were used to allow direct comparison between vessels with and without EM. Confidentiality in the EM fleet precluded the use of the full stratification currently used in the Catch Shares fishery (see Table 14).

Table 62: Number of vessels, trips and hauls, by year, gear type, and area, that carried both EM and observers and viabilities were collected on P. halibut.

Year	Sector	Gear	Area	no.Vessels	no.Trips	no.Hauls
2016	Catch Shares EM	Bottom Trawl	South of Pt. Chehalis	5	12	27
2015-16	Catch Shares EM	Pot	Coastwide	3	6	10

Table 63: Number and weight of P. halibut in each viability category, estimated total at-sea discard weight by viability category, mortality rates applied to viability categories and total discard mortality rate (DMR), for pot and bottom trawl vessels in the Catch Shares fisheries. E-Monitoring vessels carried electronic monitoring equipment. Viabilities on both EM and non-EM vessels were obtained by at-sea human observers.

	Observed							**Gross (mt)**			**Mortality (mt)**			
	Exc (mt)	**Exc (no)**	**Poor (mt)**	**Poor (no)**	**Dead (mt)**	**Dead (no)**	**total at-sea discard, gross (mt)**	**Exc**	**Poor**	**Dead**	**Exc**	**Poor**	**Dead**	**DMR**
Bottom Trawl														
S. of Pt. Chehalis E-Monitoring	0.2	16	0.1	14	0.5	50	3.10	0.7	0.6	1.8	0.1	0.3	1.7	0.68
N. of Pt. Chehalis non-EM	7.6	1079	2.4	387	4.8	719	45.65	23.3	7.5	14.8	4.7	4.1	13.3	0.48
S. of Pt. Chehalis non-EM	14.6	1850	4.9	656	16.7	2261	79.19	32.0	10.7	36.6	6.4	5.9	32.9	0.57
Pot														
Coastwide E-Monitoring	0.1	14	0.0	1	0.1	10	0.96	0.6	0.0	0.3	0.0	0.0	0.3	0.39
Coastwide non-EM	2.4	340	0.1	10	0.3	30	3.01	2.6	0.1	0.3	0.0	0.1	0.3	0.13

10.6 Appendix F: Test for Validity of Discard Ratio

In 2016, IPHC asked the WCGOP to test the validity of the use of discard ratios for the nearshore, pink shrimp, and California halibut fisheries. These fisheries catch very small amounts of P. halibut and therefore a discard ratio might be an overly complex model for these fisheries. A significant linear relationship between the numerator (amount of observed P. halibut discards) and the denominator (amount of observed retained target species) would indicate that Pacific halibut discards are correlated with retained catch, the WCGOP measure of effort in these sectors. Such a correlation would provide support for using a discard ratio estimator in these sectors. We present the results of a linear regression of the numerator (y) as a function of the denominator (x) for each of these fisheries.

In all three sectors, sample sizes were quite small and thus, either sub-sectors or states had to be combined. In all sectors, the numerator and denominator were not significantly correlated, suggesting the mean Pacific halibut discard weight per trip might be a reasonable and simpler estimate for total P. halibut discard in these sectors. However, small sample sizes preclude a clear understanding of the best estimator in these sectors. Because of time constraints, the WCGOP was unable to examine alternative discard estimates (e.g., mean discards per trip) in this report and thus, consistent with past reports, estimates reported above (Tables 38, 39, & 40) were obtained using discard ratios. The WCGOP might revisit this analysis in future versions of this report.

Figure 11: The numerator of the discard ratio, observed P. halibut discard (log transformed lbs), as a function of the denominator of the discard ratio, observed retained weight of nearshore species (log transformed, lbs) in the Nearshore fishery. Small sample sizes required combining data from both Oregon and California for this analysis.

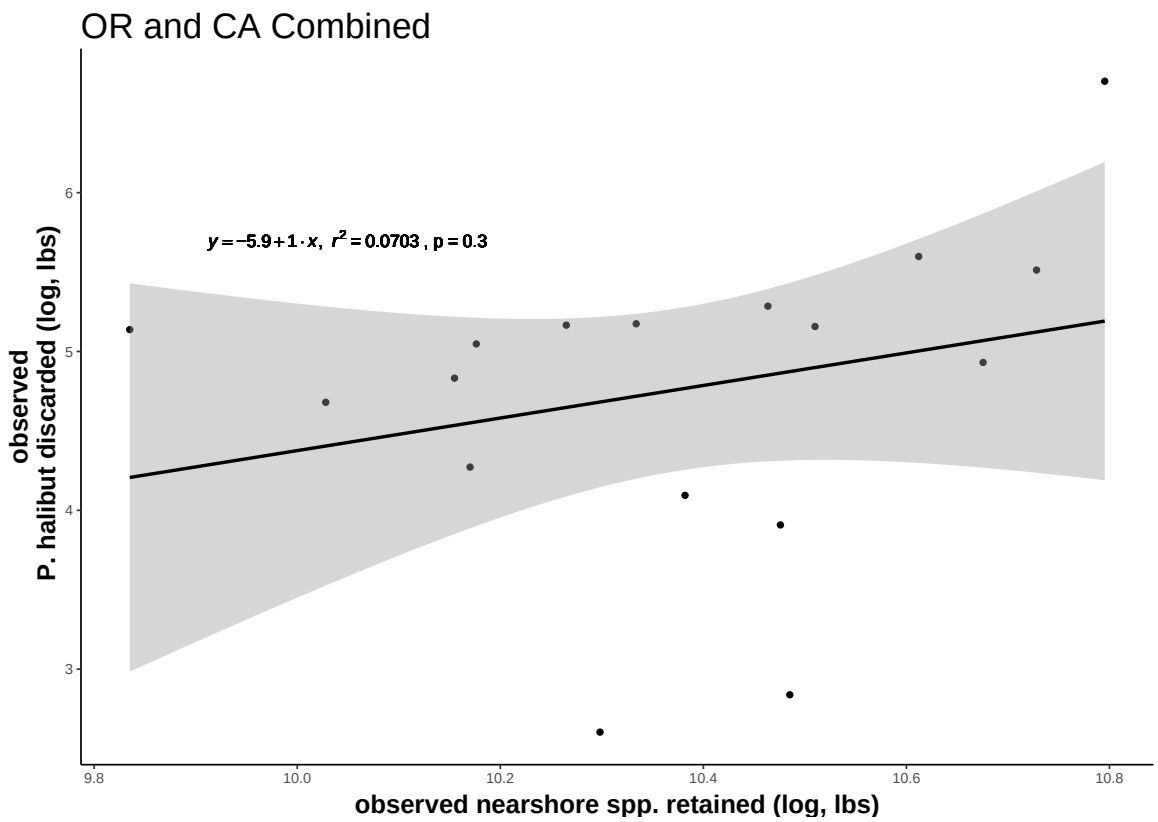


Figure 12: The numerator of the discard ratio, observed P. halibut discard (log transformed lbs), as a function of the denominator of the discard ratio, observed retained weight of pink shrimp (log transformed, lbs) in the pink shrimp fishery. Small sample sizes required combining data from Washington, Oregon, and California for this analysis.

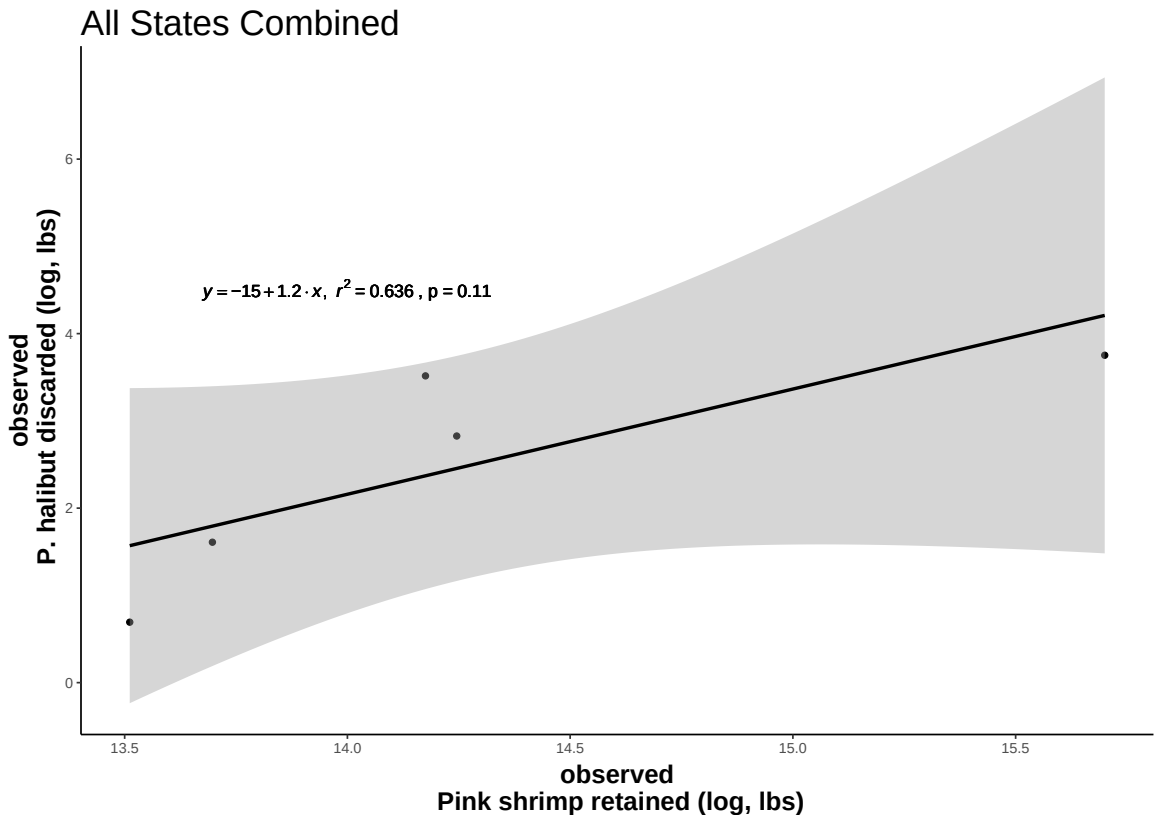
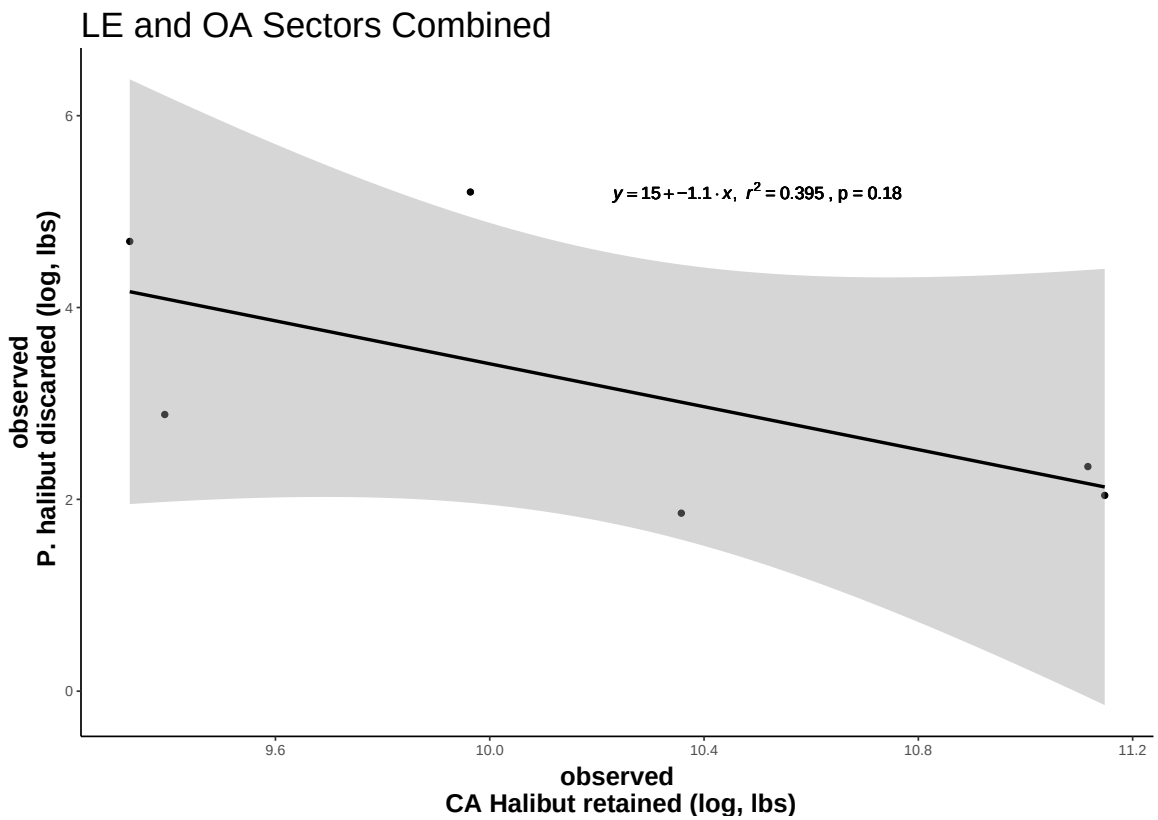


Figure 13: The numerator of the discard ratio, observed P. halibut discard (log transformed lbs), as a function of the denominator of the discard ratio, observed retained weight of California halibut (log transformed, lbs) in the California halibut fishery. Small sample sizes required combining the Limited Entry and Open Access sectors for this analysis.



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