

Incidental catch and mortality of Pacific halibut, 1962-2011

Gregg H. Williams

Abstract

Estimates of the bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) in 2011 totaled 9.99 million pounds (net weight), a decrease of 6% from 2010 and the lowest seen since 1986. The reduction is due to lower bycatch in Areas 2A and 4. In Area 2A, bycatch mortality was reduced 60% as a result of the implementation of an individual quota program for the trawl fishery. In addition, the trawl and hook-&-line fisheries for groundfish, operating in Area 4, killed 15% and 25% less halibut, respectively than in 2010. In contrast, bycatch mortality in Areas 3A and 3B increased 11% due to higher bycatch in the trawl fisheries. Observer coverage in the Gulf of Alaska groundfish fisheries remained at lower than necessary levels, continuing to raise questions about the accuracy of the estimates for that area.

Introduction

Fisheries targeting on other fish and shellfish inadvertently catch Pacific halibut (*Hippoglossus stenolepis*). Information collected by at-sea observers has indicated the incidental catch, or bycatch, is substantial. U.S. and Canadian domestic regulations require that halibut be returned to the sea with no additional injury. However, some fish die from being caught and handled. This document provides an overview of the estimated halibut bycatch mortality in 2011 by International Pacific Halibut Commission (IPHC) regulatory area.

Sources of bycatch information

IPHC relies upon information supplied by observer programs run by domestic agencies for bycatch estimates in most fisheries. Research survey information is used to generate estimates of bycatch in the few cases where fishery observations are unavailable. The U.S. National Marine Fisheries Service (NMFS) operates observer programs which monitor some of the groundfish fisheries off Alaska and the U.S. west coast, and provides IPHC with estimates of bycatch. Trawl fisheries off British Columbia are comprehensively monitored and bycatch information is provided by Fisheries and Oceans Canada (DFO).

Estimates of bycatch off Alaska for 2011 were based on bycatch reported from fishing conducted through late October and projections by IPHC staff for the remainder of the year. Observer coverage, the basis of these bycatch mortality estimates, varies by fishery and area. Coverage is based on vessel length and fishing days by calendar quarter and can range from 100% of a vessel's fishing days in many Bering Sea/Aleutian Islands (BSAI) fisheries, to as low as 0% for some Gulf of Alaska (GOA) fisheries. Therefore, estimates presented here for these GOA fisheries can be considered to be only minimum estimates of halibut mortality.

Estimates of bycatch mortality in crab pot and shrimp trawl fisheries off Alaska have been determined by IPHC staff from previous studies of these fisheries and are based on bycatch rates observed on research surveys because there are no direct fishery observations.

The amount of information varies for fisheries conducted off British Columbia. For the trawl fishery, bycatch is managed with an individual bycatch quota program implemented by DFO in 1996. Fishery observers sample the catch on each bottom trawler, collecting data to estimate bycatch and discard mortality. Bycatch in other fisheries, such as the shrimp trawl, sablefish pot, and rockfish hook-&-line fisheries, has been largely unknown until the inception of the Integrated Groundfish Management Program in 2006. The program has provisions for full accounting and accountability of all bycatch, and includes 100% at-sea monitoring, either by human observers or electronic monitoring (McElderry et al. 2003).

In 2011, an individual quota (IQ) program was implemented for the domestic groundfish trawl fisheries operating in Area 2A. The program is quite similar to the B.C. trawl program, in that it contains an individual bycatch quota component for managing and reducing halibut bycatch mortality. Fishery monitoring is required at 100% coverage levels, so all vessels carry an observer to record the vessel's catch. Shrimp trawl fishery bycatch estimates are provided by Oregon Department of Fish and Wildlife (ODFW) staff from examinations of halibut bycatch during gear experiments. Updated estimates were provided by ODFW in 2011.

Discard mortality rates and assumptions

Discard mortality rates (DMRs), used to determine the fraction of the estimated bycatch that dies, vary by fishery and area. Where observers are used for fishery monitoring, DMRs are calculated from data collected on the release viability or injury of halibut. For areas without observers, assumed DMRs are used, which are based on the similarity of fisheries to those in other areas where data are available. The mortality models used to calculate these rates have been presented by Clark et al. (1992) and Williams (1997).

Observer data are used to calculate DMRs in fisheries in three major areas. NMFS manages the groundfish fisheries off Alaska according to a schedule of DMRs recommended by IPHC (Table 1). In Areas 2A and 2B, observers deployed on the bottom trawl vessels examine each halibut to determine release viability. The bycatch mortality reported to IPHC incorporates these release mortality observations.

Data to determine DMRs for other fisheries are not available. Therefore, assumptions are made on likely DMRs based on similar fisheries with known DMRs. For the sablefish hook-&-line fishery off the US west coast, NMFS uses a DMR of 16%, based on an analysis of the observer data from the sablefish fishery off Alaska prior to the implementation of individual fishing quotas (IFQ) in 1995. Bycatch mortality in the catcher/processor midwater fishery for whiting is based on a 75% DMR.

Bycatch mortality by regulatory area

Halibut bycatch mortality was relatively low until the 1960s, when it increased rapidly due to the sudden development of the foreign trawl fisheries off the North American coast. Total bycatch mortality (excluding the Japanese directed fishery in the eastern and western Bering Sea) peaked in 1965 at about 21 million pounds (Fig. 1). Bycatch mortality declined during the late 1960s, but increased to about 20 million pounds in the early 1970s. During the late 1970s and early 1980s, it dropped to roughly 13 million pounds, as foreign fishing off Alaska came under increasing control and restrictions. By 1985, bycatch mortality had declined to 7.2 million pounds, the lowest level since the IPHC began its monitoring nearly 25 years earlier. Bycatch mortality

increased in the late 1980s due to the growth of the U.S. groundfish fishery off Alaska, which had few bycatch restrictions, peaking at 20.3 million pounds in 1992. Estimated bycatch mortality has since declined. Preliminary estimates for 2011 total 9.99 million pounds, representing a 6% decrease from 2010 and a 51% decrease from the peak in 1992 of 20.3 million pounds. Estimated bycatch mortality ranged between 12-14 million pounds from the mid-90s to 2007 and has been below 12 million pounds since 2008.

Estimates of bycatch mortality by fishery and major IPHC regulatory area for 2002 through 2011 are shown in Table 2 and discussed in the following sections. Tables 3 through 5 provide bycatch mortality estimates by various area groupings. Tables 6 and 7 provide estimates of bycatch mortality in the Alaskan groundfish fisheries operating in federal waters.

Area 2A – U.S. West Coast

In previous reports, estimates of bycatch in the current year have not been presented due to a lag in data processing and subsequent analysis. However, in 2011, NMFS provided estimates for 2010 (Jannot et al. 2011), and the inseason monitoring required of the trawl IQ program provided 2011 estimates. Thus, bycatch reporting for Area 2A is now on the same time frame as the rest of the coast.

Bycatch mortality in Area 2A was estimated at 0.14 million pounds, which is the lowest amount since bycatch estimation began for this area in 1998 and a 60% decrease from 0.35 million pounds in 2010 (Table 2). This drop was entirely due to the reductions achieved by the implementation of the IQ program for the bottom trawl fishery. In 2002, bycatch mortality in the bottom trawl fishery was estimated at 0.57 million pounds; in 2011, the estimate was 0.09 million pounds. The Pacific Fishery Management Council (PFMC) set the 2011 total halibut IQ mortality limit at 279,574 pounds for the groundfish trawl fishery, with 257,524 pounds designated for trawl fisheries north of 40°10' N. and 22,050 pounds for fisheries south of that latitude. That overall amount was roughly half of what had been taken in the past few years. With 2011 being the first year of the program, many operators apparently fished cautiously, as only roughly 60,000 pounds of halibut bycatch mortality were reported by NMFS to have been taken through October. Consultations with NMFS staff about expected fishing during the remainder of 2011 and additional data feeds into the tracking system led IPHC staff to project an annual estimate of 0.09 million pounds for the IQ trawl fishery. As the fishery continues to adapt to IQ management and seasonal patterns emerge, it is expected that more precise year-end projections will be possible.

For the 2011 fixed gear sablefish fishery, there was no halibut retention allowance. The fishery is subject to observer monitoring. A total of 50,000 pounds of bycatch mortality was estimated for the 2011 hook-&-line fishery. Mortality in the pot fishery for sablefish was quite small, based on a DMR based on sablefish pot fisheries in Alaska.

Finally, since 2001 IPHC had been attributing 25,000 pounds of mortality to the west coast shrimp trawl fishery, based on recommendations by ODFW. In 2010, ODFW staff advised IPHC that fish excluders have been required in shrimp trawls since 2003 (R. Hannah, ODFW, 2040 S.E. Marine Science Drive, Newport OR, 97365, personal communication). An excluder directs fish out of the net, so fish bycatch is practically nonexistent. Consequently, the estimate of bycatch in shrimp trawls since 2003 has been revised from 25,000 pounds to zero.

Area 2B – British Columbia

Bycatch mortality in the B.C. bottom trawl fishery was estimated at 0.3 million pounds, the highest seen since 2007 and higher than the average of 0.25 million pounds for 2002-2011 (Fig. 2). Bycatch continued to be greatest during summer months (Fig. 3). The proportion taken in January-March has been lower in recent years. Typically, less than 10% is taken during the final three months of the year.

Estimates were provided by DFO staff at the Pacific Biological Station in Nanaimo, B.C., based on data collected by observers (K. Rutherford, DFO/PBS, 3190 Hammond Bay Road, Nanaimo, B.C. V9T 6N7, personal communication). Monthly estimates of mortality were supplied for 2010 and 2011, with the 2011 data complete through August. Projections for the full calendar year 2011 were made by extrapolating to the full 12 months based on the proportion of bycatch taken through the same time period during 2006-2010.

Area 2C – Southeast Alaska

In Area 2C, halibut bycatch is at relatively low levels compared to other areas, with estimates totaling 0.3 million pounds annually. Bycatch in fisheries in state waters include pot fishing for brown king crab (*Lithodes aequispina*), which occurs in the deep waters of Chatham Strait and similar areas during the late winter months, and beam trawling for shrimp and flounders in the inside waters. Hook-&-line fisheries for sablefish also occur in state waters; halibut bycatch for these fisheries was estimated from preseason surveys where halibut bycatch was tabulated. Bycatch in these fisheries have not been reviewed since the early 1990s, but they are small scale in nature. In offshore areas, NMFS reports some small amounts of bycatch by hook-&-line vessels targeting Pacific cod (*Gadus macrocephalus*). IPHC also attributes a minor amount of bycatch to vessels fishing in the federal sablefish IFQ fishery.

In general, observer coverage is quite poor in this area because most vessels are either operating in state waters with no observer coverage requirements, or fall below the 60 ft length overall (LOA) minimum size threshold for coverage in federal waters. Therefore, bycatch is not well estimated in this area.

Area 3 – Eastern, Central, and Western Gulf of Alaska

Estimated bycatch mortality in Area 3 increased 11% from 2010 levels, due mostly to an increase in trawl fishery bycatch mortality (Table 2). Total mortality in Area 3 was estimated at 4.1 million pounds, on par with estimates for 2007 and 2009, and reversing a decline which began in 2008 (Fig. 4). The total remains below the 10-year average of 4.3 million pounds, reflecting the somewhat lower levels of bycatch seen in recent years relative to 2002-2003, when bycatch was roughly 4.9 million pounds annually.

Trawl fishery bycatch was 75% of the total bycatch in the area (Fig. 5), estimated at 3.2 million pounds. Area 3A accounted for 2.4 million pounds of this with the remainder (0.8 million pounds) from Area 3B. Target fisheries for arrowtooth flounder (*Atheresthes stomias*) and shallow water flatfish (primarily rock sole (*Lepidopsetta* spp.) and yellowfin sole (*Limanda aspera*), accounted for over half of the trawl bycatch in Area 3 (Fig. 6). The portion taken in targeted arrowtooth fishing has been growing since 2007, jumping to 43% (Fig. 7). Roughly 75% of this mortality was taken in Area 3A. Area 3 remains the area where bycatch mortality is estimated most poorly. Limited observer coverage for most fisheries, with vessel control of observer days, and the absence of coverage for others renders the estimates provided here unreliable.

Bycatch mortality in hook-&-line fisheries occurs in target fisheries for Pacific cod (*Gadus macrocephalus*). Since 2006, slightly more than half of the annual bycatch mortality from this fishery has usually been taken in Area 3B. The cod fishery occurs in January-March, when halibut tend to be in deeper water for spawning and cod are schooling in shallow water. This keeps bycatch lower than would otherwise occur. However, many of the boats fishing cod are < 60 ft LOA and are not observed, so the reliability of these estimates is poor.

The Rockfish Pilot Program (RPP), a trawl fishery pilot program operating since 2007 in the central Gulf of Alaska (Area 3A), permits harvesters to form voluntary cooperatives (“coop”) and receive exclusive harvest privileges for certain rockfish species. Coop participants are assigned rockfish quota shares based on their catch history which are then aggregated to the coop and fished collectively by its members. Two coops have been formed, one composed of catcher/processors and one of catcher vessels. The coops operate with limits to their halibut bycatch mortality and have a 100% observer requirement. The limits are a portion of the overall trawl bycatch mortality limits for the Gulf of Alaska and were set at 208 t (0.34 million pounds) for all coop fishing in 2011. Through December 10, only 73 t (0.12 million pounds, or 35%) had been taken, while 88% of the coop’s groundfish allocation had been harvested.

Area 4 – Bering Sea and Aleutian Islands

Bycatch mortality in Area 4 was estimated at 5.1 million pounds, a drop of nearly 16% from 2010 (Table 2). Since 2002, bycatch mortality in this area has been as high as 7.7 million pounds, and this is the first year it has dropped below 6 million pounds. This estimate was significantly below the 2002-2011 mean level of 6.7 million pounds. This drop was attributed to lower bycatch in both the trawl and hook-&-line fisheries.

Within the trawl fishery, over half of the bycatch mortality is taken by flatfish fisheries; specifically those targeting rock sole and yellowfin sole (Fig. 8). These fisheries accounted for a combined 57% of the trawl fishery bycatch. As recent as 2006, the cod fishery was the major source of halibut bycatch. However, bycatch in the cod trawl fishery declined to just 11% of the total trawl sector mortality, even less than that taken by the pollock fisheries.

Hook-&-line fishery bycatch was 0.8 million pounds, representing a 25% decrease from 2010. The amount estimated was slightly under the 10-year average. Pacific cod is the major bycatch fishery, which is conducted in the late winter/early spring and late summer. Almost all of the vessels are required to have 100% observer coverage because of the vessel size; very few small vessels fish cod in this area.

Pots are also used to fish for cod and sablefish (*Anoplopoma fimbria*) and fish very cleanly. Bycatch rates are quite low and survival is relatively high. Annual bycatch mortality has been less than 10,000 pounds annually since 2004. This year’s jump to 12,000 pounds was unexpected.

In the past few years, bycatch in Community Development Quota (CDQ) fishing has been tracked separately and reports have been posted online by NMFS to make this possible. Data for these fisheries have been included in the separate gear totals for Area 4.

References

Clark, W. G., Hoag, S. H., Trumble, R. J., and Williams, G. H. 1993. Re-estimation of survival for trawl caught halibut released in different condition factors. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1992: 197-206.

- Jannot, J. E., Bellman, M. A., and Majewski, J. 2011. Pacific halibut bycatch in the U.S. west coast groundfish fishery, 2002-2010. NWFSC/FRAM/WCGOP, 2725 Montlake Blvd E., Seattle, WA 98112. 64 p.
- McElderry, H., Schrader, J., and Illingworth, J. 2003. The efficacy of video-based electronic monitoring for the halibut longline fishery. Canadian Science Advisory Secretariat, Research Document 2003/042. 80 p.
- Williams, G. H. 1997. Pacific halibut discard mortality rates in the 1990-1995 Alaskan groundfish fisheries, with recommendations for monitoring in 1997. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1996: 211-227.
- Williams, G. H. 2010. Pacific halibut discard mortality rates in the 2008 CDQ and non-CDQ groundfish fisheries, and recommendations 2010-2012. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2009:413-425.

Table 1. Preseason assumed discard mortality rates used by NMFS for monitoring halibut bycatch mortality for 2010-2012 in the Alaskan groundfish fisheries. From Williams (2010).

Bering Sea/Aleutians		Gulf of Alaska	
Gear/Target	Used in 2010-2012	Gear/Target	Used in 2010-2012
<i>Trawl</i>		<i>Trawl</i>	
Atka mackerel	76	Bottom pollock	59
Bottom pollock	73	Pacific cod	62
Pacific cod	71	Deepwater flatfish	48
Other Flatfish	72	Shallow water flatfish	71
Rockfish	81	Rockfish	67
Flathead sole	74	Flathead sole	65
Pelagic pollock	89	Pelagic pollock	76
Rock sole	82	Sablefish	65
Sablefish	75	Arrowtooth fldr	72
Turbot	67	Rex sole	64
Arrowtooth fldr	76		
Yellowfin sole	81		
<i>Pot</i>		<i>Pot</i>	
Pacific cod	8	Pacific cod	17
<i>Longline</i>		<i>Longline</i>	
Pacific cod	10	Pacific cod	12
Rockfish	9	Rockfish	9
Turbot	11		

Bering Sea/Aleutian Islands Community Development Quota Fisheries

Gear/Target	Used in 2010-2012
<i>Trawl</i>	
Atka mackerel	85
Bottom pollock	85
Pacific cod	90
Rockfish	84
Flathead sole	84
Midwater pollock	90
Rock sole	87
Turbot	88
Yellowfin sole	85
<i>Pot</i>	
Sablefish	32
<i>Longline</i>	
Pacific cod	10
Turbot	4

Table 2. Estimates (thousands of pounds, net weight) of bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) by year, area, and fishery, for 2002 through 2011. Estimates for 2011 are preliminary and subject to change as new information becomes available.

Region and Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AREA 2A										
Groundfish Trawl	572	206	221	475	402	346	345	416	300	90
Shrimp Trawl	25	0	0	0	0	0	0	0	0	0
Fixed gear	38	54	67	61	178	41	78	93	46	50
Total	635	260	288	536	580	387	423	509	346	140
AREA 2B										
Domestic Trawl	244	244	251	346	294	320	143	213	181	297
Total	244	244	251	346	294	320	143	213	181	297
AREA 2C										
Crab Pot/Shrimp Trawl	303	303	303	303	303	303	303	303	303	303
Groundfish Trawl	0	0	0	0	0	0	0	0	0	0
Hook & Line (non-IFQ)	1	2	23	1	2	3	7	5	4	2
Hook & Line (IFQ)	3	3	3	3	3	3	3	3	3	3
Chatham Str. Sablefish	8	8	8	8	8	8	8	8	8	8
Clarence Str. Sablefish	25	25	25	25	25	25	25	25	25	25
Total	340	341	362	340	341	342	346	344	343	341
AREA 2 Subtotal	1,219	845	901	1,222	1,215	1,049	912	1,066	870	778
AREA 3A										
Crab Pot/Shrimp Trawl	250	250	250	250	250	250	250	250	250	250
Groundfish Trawl	1,685	2,407	3,033	2,664	2,339	2,347	2,381	2,141	2,030	2,360
Hook & Line (non-IFQ)	128	389	244	149	239	102	293	197	111	120
Hook & Line (IFQ)	119	119	119	119	119	119	119	119	119	119
Groundfish Pot	2	5	15	28	18	15	13	5	12	39
Pr Wm Sd Sablefish	10	10	10	10	10	10	10	10	10	10
Total	2,194	3,180	3,671	3,220	2,975	2,843	3,066	2,722	2,532	2,898
AREA 3B										
Crab Pot/Shrimp Trawl	50	50	50	50	50	50	50	50	50	50
Groundfish Trawl	1,508	1,341	866	862	926	795	979	865	676	754
Hook & Line (non-IFQ)	248	198	205	69	299	136	190	256	269	215
Hook & Line (IFQ)	116	116	116	116	116	116	116	116	116	116
Groundfish Pot	2	29	37	29	9	18	18	7	36	50
Total	1,924	1,734	1,274	1,126	1,400	1,115	1,353	1,294	1,147	1,185
AREA 3 Subtotal	4,118	4,914	4,945	4,346	4,375	3,958	4,419	4,015	3,679	4,083
AREA 4										
Crab Pot/Shrimp Trawl	300	300	300	300	300	300	300	300	300	300
Groundfish Trawl	5,591	5,589	5,499	6,454	6,269	5,841	4,897	4,774	4,668	3,974
Hook & Line (non-IFQ)	1,058	556	617	666	593	659	936	1,160	1,045	788
Hook & Line (IFQ)	60	60	60	60	60	60	60	60	60	60
Groundfish Pot	17	28	6	2	8	7	7	3	9	12
CDQ Trawl	131	187	176	128	187	309	223	0	0	0
CDQ Hook & Line	116	102	77	82	74	86	131	0	0	0
CDQ Pot	0	0	0	0	0	0	1	0	0	0
AREA 4 Subtotal	7,273	6,822	6,735	7,692	7,491	7,262	6,555	6,297	6,082	5,134
GRAND TOTAL	12,610	12,581	12,581	13,260	13,081	12,269	11,886	11,378	10,631	9,995

Table 3. Estimates (thousands of pounds, net weight and metric tons, round weight) of the bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) from all sources by IPHC regulatory area, since 1962. Estimates for 2011 are preliminary and subject to change as new information becomes available.

Year	<i>Thousands of Pounds, net weight</i>				<i>Metric Tons, round weight</i>			
	Area 2	Area 3	Area 4	Total	Area 2	Area 3	Area 4	Total
1962	1,383	3,083	4,143	8,609	834	1,860	2,499	5,192
1963	1,283	6,102	2,038	9,423	774	3,681	1,229	5,683
1964	1,310	11,639	2,965	15,914	790	7,020	1,788	9,599
1965	1,640	16,539	3,182	21,361	989	9,976	1,919	12,884
1966	1,879	12,495	3,400	17,774	1,133	7,537	2,051	10,721
1967	2,091	9,528	4,718	16,337	1,261	5,747	2,846	9,854
1968	2,478	7,053	5,685	15,216	1,495	4,254	3,429	9,178
1969	2,651	4,980	7,599	15,230	1,599	3,004	4,584	9,186
1970	2,032	6,230	8,028	16,290	1,225	3,758	4,842	9,825
1971	2,284	4,341	13,095	19,720	1,377	2,618	7,899	11,894
1972	2,506	7,099	9,675	19,280	1,512	4,282	5,836	11,629
1973	2,357	7,147	8,029	17,533	1,422	4,311	4,843	10,575
1974	2,738	8,667	7,620	19,025	1,651	5,228	4,596	11,475
1975	3,025	5,231	3,650	11,906	1,825	3,155	2,202	7,181
1976	3,249	5,938	4,564	13,751	1,960	3,582	2,753	8,294
1977	2,874	5,988	2,914	11,776	1,733	3,612	1,758	7,103
1978	2,325	4,895	5,023	12,242	1,402	2,952	3,029	7,384
1979	3,149	6,715	5,419	15,282	1,899	4,050	3,269	9,218
1980	2,368	7,099	9,235	18,702	1,428	4,282	5,570	11,280
1981	2,169	6,282	6,408	14,859	1,308	3,789	3,865	8,963
1982	1,644	5,972	4,756	12,373	992	3,602	2,869	7,463
1983	1,723	4,892	4,269	10,883	1,039	2,951	2,575	6,564
1984	1,851	3,647	4,692	10,189	1,116	2,199	2,830	6,146
1985	1,915	1,578	4,207	7,700	1,155	952	2,538	4,644
1986	1,940	1,246	5,576	8,762	1,170	752	3,363	5,285
1987	2,428	3,113	5,738	11,279	1,465	1,878	3,461	6,803
1988	2,389	3,415	8,858	14,662	1,441	2,060	5,343	8,844
1989	2,278	4,085	7,282	13,646	1,374	2,464	4,393	8,231
1990	2,943	6,159	8,580	17,682	1,775	3,715	5,175	10,665
1991	3,133	6,514	10,022	19,669	1,890	3,929	6,045	11,864
1992	2,925	6,650	10,718	20,293	1,764	4,011	6,465	12,240
1993	2,847	5,353	7,764	15,964	1,717	3,229	4,683	9,629
1994	2,191	5,294	9,466	16,951	1,322	3,193	5,710	10,224
1995	2,484	4,723	8,726	15,933	1,498	2,849	5,263	9,610
1996	1,258	4,700	8,507	14,465	759	2,835	5,131	8,725
1997	1,226	4,408	7,880	13,514	739	2,659	4,753	8,151
1998	1,656	4,051	7,725	13,432	999	2,443	4,660	8,102
1999	1,538	4,622	7,684	13,844	928	2,788	4,635	8,350
2000	1,447	4,402	7,441	13,290	873	2,655	4,488	8,016
2001	1,355	4,684	7,120	13,159	817	2,825	4,295	7,937
2002	1,219	4,118	7,273	12,610	735	2,484	4,387	7,606
2003	845	4,914	6,822	12,581	510	2,964	4,115	7,589
2004	901	4,945	6,735	12,581	543	2,983	4,062	7,589
2005	1,222	4,346	7,692	13,260	737	2,621	4,640	7,998
2006	1,215	4,375	7,491	13,081	733	2,639	4,518	7,890
2007	1,049	3,958	7,262	12,269	633	2,387	4,380	7,400
2008	912	4,419	6,555	11,886	550	2,665	3,954	7,169
2009	1,066	4,015	6,297	11,378	643	2,422	3,798	6,863
2010	870	3,679	6,082	10,631	525	2,219	3,669	6,412
2011	778	4,083	5,134	9,995	469	2,463	3,097	6,029

Table 4. Estimates (thousands of pounds, net weight and metric tons, round weight) of the bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) from all sources by IPHC regulatory area, since 1962. Estimates for 2011 are preliminary and subject to change as new information becomes available.

Year	Thousands of Pounds, net weight							Metric tons, round weight						
	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	TOTAL	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	TOTAL
1962	-	1,176	207	1,919	1,164	4,143	8,609	-	709	125	1,157	702	2,499	5,192
1963	-	1,077	206	3,314	2,788	2,038	9,423	-	649	124	1,999	1,682	1,229	5,683
1964	-	1,105	205	9,370	2,269	2,965	15,914	-	667	124	5,652	1,369	1,788	9,599
1965	-	1,435	205	6,097	10,442	3,182	21,361	-	866	124	3,678	6,298	1,919	12,884
1966	-	1,666	213	4,513	7,982	3,400	17,774	-	1,005	128	2,722	4,815	2,051	10,721
1967	-	1,652	439	4,633	4,895	4,718	16,337	-	996	265	2,795	2,953	2,846	9,854
1968	-	1,963	515	5,476	1,577	5,685	15,216	-	1,184	311	3,303	951	3,429	9,178
1969	-	2,183	468	3,806	1,174	7,599	15,230	-	1,317	282	2,296	708	4,584	9,186
1970	-	1,470	562	3,389	2,841	8,028	16,290	-	886	339	2,044	1,714	4,842	9,825
1971	-	1,745	539	2,974	1,367	13,095	19,720	-	1,052	325	1,794	825	7,899	11,894
1972	-	1,750	756	5,406	1,693	9,675	19,280	-	1,056	456	3,261	1,021	5,836	11,629
1973	-	1,509	848	4,452	2,695	8,029	17,533	-	910	511	2,685	1,626	4,843	10,575
1974	477	1,729	532	5,247	3,420	7,620	19,025	288	1,043	321	3,165	2,063	4,596	11,475
1975	477	1,909	639	3,158	2,073	3,650	11,906	288	1,151	385	1,905	1,250	2,202	7,181
1976	477	2,064	708	3,495	2,443	4,564	13,751	288	1,245	427	2,108	1,474	2,753	8,294
1977	477	1,817	580	4,094	1,894	2,914	11,776	288	1,096	350	2,469	1,142	1,758	7,103
1978	477	1,471	377	3,055	1,840	5,023	12,242	288	887	227	1,843	1,110	3,029	7,384
1979	476	1,852	821	5,780	935	5,419	15,282	287	1,117	495	3,486	564	3,269	9,218
1980	476	1,372	520	5,852	1,246	9,235	18,702	287	828	314	3,530	752	5,570	11,280
1981	475	1,188	507	4,720	1,563	6,408	14,859	287	716	306	2,847	942	3,865	8,963
1982	475	867	302	3,797	2,175	4,756	12,373	287	523	182	2,290	1,312	2,869	7,463
1983	476	943	304	2,957	1,935	4,269	10,883	287	568	183	1,784	1,167	2,575	6,564
1984	475	1,074	302	2,140	1,507	4,692	10,189	287	648	182	1,290	909	2,830	6,146
1985	475	1,139	301	1,001	577	4,207	7,700	287	687	182	604	348	2,538	4,644
1986	476	1,161	303	836	410	5,576	8,762	287	700	183	504	247	3,363	5,285
1987	476	1,649	303	2,240	873	5,738	11,279	287	995	183	1,351	527	3,461	6,803
1988	477	1,609	303	3,365	50	8,858	14,662	288	971	183	2,030	30	5,343	8,844
1989	477	1,498	303	3,267	818	7,282	13,646	288	904	183	1,971	494	4,393	8,231
1990	408	1,679	856	4,114	2,045	8,580	17,682	246	1,013	516	2,481	1,233	5,175	10,665
1991	408	1,992	733	4,843	1,671	10,022	19,669	246	1,202	442	2,921	1,008	6,045	11,864
1992	444	1,745	736	4,668	1,982	10,718	20,293	268	1,053	444	2,816	1,195	6,465	12,240
1993	444	1,661	742	4,291	1,062	7,764	15,964	268	1,002	448	2,588	641	4,683	9,629
1994	444	1,219	528	3,907	1,387	9,466	16,951	268	735	318	2,357	837	5,710	10,224
1995	614	1,522	348	2,963	1,760	8,726	15,933	370	918	210	1,787	1,062	5,263	9,610
1996	614	299	345	2,743	1,957	8,507	14,465	370	180	208	1,655	1,180	5,131	8,725
1997	614	215	397	2,965	1,443	7,880	13,514	370	130	239	1,788	870	4,753	8,151
1998	1,082	213	361	2,662	1,389	7,725	13,432	653	128	218	1,606	838	4,660	8,102
1999	987	193	358	2,885	1,737	7,684	13,844	595	116	216	1,740	1,048	4,635	8,350
2000	822	230	395	2,892	1,510	7,441	13,290	496	139	238	1,744	911	4,488	8,016
2001	837	177	341	3,009	1,675	7,120	13,159	505	107	206	1,815	1,010	4,295	7,937
2002	635	244	340	2,194	1,924	7,273	12,610	383	147	205	1,323	1,161	4,387	7,606
2003	260	244	341	3,180	1,734	6,822	12,581	157	147	206	1,918	1,046	4,115	7,589
2004	288	251	362	3,671	1,274	6,735	12,581	174	151	218	2,214	768	4,062	7,589
2005	536	346	340	3,220	1,126	7,692	13,260	323	209	205	1,942	679	4,640	7,998
2006	580	294	341	2,975	1,400	7,491	13,081	350	177	206	1,794	844	4,518	7,890
2007	387	320	342	2,843	1,115	7,262	12,269	233	193	206	1,715	673	4,380	7,400
2008	423	143	346	3,066	1,353	6,555	11,886	255	86	209	1,849	816	3,954	7,169
2009	509	213	344	2,722	1,294	6,297	11,378	307	128	207	1,642	780	3,798	6,863
2010	346	181	343	2,532	1,147	6,082	10,631	209	109	207	1,527	692	3,669	6,412
2011	140	297	341	2,898	1,185	5,134	9,995	84	179	206	1,748	715	3,097	6,029

Table 5. Estimates (thousands of pounds, net weight and metric tons, round weight) of the bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) from all sources by geographic region of the coast, since 1962. Estimates for 2011 are preliminary and subject to change as new information becomes available.

Year	<i>Thousands of pounds, net weight</i>					<i>Metric tons, round weight</i>				
	Wash., Oreg., Calif.	B.C.	Gulf of Alaska	Bering Sea & Aleu.	Total	Wash., Oreg., Calif.	B.C.	Gulf of Alaska	Bering Sea & Aleu.	Total
1962	-	1,176	3,290	4,143	8,609	-	709	1,984	2,499	5,192
1963	-	1,077	6,308	2,038	9,423	-	649	3,805	1,229	5,683
1964	-	1,105	11,844	2,965	15,914	-	667	7,144	1,788	9,599
1965	-	1,435	16,744	3,182	21,361	-	866	10,100	1,919	12,884
1966	-	1,666	12,708	3,400	17,774	-	1,005	7,665	2,051	10,721
1967	-	1,652	9,967	4,718	16,337	-	996	6,012	2,846	9,854
1968	-	1,963	7,568	5,685	15,216	-	1,184	4,565	3,429	9,178
1969	-	2,183	5,448	7,599	15,230	-	1,317	3,286	4,584	9,186
1970	-	1,470	6,792	8,028	16,290	-	886	4,097	4,842	9,825
1971	-	1,745	4,880	13,095	19,720	-	1,052	2,943	7,899	11,894
1972	-	1,750	7,855	9,675	19,280	-	1,056	4,738	5,836	11,629
1973	-	1,509	7,995	8,029	17,533	-	910	4,822	4,843	10,575
1974	477	1,729	9,199	7,620	19,025	288	1,043	5,549	4,596	11,475
1975	477	1,909	5,870	3,650	11,906	288	1,151	3,541	2,202	7,181
1976	477	2,064	6,646	4,564	13,751	288	1,245	4,009	2,753	8,294
1977	477	1,817	6,568	2,914	11,776	288	1,096	3,962	1,758	7,103
1978	477	1,471	5,272	5,023	12,242	288	887	3,180	3,029	7,384
1979	476	1,852	7,536	5,419	15,282	287	1,117	4,545	3,269	9,218
1980	476	1,372	7,619	9,235	18,702	287	828	4,595	5,570	11,280
1981	475	1,188	6,789	6,408	14,859	287	716	4,095	3,865	8,963
1982	475	867	6,274	4,756	12,373	287	523	3,784	2,869	7,463
1983	476	943	5,196	4,269	10,883	287	568	3,134	2,575	6,564
1984	475	1,074	3,949	4,692	10,189	287	648	2,382	2,830	6,146
1985	475	1,139	1,879	4,207	7,700	287	687	1,133	2,538	4,644
1986	476	1,161	1,549	5,576	8,762	287	700	934	3,363	5,285
1987	476	1,649	3,416	5,738	11,279	287	995	2,060	3,461	6,803
1988	477	1,609	3,718	8,858	14,662	288	971	2,243	5,343	8,844
1989	477	1,498	4,388	7,282	13,646	288	904	2,647	4,393	8,231
1990	408	1,679	7,015	8,580	17,682	246	1,013	4,231	5,175	10,665
1991	408	1,992	7,247	10,022	19,669	246	1,202	4,371	6,045	11,864
1992	444	1,745	7,386	10,718	20,293	268	1,053	4,455	6,465	12,240
1993	444	1,661	6,095	7,764	15,964	268	1,002	3,676	4,683	9,629
1994	444	1,219	5,822	9,466	16,951	268	735	3,512	5,710	10,224
1995	614	1,522	5,071	8,726	15,933	370	918	3,059	5,263	9,610
1996	614	299	5,045	8,507	14,465	370	180	3,043	5,131	8,725
1997	614	215	4,805	7,880	13,514	370	130	2,898	4,753	8,151
1998	1,082	213	4,412	7,725	13,432	653	128	2,661	4,660	8,102
1999	987	193	4,980	7,684	13,844	595	116	3,004	4,635	8,350
2000	822	230	4,797	7,441	13,290	496	139	2,893	4,488	8,016
2001	837	177	5,025	7,120	13,159	505	107	3,031	4,295	7,937
2002	635	244	4,458	7,273	12,610	383	147	2,689	4,387	7,606
2003	260	244	5,255	6,822	12,581	157	147	3,170	4,115	7,589
2004	288	251	5,307	6,735	12,581	174	151	3,201	4,062	7,589
2005	536	346	4,686	7,692	13,260	323	209	2,826	4,640	7,998
2006	580	294	4,716	7,491	13,081	350	177	2,845	4,518	7,890
2007	387	320	4,300	7,262	12,269	233	193	2,594	4,380	7,400
2008	423	143	4,765	6,555	11,886	255	86	2,874	3,954	7,169
2009	509	213	4,359	6,297	11,378	307	128	2,629	3,798	6,863
2010	346	181	4,022	6,082	10,631	209	109	2,426	3,669	6,412
2011	140	297	4,424	5,134	9,995	84	179	2,668	3,097	6,029

Table 6. Estimates (thousands of pounds, net weight and metric tons, round weight) of the bycatch mortality of Pacific halibut (*Hippoglossus stenolepis*) from the Alaskan groundfish fishery since 1990. Estimates for 2011 are preliminary and subject to change as new information becomes available. All federally managed fisheries are represented, including the Individual Fisheries Quota sablefish fishery and Community Development Quota fisheries. However, fisheries operating within State of Alaska jurisdiction, e.g., Chatham Strait sablefish fishery, are excluded.

<i>GULF OF ALASKA</i>								
Year	<i>Thousands of Pounds, net weight</i>				<i>Metric Tons, round weight</i>			
	Trawls	H&L	Pot	Total	Trawls	H&L	Pot	Total
1990	4,331	2,012	52	6,395	2,612	1,214	31	3,857
1991	4,538	2,081	7	6,626	2,737	1,255	4	3,997
1992	4,060	2,684	26	6,770	2,449	1,619	16	4,083
1993	3,548	1,900	19	5,467	2,140	1,146	19	3,305
1994	3,619	1,512	23	5,154	2,183	912	14	3,109
1995	3,745	645	35	4,425	2,259	389	21	2,669
1996	3,890	498	11	4,399	2,346	300	7	2,653
1997	3,291	855	13	4,159	1,985	516	8	2,509
1998	3,042	705	19	3,766	1,835	425	11	2,272
1999	3,333	854	147	4,334	2,010	515	89	2,614
2000	3,416	718	17	4,151	2,060	433	10	2,504
2001	3,724	614	41	4,379	2,246	370	25	2,641
2002	3,193	615	4	3,812	1,926	371	2	2,299
2003	3,748	827	34	4,609	2,261	499	21	2,780
2004	3,899	710	52	4,661	2,352	428	31	2,811
2005	3,526	457	57	4,040	2,127	276	34	2,437
2006	3,265	778	27	4,070	1,969	469	16	2,455
2007	3,142	479	33	3,654	1,895	289	20	2,204
2008	3,360	728	31	4,119	2,027	439	19	2,484
2009	3,006	622	11	3,639	1,813	375	7	2,195
2010	2,706	622	48	3,376	1,632	375	29	2,036
2011	3,114	575	89	3,778	1,878	347	54	2,279

Table 6. (Continued)

<i>BERING SEA/ALEUTIANS</i>								
Year	<i>Thousands of Pounds, net weight</i>				<i>Metric Tons, round weight</i>			
	Trawls	H&L	Pot	Total	Trawls	H&L	Pot	Total
1990	6,309	627	4	6,940	3,805	378	2	4,186
1991	8,254	1,464	4	9,722	4,979	883	2	5,864
1992	7,622	2,775	21	10,418	4,597	1,674	13	6,284
1993	6,603	861	tr	7,464	3,983	519	tr	4,502
1994	7,199	1,944	9	9,152	4,342	1,173	5	5,520
1995	6,610	1,731	25	8,366	3,987	1,044	15	5,046
1996	6,582	1,535	30	8,147	3,970	926	18	4,914
1997	5,947	1,564	9	7,520	3,587	943	5	4,536
1998	5,945	1,409	11	7,365	3,586	850	7	4,442
1999	6,159	1,214	11	7,384	3,715	732	7	4,454
2000	5,443	1,674	24	7,141	3,283	1,010	14	4,307
2001	5,379	1,428	13	6,820	3,244	861	8	4,114
2002	5,722	1,234	17	6,973	3,451	744	10	4,206
2003	5,776	718	28	6,522	3,484	433	17	3,934
2004	5,675	754	6	6,435	3,423	455	4	3,881
2005	6,582	808	2	7,392	3,970	487	1	4,459
2006	6,456	727	8	7,191	3,894	439	5	4,337
2007	6,150	805	7	6,962	3,710	486	4	4,199
2008	5,120	1,127	7	6,254	3,088	680	4	3,772
2009	4,774	1,220	3	5,997	2,880	736	2	3,617
2010	4,668	1,105	9	5,782	2,816	667	5	3,488
2011	3,974	848	12	4,834	2,397	511	7	2,916

<i>TOTAL ALASKA</i>								
Year	<i>Thousands of Pounds, net weight</i>				<i>Metric Tons, round weight</i>			
	Trawls	H&L	Pot	Total	Trawls	H&L	Pot	Total
1990	10,640	2,639	56	13,335	6,418	1,592	34	8,043
1991	12,792	3,545	11	16,348	7,716	2,138	7	9,861
1992	11,682	5,459	47	17,188	7,046	3,293	28	10,367
1993	10,151	2,761	19	12,931	6,123	1,665	19	7,807
1994	10,818	3,456	32	14,306	6,525	2,085	19	8,629
1995	10,355	2,376	60	12,791	6,246	1,433	36	7,715
1996	10,472	2,033	41	12,546	6,316	1,226	25	7,567
1997	9,238	2,419	22	11,679	5,572	1,459	13	7,044
1998	8,987	2,114	30	11,131	5,421	1,275	18	6,714
1999	9,492	2,068	158	11,718	5,725	1,247	95	7,068
2000	8,859	2,392	41	11,292	5,344	1,443	25	6,811
2001	9,103	2,042	54	11,199	5,491	1,232	33	6,755
2002	8,915	1,849	21	10,785	5,377	1,115	13	6,505
2003	9,524	1,545	62	11,131	5,745	932	37	6,714
2004	9,574	1,464	58	11,096	5,775	883	35	6,693
2005	10,108	1,265	59	11,432	6,097	763	36	6,895
2006	9,721	1,505	35	11,261	5,863	908	21	6,792
2007	9,292	1,284	40	10,616	5,605	774	24	6,403
2008	8,480	1,855	38	10,373	5,115	1,119	23	6,257
2009	7,780	1,842	14	9,636	4,693	1,111	8	5,812
2010	7,374	1,727	57	9,158	4,448	1,042	34	5,524
2011	7,088	1,423	101	8,612	4,275	858	61	5,195

Table 7. Estimates of 2011 groundfish catch and Pacific halibut bycatch mortality (thousands of pounds, net weight and metric tons, round weight) by region, gear, and target fishery in the groundfish fisheries off Alaska. Does not include Individual Fishing Quota fisheries. Data represent fishing through October 29, 2011.

Region & Target fishery	Hook & Line		Pot		Trawl	
	Groundfish Catch (mt)	Hbt Byc Mort (Klbs)	Groundfish Catch (mt)	Hbt Byc Mort (Klbs)	Groundfish Catch (mt)	Hbt Byc Mort (Klbs)
<i>Bering Sea</i>						
Alaska plaice					2,165	12
Arrowtooth flndr	3	0			17,488	288
Atka mackerel					53,852	190
Bottom pollock	8	0			119,112	231
Flathead sole					7,650	114
Kamchatka flndr					8,722	143
Midwater pollock					1,003,885	381
Other flatfish					22	1
Other species	25	0			8	2
Pacific cod	120,707	643	27,770	8	44,617	426
Rock sole					70,004	821
Rockfish	13	1			15,974	76
Sablefish			407	2		
Turbot	2,323	5			8	2
Yellowfin sole					166,796	998
Total	123,079	650	28,177	10	1,510,303	3,686
<i>Gulf of Alaska</i>						
Arrowtooth flndr					32,265	1,225
Atka mackerel					228	1
Bottom pollock					17,615	132
Flathead sole					1,708	99
Midwater pollock					17,578	3
Pacific cod	15,677	337	45,476	89	13,904	707
Rex sole					3,940	182
Rockfish					23,658	119
Sablefish					298	6
Shallow water flats					5,120	401
Total	15,677	337	45,476	89	116,314	2,876

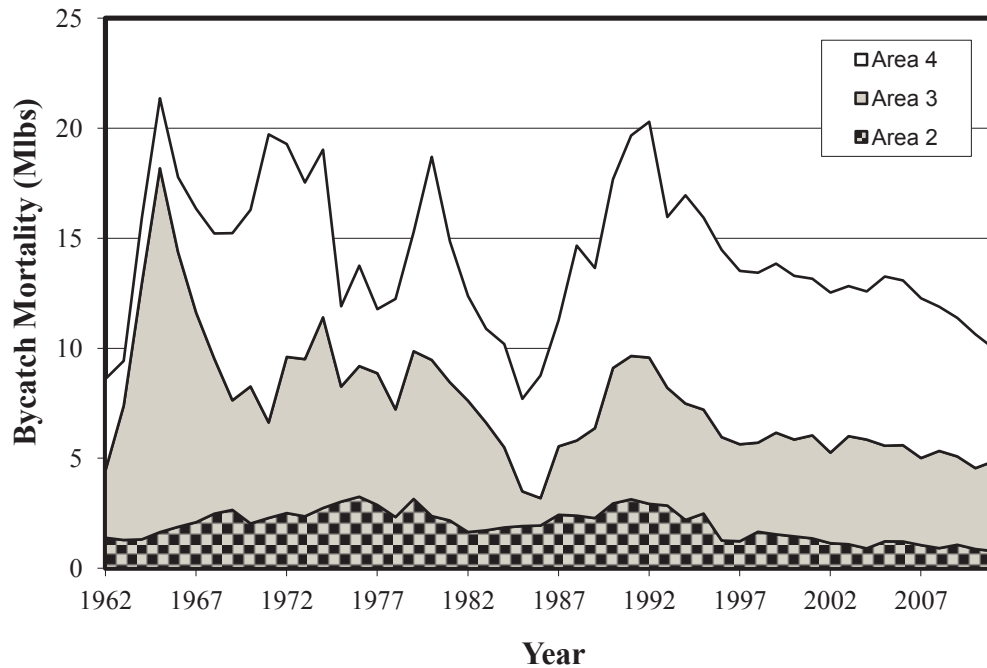


Figure 1. Bycatch mortality of Pacific halibut by IPHC regulatory area (millions of pounds, net weight), 1962-2011.

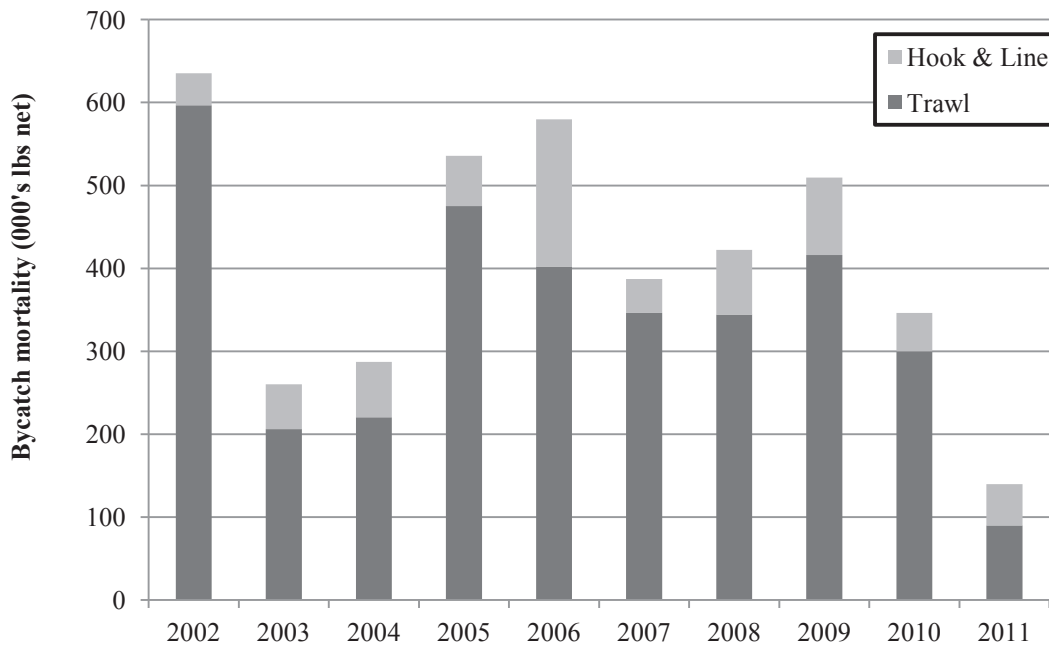


Figure 2. Pacific halibut bycatch mortality (thousands of pounds, net weight) in the trawl and hook-&-line groundfish fisheries in IPHC Area 2A during 2002-2011. Data for 2002-2010 from Jannot et al. (2011).

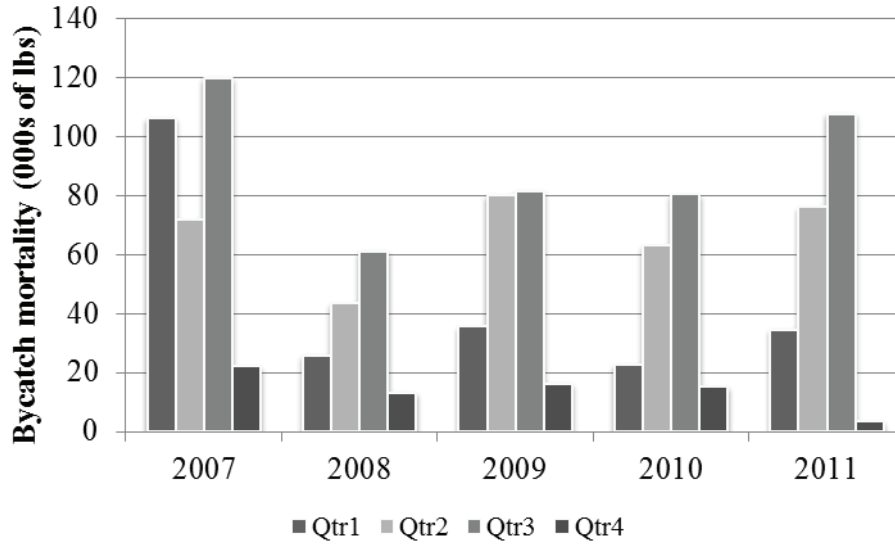


Figure 3. Pacific halibut bycatch mortality (thousands of pounds, net weight) by calendar quarter in the 2007-2011 Area 2B (B.C.) bottom trawl groundfish fishery.

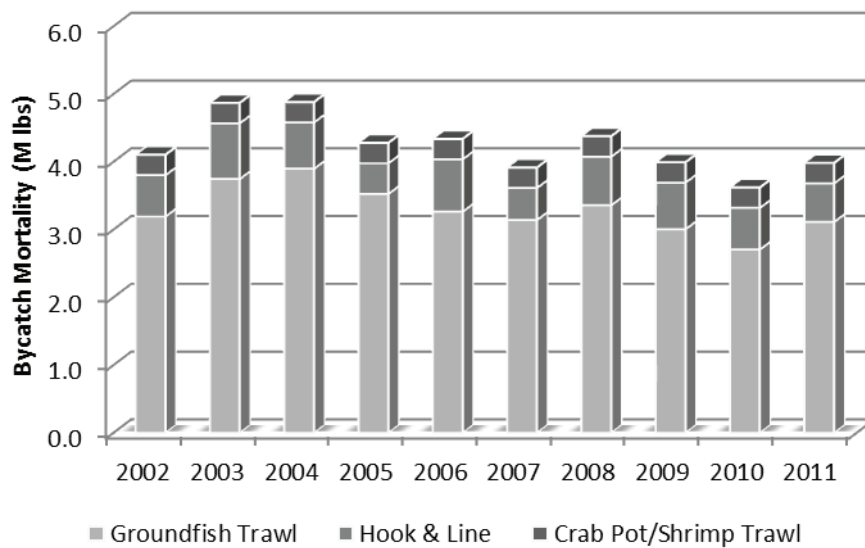


Figure 4. Bycatch mortality (millions of pounds, net weight) in Areas 3A/3B during 2002-2012 by gear. Groundfish pots are not shown, as amount is too small to be visible on the figure.

Figure 5. Proportion of 2011 bycatch mortality in Area 3 by gear type.

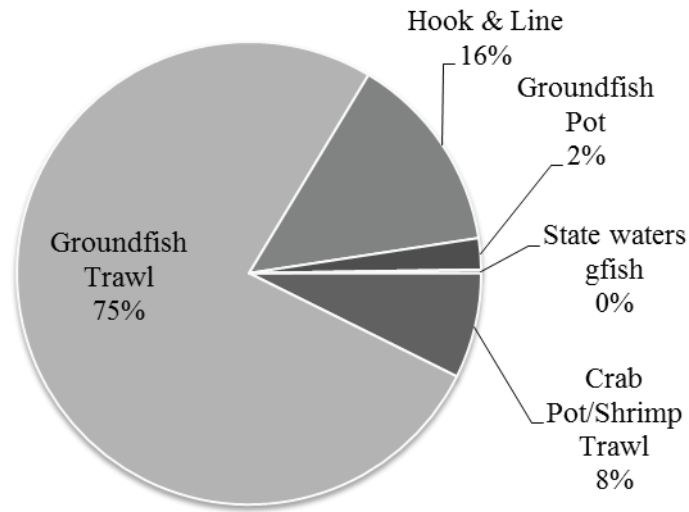


Figure 6. Breakdown of 2011 trawl bycatch mortality by target fishery in Areas 3A/3B.

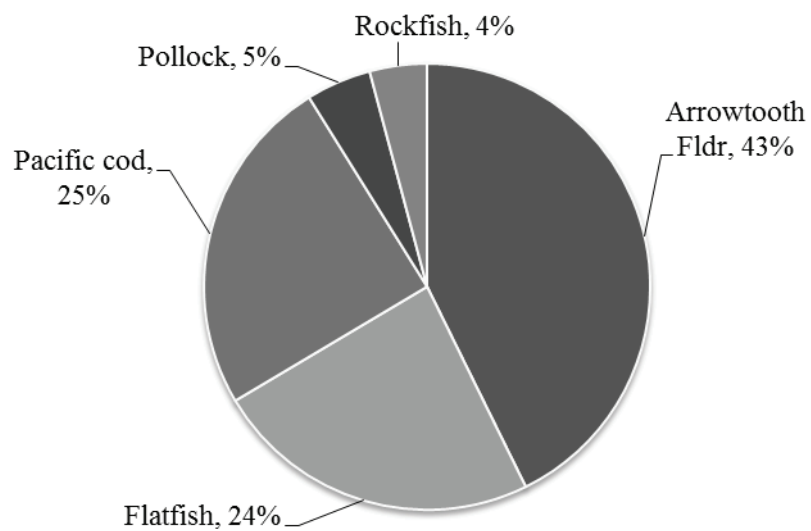


Figure 7. Percent of annual bycatch mortality by major trawl fishery in Areas 3A/3B.

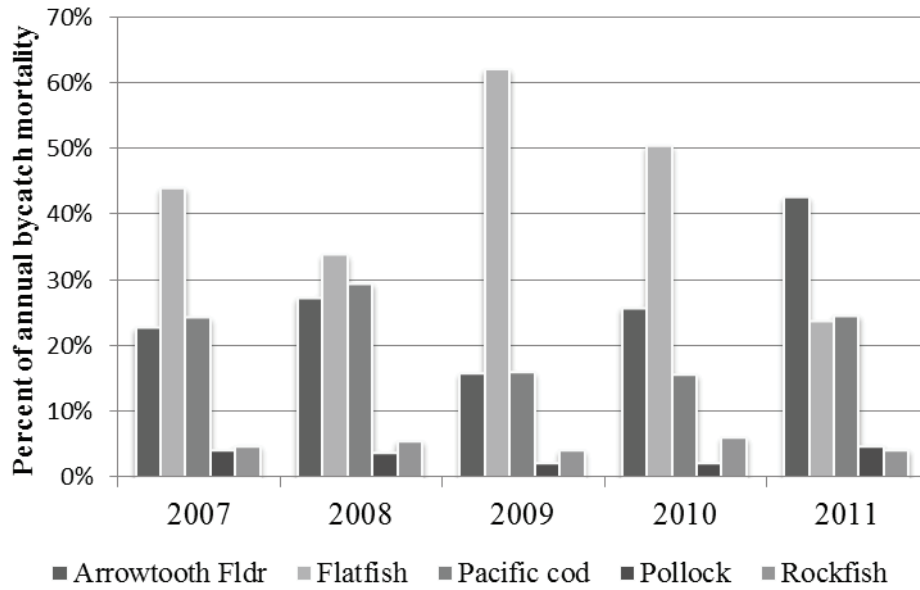
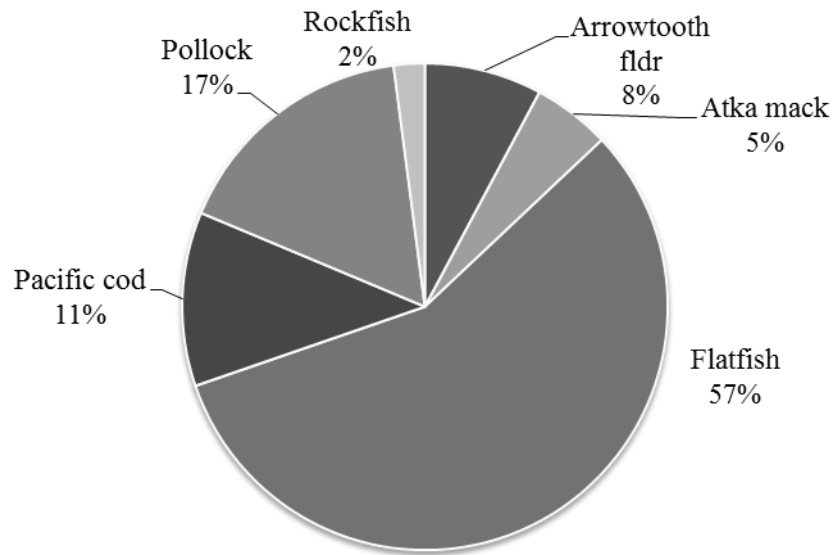


Figure 8. Proportion of the 2011 Bering Sea/Aleutian Islands region trawl fishery bycatch by



target fishery. The flatfish category is primarily yellowfin sole and rock sole.