

Prior hook injuries: results from the 2008 IPHC SSA and NMFS surveys

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Abstract

Data on the occurrence of prior hook injuries (PHI) of halibut caught on the standardized stock assessment (SSA) surveys have been collected since 1997. In 2008, the incidence of PHIs decreased in Areas 2C, 3B, 4A-Aleutians, 4A-Bering Sea and 4B, and increased in Areas 2A, 3A, 4C and 4D. Rates remained relatively unchanged in Area 2B. PHI rates remain very high in Areas 4D, and have risen markedly this year in both Areas 4C and 4D. Rates in Area 4A-Aleutians are down markedly from last year. Overall, the coastwide average (7.1 %) has risen only slightly since 2007 (up from 6.6 %). Sublegal PHI rates have decreased in Area 3B and 4A-Aleutians, have risen in Areas 2A, 3A, 4D, and have risen dramatically in Area 4C. Rates of injuries on sublegals have stayed about the same in Areas 2B, 2C, 4A-Bering Sea, and 4B. PHI rates observed during Bering Sea trawl surveys were 2.3 %, about the same as the 2.2 % seen last year.

Introduction

The establishment of a coastwide, comprehensive longline survey along the North American west coast by the International Pacific Halibut Commission (IPHC) provides a unique opportunity to gather information showing geographic differences among components of the Pacific halibut population. In the mid-1990s, halibut fishers began to notice increasing rates of hook injuries from previous captures. Although groundfish and halibut longline harvesters in Alaska are required to practice careful release¹ techniques for all halibut intended for return to the sea, it was suspected that either the regulations were not being observed by all fishers, or that careful release procedures were inflicting worse damage than expected. The IPHC standardized stock assessment (SSA) surveys provide a means of examining geographic and size trends in hook removal injuries across the entire range of halibut in the northeastern Pacific Ocean and Bering Sea.

In 1997, prior hook injury (PHI) data were collected during the IPHC coastwide survey for the first time. The collection method proved to be successful and allowed us to continue the research of PHI incidence in 1998 and subsequent years. In 1998, the PHI categories were expanded to more closely reflect those used by National Marine Fisheries Service (NMFS) observers. These new classifications provided more details about the severity of an individual injury.

Data collection procedures

All halibut captured during the 2008 IPHC grid survey were examined for the presence of PHIs. We examined fewer fish during 2008 than during 2007; the decrease was due primarily to overall lower catch rates. PHIs were defined as injuries that occurred when the fish was being released during a previous capture by hook-and-line gear. The fish may have been hooked recently, in which case the injury should be easily noticed, or the injury may have happened some time in the past and the injury would be scarred over. Some difficulty for the vessel samplers was expected, as

¹Accepted careful release techniques include careful shaking, hook straightening, and gangion cutting.

fresh injuries could be mistakenly attributed to the current capture, whereas old injuries may have been healed sufficiently so as to actually mask or hide the injury. Injuries are observed primarily to the jaw, but may occur to the eye and eye socket, either alone or in conjunction with a jaw injury.

In 1997, a fish was coded as having an injury (Y), not having an injury (N), or unsure as to whether an injury is present (U). In 1998, the observation codes were revised to capture more specific details of the injury. The new condition codes were either “1” for no injury, “2” for a minor injury, “3” for a moderate injury, “4” for a severe injury, or “9” for unknown. These categories have been continued through 2008 and are described in Table 1.

Results

Approximately 75,000 halibut were examined during the 2008 IPHC SSA surveys (Tables 2 and 3). This is similar to the 76,000 halibut examined during 2007. A total of 6,283 standard survey skates was examined in 2008, very similar to the 6,275 skates examined in 2007. In the 2008 surveys, 5,121 halibut were found to have a prior injury. On a regulatory area basis, the percentage of halibut with a prior injury ranged from a low of 3.9 % (Area 3A) to a high of 23.4 % (Area 4D) and averaged 7.1 % coastwide (Table 3). The 2008 coastwide PHI rate was higher than that of either 2007 (6.6 %) or 2006 (6.5 %; Kaimmer and Leickly 2008). The incidence of prior hook injuries on the 2008 surveys decreased in Areas 2C, 3B, 4A-Aleutians, 4A-Bering Sea and 4B. The decrease was marked in Area 4A-Aleutians (4.5% from 13.4 %). PHI rates increased in Areas 2A, 3A, 4C and 4D, markedly so in Areas 4C (15.1 % up from 8.1 %) and 4D (23.4 % up from 15.3 %). Rates remained relatively unchanged in Area 2B. Comparing across areas, the highest 2008 PHI rates were in Areas 4C (15.1 %) and 4D (23.4 %).

Looking at just the sublegal halibut (fork length less than 32 inches or 82 cm), the overall incidence of PHI remained about the same as that observed in 2007 (4.1 % up from 3.8 %). By area, sublegal PHI levels stayed unchanged in Areas 2B, 2C, 4A-Bering Sea and 4B, increased in Areas 2A, 3A, 4C and 4D, and decreased in Areas 3B and 4A-Aleutians. The decrease in Area 4A-Aleutians was dramatic, dropping to 2.9 % from the 10.3 % observed in 2007. The highest occurrences of sublegal PHI were seen in Areas 4C (11.9 %) and 4D (12.2 %).

IPHC samplers on board NMFS trawl surveys in the Bering Sea region also gathered PHI data. In the 2008 Bering Sea trawl survey, 1,711 halibut were inspected and PHI rates were 2.4 %, about the same as the 2.2 % seen in 2007 (Table 4).

Figure 1 illustrates the time series of PHI incidence data collected by IPHC regulatory area. PHI rates in all areas have fluctuated at one time or another. In 2008, the rates have increased markedly in Area 4D, and notably in Areas 2A and 3A. Rates have fallen markedly in Area 4A-Aleutians.

The distribution of injury types within fish that had some type of PHI during 2008 is shown by area in Figure 2. In 2008, the proportion of moderate injuries in Areas 2A, 3A and 4D increased relative to the minor injuries. The distribution in other areas remained relatively unchanged.

Figures 3 through 5 illustrate the geographic distribution of PHIs among halibut caught on IPHC surveys in 2008. These maps display PHI observations divided into either four or five categories that describe the percentage of the catch with any PHI (Figs. 3 and 4) or with severe PHI (Fig. 5). Because PHIs are common throughout the range of halibut, rates of PHI less than 5 % are not shown in Figures 3 and 4. This allows us to indicate more clearly where higher levels

of PHIs were observed. In Figure 5 (severe PHI) we show every non-zero value because severe PHI is not ubiquitous.

Since we started collecting PHI data, the incidence of PHIs in the Gulf of Alaska areas has ranged from 4 to 8 %, and has not exceeded 10 %. This notwithstanding, the widespread nature of high PHIs is demonstrated by localized PHI rates of 25 % or more from some individual stations in these areas, including stations off the Washington and British Columbia coasts, off southeastern Alaska, and below Kodiak Island. Stations with PHI rates between 15 and 25 % are widespread over the entire survey range. Overall values in the Bering Sea regions have recently been 8 % or more, and in Area 4D the value has exceeded 20 % for three of the past five years. Referring to Figures 3 and 4, it is clear that in general a PHI rate of 5 to 15 % at an individual location is very common and the rate is often higher. For example, survey stations in the Bering Sea edge, particularly in Area 4D, show a high rate of PHI (Fig. 3). Figure 5 shows the proportion of observed injuries at any station which are judged to be severe. A high rate of severe injury continues to occur at many of the stations sampled throughout the survey range.

Discussion

The overall rate of PHI occurrences in 2008 remained at about the same high level as seen in recent years. Figure 1 shows that this level has been maintained over the last few years, particularly in the Bering Sea areas, but also in Area 2A, and this year dramatically so in that area. The high PHI rates observed on IPHC surveys in the Bering Sea and Aleutians most likely reflect the interception of halibut by the Pacific cod groundfish fisheries in those areas (Williams 2006).

The impact of halibut PHI goes beyond the injured fish that are observed. The PHI observations provide an accounting of only those fish that survived hooking injuries. Our own studies have shown that moderate and severe injuries often kill fish, and that fish that do survive either stop growing or grow at a much-reduced rate (Kaimmer 1994, Kaimmer and Trumble 1997, 1998).

There has to be a direct connection between the PHI rate (the tally of those fish that have survived catch and release) and bycatch mortality, but the understanding of that connection still eludes us. There are two contrasting interpretations. The first is that an increase in the number of observed PHIs reflects poor handling by fisheries which catch and then release the halibut, with an associated increase in halibut mortality. The alternate theory holds that the presence of more halibut with prior injuries reflects a higher survival rate of those fish that are caught and released, and a resulting lower overall mortality to the stocks. A high rate of PHI, especially severe PHI, indicates that the fishers are releasing fish in a non-lethal way whereas a very low number of severe injuries would indicate that fish are dying after the hooking event.

The available data could support either interpretation. PHI occurrence rates among sublegal halibut tend to be about half the rate seen when we consider all halibut caught. This suggests that the infliction of these injuries does not happen just to smaller-sized halibut, but that injuries continue to accumulate within the stock as the fish survive year to year. An alternative explanation could be that small fish are subject to as many injuries as larger fish, but that the mortality on small fish is higher. In the Bering Sea fisheries, NMFS observer data indicate steady or decreasing rather than increasing halibut mortality from these fisheries over the last decade (Williams 2006). The halibut mortality is a function of both PHI incidence and the severity of individual PHIs. Our survey data indicate that, particularly in the last few years, many of the halibut caught in Area 4 are accumulating a higher proportion of PHIs relative to other areas.

While many fishers undoubtedly handle halibut bycatch with careful release, substantial improvements are unlikely without direct individual incentives for such behavior. The fisher education efforts made in the last decade seem to have only stabilized or reduced the rates of hooking injury. Continued progress in reducing halibut PHI will require the cooperation of all fishers, and may require a more individualized accounting as a disincentive.

Reference

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Table 1. Descriptions of the prior hook injury (PHI) categories used on the 1998-2008 stock assessment surveys.

Injury Locations	Codes only apply to <u>prior</u> hook injuries, if any. Worst injury of jaw, eye, & eye socket prevails.				Did Not Check Or Can't Tell
	None (Code 1)	Minor (Code 2)	Moderate (Code 3)	Severe (Code 4)	Unknown (Code 9)
Jaw	No Injury	Jaw in one piece, not split or separated from head. Skin of lip may be torn, but jaw is intact.	Upper or lower jaw bone may be torn through, hanging from fish, or torn away on either side of the head. Tear may or may not include tearing through the cheek area. Lower or upper jaw may be split laterally, tearing through either snout or lower mouth.	Removal of hook has torn large flap from side of head, usually originating in cheek area. Flap, usually including part of jaw, is either hanging loosely or missing.	Did not examine the fish, or can't tell
Eyeball & Eye socket	No PHI Injury	Eye socket may be torn, but eyeball is undamaged.	Eyeball punctured.		Did not examine the fish, or can't tell

Table 2. Prior hooking injury (PHI) data collected on 2008 standardized stock assessment (SSA) standard grid surveys. Length group definitions: sublegal is ≤ 81 cm; legal is ≥ 82 cm (32 in). This table does not include 1,290 halibut where the length was not recorded.

Reg. Area	Length Group	Injuries										Grand Total
		None		Minor		Moderate		Severe		Unknown		
		No.	%	No.	%	No.	%	No.	%	No.	%	
2A	Sublegal	304	94.1%	10	3.1%	5	1.5%	1	0.3%	3	0.9%	323
	Legal	305	80.9%	44	11.7%	22	5.8%	1	0.3%	5	1.3%	377
	Total	609	85.5%	54	7.6%	27	3.8%	2	0.3%	20	2.8%	712
2B	Sublegal	3,383	93.5%	188	5.2%	32	0.9%	2	0.1%	13	0.4%	3,618
	Legal	2,875	89.3%	220	6.8%	98	3.0%	6	0.2%	21	0.7%	3,220
	Total	6,259	90.5%	408	5.9%	130	1.9%	8	0.1%	108	1.6%	6,913
2C	Sublegal	2,432	95.6%	68	2.7%	17	0.7%	5	0.2%	22	0.9%	2,544
	Legal	2,283	88.8%	157	6.1%	73	2.8%	6	0.2%	51	2.0%	2,570
	Total	4,715	90.9%	225	4.3%	90	1.7%	11	0.2%	146	2.8%	5,187
3A	Sublegal	11,812	94.5%	508	4.1%	78	0.6%	5	0.0%	102	0.8%	12,505
	Legal	14,717	87.7%	1,429	8.5%	328	2.0%	12	0.1%	301	1.8%	16,787
	Total	26,530	89.5%	1,937	6.5%	406	1.4%	17	0.1%	765	2.6%	29,655
3B	Sublegal	12,743	97.0%	257	2.0%	65	0.5%	9	0.1%	59	0.4%	13,133
	Legal	7,543	90.9%	378	4.6%	111	1.3%	5	0.1%	261	3.1%	8,298
	Total	20,289	92.7%	635	2.9%	176	0.8%	14	0.1%	769	3.5%	21,883
4A-Aleu.	Sublegal	2,294	95.4%	59	2.5%	8	0.3%	1	0.0%	43	1.8%	2,405
	Legal	874	89.6%	69	7.1%	12	1.2%	2	0.2%	18	1.8%	975
	Total	3,168	90.3%	128	3.6%	20	0.6%	3	0.1%	189	5.4%	3,508
4A-BSea	Sublegal	1,086	93.0%	61	5.2%	13	1.1%	3	0.3%	5	0.4%	1,168
	Legal	1,194	83.6%	138	9.7%	34	2.4%	4	0.3%	59	4.1%	1,429
	Total	2,281	83.7%	199	7.3%	47	1.7%	7	0.3%	192	7.0%	2,726
4B	Sublegal	424	77.8%	9	1.7%	7	1.3%	1	0.2%	104	19.1%	545
	Legal	1,421	84.7%	83	4.9%	82	4.9%	6	0.4%	86	5.1%	1,678
	Total	1,845	82.5%	92	4.1%	89	4.0%	7	0.3%	203	9.1%	2,236
4C	Sublegal	238	87.8%	21	7.7%	11	4.1%		0.0%	1	0.4%	271
	Legal	217	78.6%	28	10.1%	21	7.6%		0.0%	10	3.6%	276
	Total	455	81.8%	49	8.8%	32	5.8%		0.0%	20	3.6%	556
4D	Sublegal	396	87.6%	37	8.2%	18	4.0%		0.0%	1	0.2%	452
	Legal	611	69.6%	129	14.7%	116	13.2%	8	0.9%	14	1.6%	878
	Total	1,007	73.7%	166	12.2%	134	9.8%	8	0.6%	51	3.7%	1,366
Grand Total		67,158	89.9%	3,893	5.2%	1,151	1.5%	77	0.1%	2,463	3.3%	74,742

Table 3. Summary of PHI data collected during the 2008 SSA setline surveys. This table does not include 2,463 halibut where the PHI was coded as ‘unknown’.

Reg. Area	No. of sets	No. Std. Skates	<u>All halibut¹</u>				<u>Sublegal halibut (<82 cm)</u>		
			No. examined	No. fish with injury	% with injury	No. inj. per std. Skate	No. with injury ¹	% with injury	No. inj. per std. Skate
2A	84	422	692	83	12.0%	0.20	16	5.0%	0.04
2B	170	845	6,805	546	8.0%	0.65	222	6.2%	0.26
2C	123	609	5,041	326	6.5%	0.54	90	3.6%	0.15
3A	375	1,878	28,890	2,360	8.2%	1.26	591	4.8%	0.31
3B	230	1,149	21,114	825	3.9%	0.72	331	2.5%	0.29
4A-Aleu.	53	263	3,319	151	4.5%	0.57	68	2.9%	0.26
4A-Bsea	89	434	2,557	253	9.9%	0.58	77	6.6%	0.18
4B	61	303	2,010	188	9.4%	0.62	17	3.9%	0.06
4C	19	93	536	81	15.1%	0.87	32	11.9%	0.34
4D	58	288	1,315	308	23.4%	1.07	55	12.2%	0.19
Total	1,262	6,283	72,279	5,121	7.1%	0.82	1,499	4.1%	0.24

¹Numbers do not include fish with PHI coded Unknown (i.e., unknown ,forgot to check, can't tell)

Table 4. Prior hook injury data collected on the 1998-2008 NMFS trawl surveys by IPHC samplers.

	1998	1999	2000	2001	2002	2003	2005	2006	2007	2008
Bering Sea										
Total number examined	903	831	661	1,002	843	835	883	2955	1,570	1,711
No without injuries	839	814	630	958	54	806	846	2905	1,535	1,670
Minor injuries	24	6	24	30	45	23	20	24	20	18
Moderate injuries	28	6	7	12	9	4	15	13	12	23
Severe injuries	12	5	-	2	-	2	1	1	3	0
Unknown or not examined	-	-	-	-	-	-	1	12	4	0
Percent of halibut with PHI	7.1	2.8	4.7	4.4	6.3	3.5	4.2	1.3	2.2	2.3
Gulf of Alaska										
Total number examined	-	2,347	624	3,176	-	8,954	2,599	-	2,598	-
No without injuries	-	2,279	559	3,083	-	8,248	2,505	-	2,472	-
Minor injuries	-	23	39	34	-	30	34	-	73	-
Moderate injuries	-	26	20	46	-	82	51	-	45	-
Severe injuries	-	19	6	5	-	10	7	-	6	-
Unknown or not examined	-	-	-	8	-	584	2	-	2	-
Percent of halibut with PHI	-	2.9	10.4	2.7	-	1.5	3.6	-	4.8	-



Figure 1. Trends in the percent of halibut observed with any prior hook injuries (PHI) during the 1997-2008 IPHC standardized stock assessment (SSA) surveys.

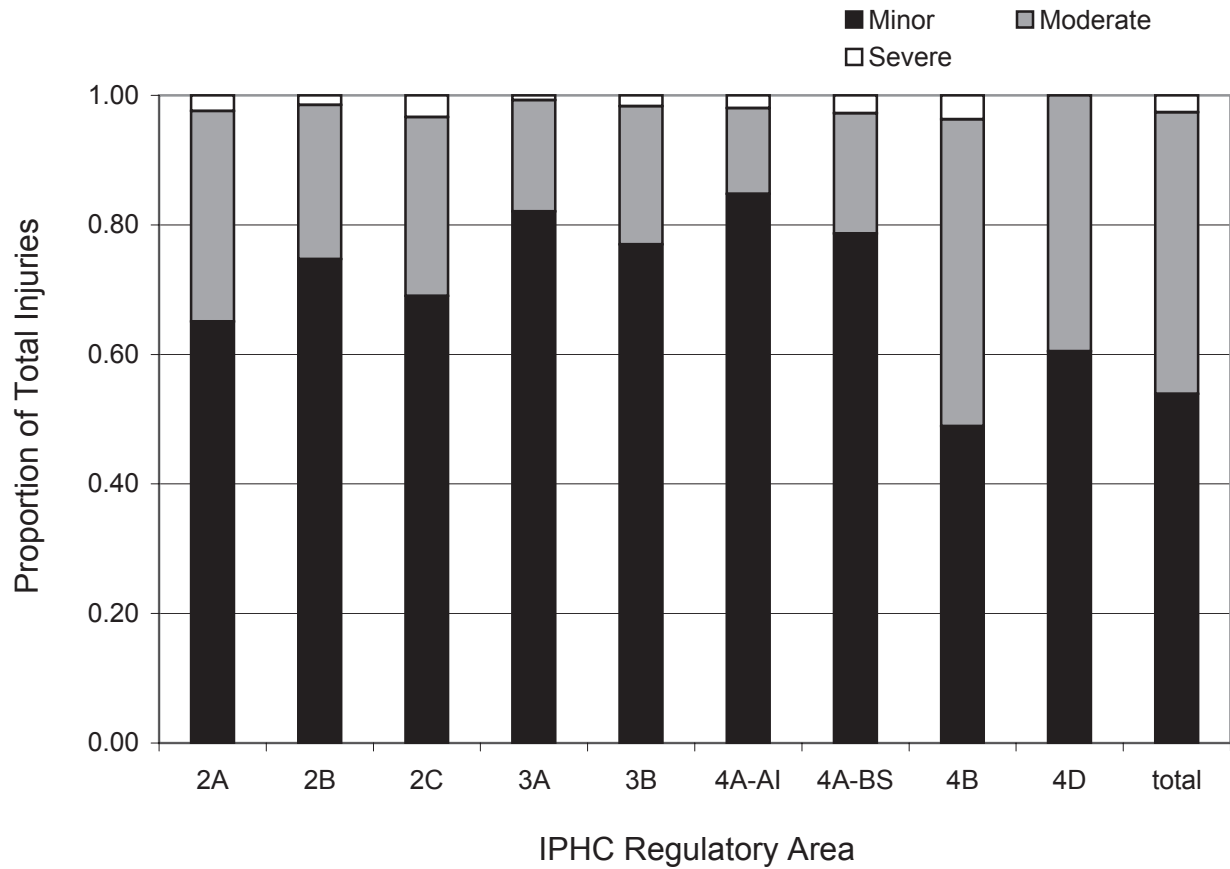


Figure 2. Distribution of injury severity on fish with injuries from the 2008 standardized stock assessment (SSA) surveys (AI = Aleutians; BS = Bering Sea).

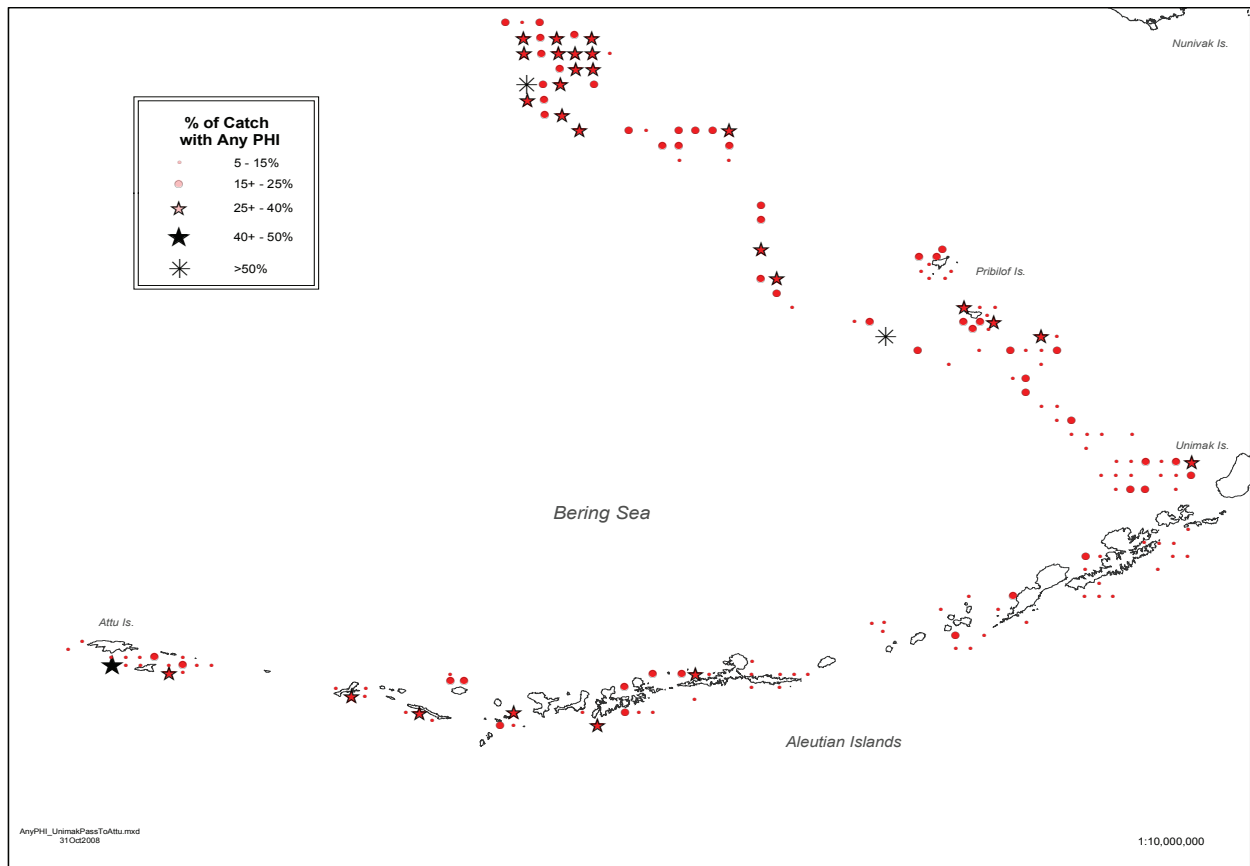


Figure 3. Distribution of 2008 survey stations depicting the proportion of prior hook injuries (PHI) among observed halibut in the western Gulf of Alaska and Bering Sea survey regions. Stations with <5% PHI observed are not shown.

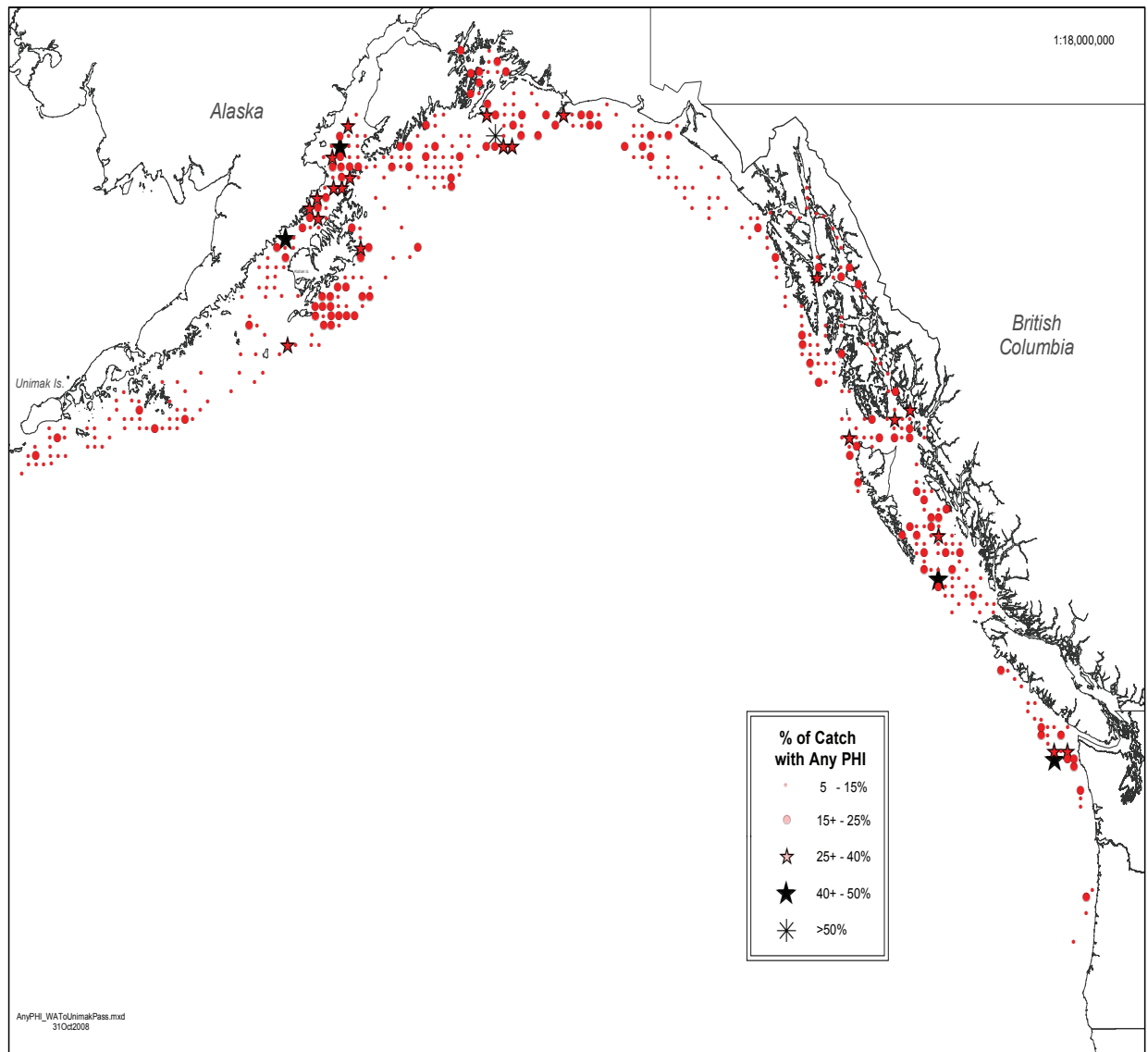


Figure 4. Distribution of 2008 survey stations depicting the proportion of prior hook injuries (PHI) among observed halibut in the eastern Gulf of Alaska, British Columbia, and U.S. West Coast survey regions. Stations with <5% PHI observed are not shown.

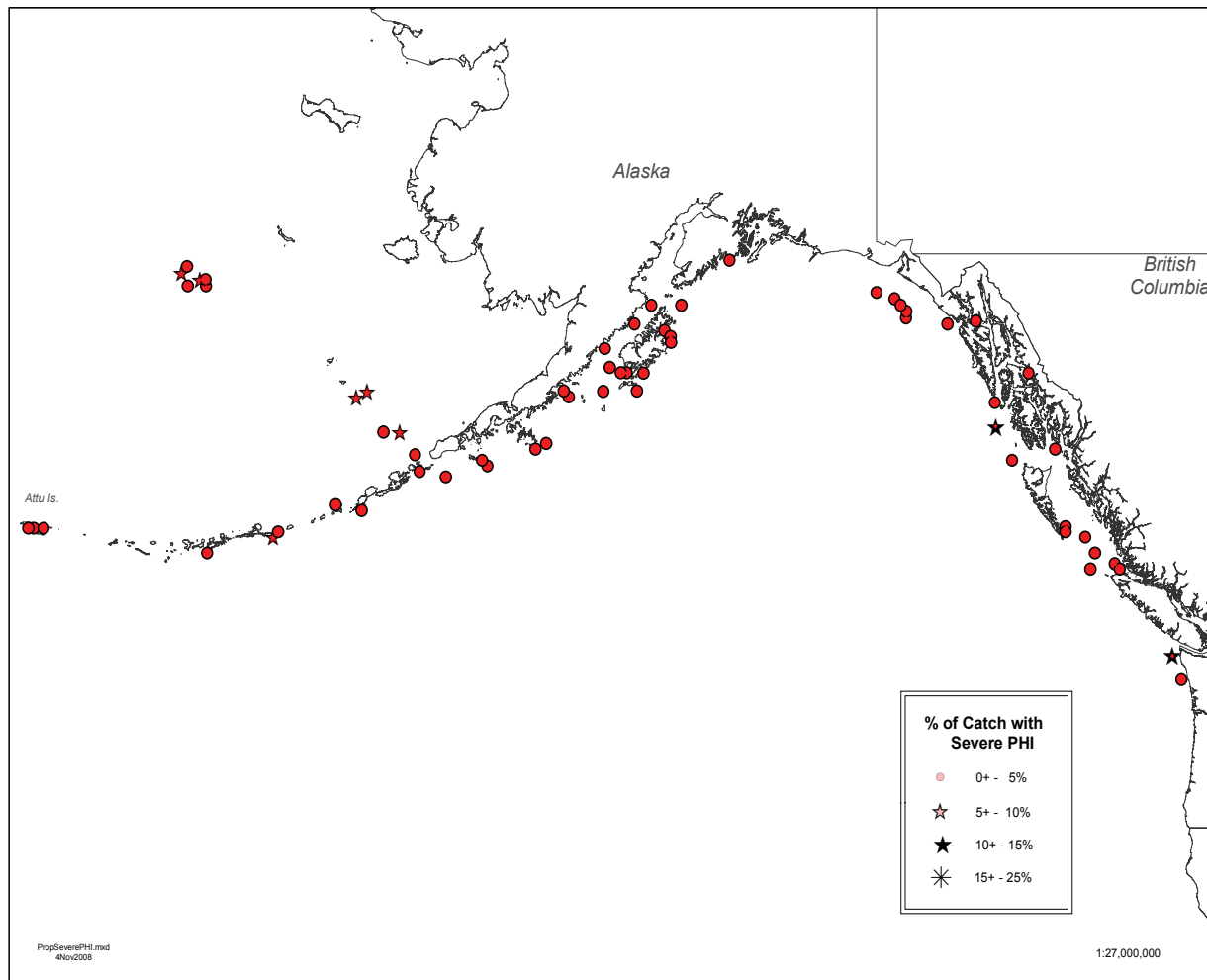


Figure 5. Location of 2008 survey stations according to the proportion of severe prior hook injuries (PHI) among observed halibut. Stations with less than four halibut or with no observed severe PHI are not shown.