

Estimates of Pacific Halibut Bycatch and Mortality in IPHC Area 2A in 1998, 1999 and early 2000

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A series of analyses have been conducted with the objective of estimating halibut bycatch in the bottom trawl fishery for groundfish and shrimp off the west coast. Halibut bycatch and mortality were estimated for 1987, 1992, and 1995 by Williams, et al. (Jan. 23, 1998 document¹). New estimates of halibut bycatch and mortality for the Oregon and Washington bottom trawl fisheries for groundfish are calculated for 1998, 1999, and January-May 2000, based on more recent observer information from the Enhanced Data Collection Program (EDCP). New estimates for the Oregon bottom trawl fishery for shrimp are also calculated for 1998.

For a historical perspective, estimates of bycatch mortality of Pacific halibut by fisheries operating in Area 2A since 1977 are presented in Table 7 and comparable estimates for legal-sized halibut are given in Table 8.

Bottom Trawl Fishery for Groundfish

Estimated bycatch and mortality of halibut in 1987, 1992, and 1995 are summarized in Table 1. As described by Williams, et al. (1998), these halibut bycatch and mortality estimates were based upon catch rates observed during a voluntary fisheries observer program conducted during the late 1980s. Approximately 1062 tows by bottom trawl fisheries off Oregon and Washington were observed during 1985-1987. An additional 65 tows were observed off California during 1988-1990. Catch rates were stratified by fishing strategy, depth, season, and area as described by Pikitch, et al. (1998)².

Estimated bycatch and mortality of halibut during 1998, 1999, and January-May 2000 are summarized for Oregon and Washington bottom trawl fisheries in Table 2. For seasonal comparison, halibut bycatch and mortality estimates for January-May during 1998, 1999, and 2000 are given in Table 3.

Analysis of Enhanced Data Collection Program

During November 1995 through December 1998, halibut catches by bottom trawl fisheries on the west coast were observed during the Enhanced Data Collection Program (EDCP). In 1728 observed tows, 9739 halibut were measured. These data on halibut catch rates and size were stratified by season, depth, area and catch of arrowtooth flounder. Numbers of tows, halibut catches, halibut catch rates, and proportion of legal-sized halibut (>81 cm) are given for each of these strata in Table 4. John Wallace, NWFSC, used similar methods to those in Pikitch (1998) to analyze the EDCP data and identify appropriate strata for bycatch estimation. These methods and preliminary results were reviewed and approved by the Pacific Fishery Management Council's Scientific and Statistical Committee during the June and September 2000 meetings.

Fleet Expansion of EDCP Results Using Logbooks

The observed encounter rates and size of halibut were expanded to the entire fleet, based on bottom trawl effort obtained from groundfish trawl logbooks for 1998, 1999, and January through May of 2000. These logbook data were available from Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fisheries (WDFW). ODFW staff developed a program to bin the known trawl effort from logbooks into each of the strata identified in the EDCP analyses. Port and Month were added as factors for Oregon logbooks to avoid any potential bias created by unequal collection of

1 Pacific halibut bycatch in IPHC Area 2A: Bycatch rates and current estimates of bycatch mortality. By Gregg Williams, Gary Stauffer, Hal Weeks, Mark Saelens, Joe Scordino, Don Bodenmiller, and Tom Northup, dated Jan. 23, 1998, 14 p.

2 Pikitch, E.K., Wallace, J.R., Babcock, E.A., Erickson, D.L., Saelens, M., and Oddsson, Geir. 1998. Pacific halibut bycatch in the Washington, Oregon, and California groundfish and shrimp trawl fisheries. *North American Journal of Fisheries Management*. Volume 18, pp. 569-586.

logbooks in the three major ports (Astoria, Newport, and Coos Bay). ODFW collects logbook data for 70-80% of the trawl deliveries during a typical year, thus the need to avoid collection bias. Total trawl effort (hours) for the entire Oregon fleet was based on expanding the groundfish catch rates in logbook data by the total groundfish catch reported on fish tickets, as follows. The average groundfish CPUE (catch per hour) was estimated from logbooks for each stratum in the EDCP analysis. The remaining "unknown" groundfish catch from deliveries for which representative logbooks were not available was divided by this average CPUE to estimate non-logbook effort. Total fleet effort is the combined logbook effort plus the estimated non-logbook effort in each stratum. Such an effort expansion was not conducted for the Washington fleet because WDFW provides essentially 100% logbook coverage, so total fleet effort is equal to reported logbook effort.

Halibut bycatch for each stratum is estimated by multiplying total effort and the appropriate halibut bycatch rate for that stratum. Bycatch by the bottom trawl fleet is estimated by summing across strata. As in earlier years, about half of released halibut are assumed to survive capture, and therefore, bycatch mortality of halibut is assumed to be 50% of total bycatch. The bycatch mortality of legal-sized halibut (> 81cm) is estimated from the length frequencies of halibut measured in the EDCP study. Measurements of fish lengths were converted to fish weight based on a length-weight relationship for Pacific halibut (IPHC, personal communication), and the proportion of legal-sized fish (by weight) was computed for each stratum in the EDCP analysis.

Groundfish Trawl Management During 2000

Reductions in fishing opportunity during 2000 may result in reduced halibut bycatch. For 2000 the trip limits for rockfish inhabiting the shelf area were severely reduced, by 80-90% from 1999 limits. Further, to land rockfish from nearshore or shelf areas, trawlers were allowed to use only small footrope gear (rollers of 8" or less). The intent of this gear requirement is to reduce rockfish catches to incidental levels. In contrast, some additional trawl effort is likely to move nearshore to harvest flatfish. Relatively minor reductions in fishing opportunity occurred on the continental slope.

The combined effect of these changes on halibut bycatch is not known. However, for the first 5 months (January through May) of 2000, estimated bycatch of legal-sized halibut decreased by 17% from 1999 and 18% from 1998 levels. Restricted fishing opportunity is likely to continue or become even more restrictive during 2001. During 1998 and 1999, the estimated bycatch of legal-sized halibut taken during January-May accounted for 35% and 36% of the annual totals, respectively.

Bottom Trawl Fishery for Shrimp

Halibut bycatch in shrimp trawls in 1987, 1992, and 1995 reported by Williams, et al (1998), are shown in Table 5.

Bob Hannah (ODFW, personal communication) produced three estimates of the 1998 halibut bycatch for PSFMC Areas 2B-3C and these are given in Table 6. Given the range of estimates and the data limitations, Hannah suggests that the 1998 bycatch mortality of legal-sized halibut (>81 cm) from Oregon is about 16,000 lbs, net weight. The three bycatch estimates were based on three different data sources: 1) bycatch rates observed during 128 tows by Pikitch, et al., during 1985-87; 2) control net catch rates from 166 tows observed by Hannah, et al. (1996); and 3) data compiled from shrimp fishing trips observed during 1996-99 by the EDCP, combined with control net catches from ODFW research charters during the same time period (for a total of 203 observed tows).

The approximate number of tows in the 1998 Oregon shrimp fishery was over 10,000. The halibut bycatch estimates for this fishery are based on expanding the encounter rates (pounds of halibut per single-rig equivalent hour (sreh)) by the effort expended by vessels landing shrimp in Oregon ports only. Bycatch from vessels landing shrimp into Washington ports is not included.

The estimates are not stratified by depth because the depth range of the shrimp fishery is very restricted and the amount of data is very limited.

Table 1. Halibut bycatch and mortality in the bottom trawl fisheries for groundfish off the west coast, estimated from Pikitch, et al., 1998 and reported by Williams, et al., Jan. 23, 1998 document.

Year	Trawl Effort (hours)	Estimated Halibut Bycatch (numbers)	Estimated Halibut Bycatch (kg., round)	Estimated Halibut Bycatch (lbs, net)	Estimated Total Halibut Mortality (lbs, net)	Estimated Legal-Sized Halibut Mortality (lbs, net)
1987	135,075	78,765	372,911	616,702	308,351	191,178
1992	182,155	89,756	465,595	769,979	384,989	238,693
1995	72,295	113,702	663,262	1,096,870	548,435	340,030

Note: For 1995, bycatch estimates for Areas 1B-2A off California are not included. Mortality estimated at 50% of bycatch. Legal-sized mortality (>81 cm) estimated at 62%, by weight, of total mortality. 1 kg, round = 1.65375 lbs, net weight.

Table 2. Halibut bycatch and mortality in the Oregon and Washington bottom trawl fisheries for groundfish off the west coast, estimated from the Enhanced Data Collection Program (EDCP).

Year	Trawl Effort (hours)	Estimated Halibut Bycatch (numbers)	Estimated Halibut Bycatch (kg., round)	Estimated Halibut Bycatch (lbs, net)	Estimated Total Halibut Mortality (lbs, net)	Estimated Legal-Sized Halibut Mortality (lbs, net)
1998	92,294	160,826	1,227,225	2,029,523	1,014,762	322,928
1999	83,051	159,097	1,220,533	2,018,456	1,009,228	315,163
2000(Jan-May)	28,117	58,482	442,032	731,010	365,505	93,801

Note: Halibut bycatches by California bottom trawl fisheries are not included. Mortality estimated at 50% of bycatch. Proportion of legal-sized mortality (>81 cm) estimated from length frequencies of fish measured in EDCP. 1 kg, round = 1.65375 pounds, net weight.

Table 3. Halibut bycatch and mortality during January – May in the Oregon and Washington bottom trawl fisheries for groundfish off the west coast, estimated from the Enhanced Data Collection Program (EDCP).

January – May Year	Trawl Effort (hours)	Estimated Halibut Bycatch (numbers)	Estimated Halibut Bycatch (kg., round)	Estimated Halibut Bycatch (lbs, net)	Estimated Total Halibut Mortality (lbs, net)	Estimated Legal-Sized Halibut Mortality (lbs, net)
1998 OREGON	26,933	30,737	245,064	405,275	202,637	78,646
1998 WASHINGTON	5,727	37,602	261,937	433,178	216,589	34,641
1998 TOTAL	32,660	68,339	507,001	838,453	419,226	113,287
1999 OREGON	25,693	38,635	307,062	507,804	253,902	80,810
1999 WASHINGTON	4,721	32,594	226,486	374,551	187,276	33,245
1999 TOTAL	30,414	71,229	533,548	882,355	441,178	114,055
2000 OREGON	23,389	36,352	285,914	472,830	236,415	66,170
2000 WASHINGTON	4,728	22,130	156,118	258,180	129,090	27,631
2000 TOTAL	28,117	58,482	442,032	731,010	365,505	93,801

Note: Halibut bycatches by California bottom trawl fisheries are not included. Mortality estimated at 50% of bycatch. Proportion of legal-sized mortality (>81 cm) estimated from length frequencies of fish measured in EDCP. 1 kg, round = 1.65375 pounds, net weight.

Table 4. Numbers of tows, halibut catches, and halibut catch rates, by strata, observed during the financed Data Collection Program of the bottom trawl fishery for groundfish.

SEASON: JANUARY - AUGUST

Arrowtooth Catch (lbs)	Latitude	Depth (Fathoms)	Number of Observed Tows	Number of Tows with No Halibut	Number of Tows with >1 Halibut	Total Number of Halibut	Number of Halibut per Hour	Wgt. (kg., rnd) Halibut per Hour	Proportion Legal by Weight	Proportion Legal by Number
< 20	40.667 - 41.667	0 - 100	0							
		100 - 300	0							
		300 - 700	2	2	0	0	0.0000	0.0000		
41.667 - 42.667		0 - 100	2	1	1	7	1.9905	16.6102	0.837	0.714
		100 - 300	9	9	0	0	0.0000	0.0000		
		300 - 700	14	13	1	1	0.0103	0.1381	1.000	1.000
42.667 - 46.667		0 - 100	147	83	64	236	0.5475	5.2473	0.800	0.614
		100 - 300	164	83	81	590	0.7960	8.1169	0.542	0.458
		300 - 700	137	134	3	5	0.0038	0.0258	0.670	0.600
46.667 - 47.667		0 - 100	68	28	40	238	3.8056	32.6529	0.627	0.475
		100 - 300	24	10	14	83	0.8077	6.4739	0.630	0.470
		300 - 700	37	35	2	2	0.0179	0.1087	0.618	0.500
47.667 - 48.667		0 - 100	98	41	57	571	2.4763	16.4137	0.207	0.145
		100 - 300	76	24	52	1196	4.2873	26.7102	0.233	0.144
		300 - 700	57	43	14	312	0.6363	4.0503	0.282	0.170
> 20	40.667 - 41.667	0 - 100	0							
		100 - 300	0							
		300 - 700	0							
41.667 - 42.667		0 - 100	0							
		100 - 300	1	0	1	1	1.3333	8.8284	1.000	1.000
		300 - 700	0							
42.667 - 46.667		0 - 100	58	26	32	295	1.5494	14.1539	0.709	0.539
		100 - 300	89	35	54	658	1.4499	13.0713	0.463	0.356
		300 - 700	8	5	3	5	0.1022	1.0992	1.000	1.000
46.667 - 47.667		0 - 100	10	1	9	161	2.9772	21.2403	0.333	0.211
		100 - 300	17	1	16	486	8.0128	70.7112	0.369	0.292
		300 - 700	2	1	1	12	1.0909	7.0047	0.266	0.167
47.667 - 48.667		0 - 100	36	1	35	1179	10.6296	68.5951	0.195	0.123
		100 - 300	50	7	43	2157	16.3740	114.6754	0.094	0.056
		300 - 700	0							

Table 4. Continued.

SEASON: SEPTEMBER - DECEMBER

Arrowtooth Catch (lbs)	Latitude	Depth (Fathoms)	Number of Observed Tows	Number of Tows with No Halibut	Number of Tows with ≥ 1 Halibut	Total Number of Halibut	Number of Halibut per Hour	Wgt. (kg, rnd) Halibut per Hour	Proportion Legal by Weight	Proportion Legal by Number
≤ 20	40.667 - 41.667	0 - 100	1	1	0		0.0000	0.0000		
		100 - 300	5	5	0		0.0000	0.0000		
		300 - 700	9	9	0		0.0000	0.0000		
41.667 - 42.667		0 - 100	19	10	9	32	0.5270	9.3711	0.981	0.937
		100 - 300	6	3	3	5	0.1996	2.0303	0.745	0.600
		300 - 700	19	19	0		0.0000	0.0000		
42.667 - 46.667		0 - 100	198	148	50	145	0.2921	2.4819	0.720	0.517
		100 - 300	124	72	52	518	1.1362	12.4821	0.412	0.363
		300 - 700	65	62	3	4	0.0061	0.0361	0.392	0.250
46.667 - 47.667		0 - 100	37	15	22	83	0.6356	7.0247	0.800	0.578
		100 - 300	11	7	4	25	0.4208	3.0317	0.392	0.240
		300 - 700	12	11	1	5	0.0395	0.4615	0.795	0.600
47.667 - 48.667		0 - 100	31	18	13	133	2.5174	18.6845	0.257	0.195
		100 - 300	26	6	20	444	5.8691	36.8507	0.093	0.068
		300 - 700	6	5	1	23	0.3844	3.7322	0.335	0.261
> 20	40.667 - 41.667	0 - 100	0							
		100 - 300	0							
		300 - 700	0							
41.667 - 42.667		0 - 100	0							
		100 - 300	0							
		300 - 700	0							
42.667 - 46.667		0 - 100	16	12	4	6	0.1230	1.8872	0.872	0.667
		100 - 300	19	10	9	57	0.8510	7.9960	0.781	0.632
		300 - 700	0							
46.667 - 47.667		0 - 100	0							
		100 - 300	7	1	6	11	0.2688	2.9705	0.857	0.727
		300 - 700	0							
47.667 - 48.667		0 - 100	0							
		100 - 300	11	3	8	53	1.4133	14.7495	0.568	0.472
		300 - 700	0							
OBSERVED TOTAL			1728	1000	728	9739				

Table 5. Halibut bycatch and mortality in the bottom trawl fishery for pink shrimp off the west coast, reported by Williams, et al., Jan. 23, 1998 document.

Year	Trawl Effort (hours)	Estimated Halibut Bycatch (numbers)	Estimated Halibut Bycatch (kg., round)	Estimated Halibut Bycatch (lbs, net)	Estimated Total Halibut Mortality (lbs, net)	Legal-sized Bycatch Mortality (lbs, net)
1987	193,694	20,536	98,983	163,693	81,847	50,745
1992	107,015	10,244	51,671	85,450	42,725	26,490
1995	----	----	----	100,000	50,000	31,000

Note: For 1995, bycatch estimates for Areas 1B-2A off California are not included. Mortality estimated at 50% of bycatch. Proportion of legal-sized mortality (>81 cm) is assumed to be 62% by weight. 1 kg, round = 1.65375 lbs, net weight.

Table 6. Estimated 1998 halibut bycatch and mortality in the bottom trawl fishery for pink shrimp (landings into Oregon ports only). (Bob Hannah, personal communication, October 8, 1999 memo).

Data Source	Single-rig Equivalent Hours (sreh) Observed	Bycatch Rate (lbs/sreh)	Fishing Effort (sreh) in Oregon Landings	Bycatch Estimate (kg., round)	Bycatch Mortality (lbs, net)	Legal-sized Bycatch Mortality (lbs, net)
Pikitch (1)	---	1.22	34,543	19,155	15,839	9,820
Hannah (2)	236.5	2.60	34,543	40,824	33,756	20,929
EDCP (3)	551.1	2.12	34,543	33,287	27,524	17,065

Note: Mortality estimated at 50% of bycatch. Proportion of legal-sized mortality (>81 cm) is assumed to be 62% by weight. 1 kg, round = 1.65375 pounds, net weight.

Table 7. Summary of total estimated bycatch mortality of Pacific halibut, in thousands of pounds, net weight, by fishery in 2A. Bycatch mortality estimates for 1977-1997 are reported from Table 6 in Williams, et al. 1998. Bycatch mortality estimates for 1998 and 1999 are from this report.

Year	Foreign, JV & Catcher-Proc.	Groundfish Trawls	Shrimp Trawls	Hook & Line	TOTAL
1977	3	308	82	16	409
1978	2	308	82	16	408
1979	1	308	82	16	407
1980	1	308	82	16	407
1981	Trace	308	82	16	406
1982	Trace	308	82	16	406
1983	1	308	82	16	407
1984	Trace	308	82	16	406
1985	Trace	308	82	16	406
1986	1	308	82	16	407
1987	1	308	82	16	407
1988	1	308	82	16	407
1989	2	308	82	16	408
1990	2	308	82	16	408
1991	2	308	82	16	408
1992	0	385	43	16	444
1993	0	385	43	16	444
1994	0	385	43	16	444
1995	0	548	50	16	614
1996	0	548	50	16	614
1997	0	548	50	16	614
1998	---	1,015	25	---	---
1999	---	1,009	---	---	---

Note: Bycatch mortality by groundfish trawls in 1998 and 1999 does not include fisheries off California. Bycatch mortality by shrimp trawls in 1998 does not include fisheries off California and Washington.

Table 8. Summary of total estimated bycatch mortality of legal-sized Pacific halibut, in thousands of pounds, net weight, by fishery in 2A. Legal-sized mortality for 1977-1997 is estimated as 62% of total mortality for these years (as given in Table 7). Bycatch mortality estimates for legal-sized halibut for 1998 and 1999 are from this report. (Sums across fisheries may not always equal Total due to rounding.)

Year	Foreign, JV & Catcher-Proc.	Groundfish Trawls	Shrimp Trawls	Hook & Line	TOTAL
1977	2	191	51	10	254
1978	1	191	51	10	253
1979	0.6	191	51	10	252
1980	0.6	191	51	10	252
1981	Trace	191	51	10	252
1982	Trace	191	51	10	252
1983	0.6	191	51	10	252
1984	Trace	191	51	10	252
1985	Trace	191	51	10	252
1986	0.6	191	51	10	252
1987	0.6	191	51	10	252
1988	0.6	191	51	10	252
1989	1	191	51	10	253
1990	1	191	51	10	253
1991	1	191	51	10	253
1992	0	239	27	10	275
1993	0	239	27	10	275
1994	0	239	27	10	275
1995	0	340	31	10	381
1996	0	340	31	10	381
1997	0	340	31	10	381
1998	---	323	16	---	---
1999	---	315	---	---	---

Note: Bycatch mortality by groundfish trawls in 1998 and 1999 does not include fisheries off California. Bycatch mortality by shrimp trawls in 1998 does not include fisheries off California and Washington.