

Recommendations for Pacific halibut discard mortality rates in the 2013-2015 groundfish fisheries off Alaska

Gregg H. Williams

Abstract

Analysis of 2009-2011 observer data on the release condition of halibut from trawl, longline and pot vessels fishing groundfish off Alaska has resulted in new estimates of discard mortality rates for discarded halibut in each target fishery in those years. The new rates are similar to those determined in previous analyses. The rates were added to the accumulated time series and serve as the basis for recommendations to the North Pacific Fishery Management Council and the National Marine Fisheries Service for assumed rates to be used in the inseason estimation of halibut bycatch mortality for the 2013-2015 groundfish fisheries off Alaska.

Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability (injury and condition) data collected by fishery observers. These data are analyzed each year by staff of the International Pacific Halibut Commission (IPHC). This paper reports on an analysis of viability data collected during the 2009-2011 Community Development Quota (CDQ) and non-CDQ groundfish fisheries off Alaska. The results also form the basis for recommended DMRs to be used for inseason estimation and management of halibut bycatch mortality in the 2013-2015 CDQ and non-CDQ groundfish fisheries.

Data description and methods

The analysis followed the same approach that has been employed since 1996, which was originally described by Williams (1996). Observer haul data from the NMFS groundfish observer database formed the basis of the analysis. The data records included the catch of groundfish by species or species group, estimates of the number and weight (kg) of halibut, and the number and length of halibut assessed for release viability by category (excellent/poor/dead for trawl and pot gear; minor/moderate/severe/dead for longline gear). Records for all hauls sampled by observers in 2009-2011 were obtained; hauls not sampled for species composition were excluded.

The records were assigned to target fishery categories based on the catch of the particular species within the haul catch composition, relative to the overall total and retained catches (Table 1). For example, hauls were coded as midwater pollock if pollock comprised 95% or more of the summed total catch for the reporting week (Sunday-Saturday). Flatfish targets in the Bering Sea/Aleutians (BSA) were determined in a succession of comparisons of individual flatfish species compositions in the catch. The determination for the flatfish targets was based on the greatest percentage of the non-arrowtooth flounder catch. Table 1 shows the target codes and definitions used.

Fishery observers examined halibut for release condition or injury immediately before being returned to the sea. Each fish was judged according to a set of criteria (Williams and Chen 2003), which were used to determine the presence and extent of internal and external injuries, and body damage from predators (e.g., amphipods and marine mammals). A dichotomous key, introduced

in 2000, was supplied to observers to reduce subjectivity in the determinations of condition and injury. Observers recorded the number of halibut in excellent, poor, and dead condition (trawls and pots) or with minor, moderate, severe injuries, or dead (longlines) on each haul or set sampled, respectively. Samples were only collected on hauls that were sampled for species composition. The species composition sampling provides an estimate of the total number of halibut caught in the haul, as well as the catch of groundfish, necessary for determining the target. Observers were instructed to limit the number of fish examined to a maximum of 20, although this was occasionally exceeded by enthusiastic observers.

Next, the viability distribution for a target fishery was calculated. First, for each haul, the proportion of halibut in each category was extrapolated to the total number of halibut caught. The extrapolated numbers of halibut for each vessel by viability category were then summed within each region/gear/target strata.

The general model for calculating the DMR for halibut caught by gear g was of the form:

$$DMR_g = \sum_{i=1}^4 (m_{i,g} \times P_i)$$

where m is the mortality rate for gear g , and P is the proportion of halibut in condition i , where 1 is excellent/minor, 2 is poor/moderate, 3 is dead (trawl or pot)/severe, and 4 is dead (longline).

There are several factors that contribute to release viability, which vary by gear type. With trawl-caught halibut, condition is related to the size of the catch, tow duration, and halibut size. For longline bycatch, injuries are most frequently caused by improper release methods used by vessel crews. Another significant factor is the length of the soak time, which can exacerbate the mortality caused by hooking injuries and also increase the potential for amphipod predation. The condition of halibut caught in pots is affected by soak time and the presence of other animals in the pot, especially crabs, whose spiny carapace has been observed to scratch and abrade the skin of the captive halibut.

The mortality rate m varies among gear types and represents the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods or marine mammals. The mortality rates have been determined through long term tagging studies conducted by IPHC. See Clark et al. (1992) for trawls, Williams (1996) for pots, and Kaimmer and Trumble (1998) for longlines. Estimated halibut mortality rates by gear and condition/injury were as follows:

Gear (g)	m_{exc}	m_{poor}	m_{dead}	
Trawl	0.20	0.55	0.90	
Pot	0.00	1.00	1.00	
	m_{minor}	$m_{moderate}$	m_{severe}	m_{dead}
Longline	0.035	0.363	0.662	1.00

Mean fishery DMRs and associated standard errors were estimated by assuming that each vessel acts as a separate sampling unit, so that a DMR was calculated for each individual vessel in a target fishery. The DMR for a target fishery was then estimated as the mean of vessel DMRs, where the vessel's proportion of the total number of bycaught halibut was used as a weighting factor, as follows:

Let DMR_v = observed DMR on vessel v
 p_v = proportion of total number of halibut caught on vessel v in a fishery

$$\text{Then } \overline{DMR} = \sum_{v=1}^n (p_v \times DMR_v)$$

Standard errors of the weighted mean DMR were estimated as:

$$V(\overline{DMR}) = \sum_{v=1}^n (p_v^2 \times V(DMR_v))$$

and $SE(\overline{DMR}) = \sqrt{V(\overline{DMR})}$

where $V(DMR_v)$ is the sample variance of all the DMR_{s_v} , and $V(\overline{DMR})$ and $SE(\overline{DMR})$ are the variance and standard error of \overline{DMR} , respectively.

Results

Non-CDQ fisheries

A summary of observer coverage, sampling, and halibut size composition data is shown in Table 2. Coverage and sampling in the major targets produced a large number of sampled hauls, and a substantial number of halibut sampled. For example, observers sampled over 5,000 hauls and 4,200 halibut in the BSA midwater pollock fishery in 2009. Two flatfish targets, yellowfin and rock soles, often had some of the largest halibut sample sizes than any other target. Sample sizes were generally very high (>1,000 hauls and/or >1,000 halibut measured) in most BSA trawl fisheries. The longline fishery for cod was the only BSA longline fishery to receive significant sampling in 2009-2011. In past years, sampling has also occurred on rockfish and turbot vessels but only minimally, and 2009-2011 was no exception, as only turbot fishing had any sampling. Pot fishing was focused on cod, as in past years.

Most of the sampling in GOA trawl fisheries occurred in the cod, rockfish, and flatfish targets. The rockfish fishery tallied the largest number of observed tows; this probably reflects the higher observer coverage requirements of the Central Gulf Rockfish Program. Sampling of the cod and the two pollock fisheries occurred at similar levels (31-39 vessels; roughly 200-400 hauls). Sampling of flatfish fishing occurred in the shallow water flatfish, arrowtooth, and rex sole targets. Only minimal vessel effort was noted in the deepwater flatfish target, which in past years was primarily directed at Dover sole. The number of sampled longline and pot vessels targeting cod was similar to past years.

Sampling and fishery totals of release viability (condition or injury) data by region and fishery are summarized in Table 3. The sample totals represent the summed observations recorded by observers. In most cases, these raw data total less than those shown in Table 2, as the latter include some halibut which were not examined for condition/injury. The observations on each haul were extrapolated upwards to the total number of halibut caught on the haul, and then summed across vessel and target fishery strata. For most fisheries, the distribution of the extrapolated viability data is very similar to the raw data. The complete time series of fishery DMRs is provided in Tables 4 and 5 for the BSA and GOA, respectively.

CDQ fisheries

In 2009-2011, CDQ fishing was conducted using pots, trawls, and longlines. The primary species targeted by trawl operations included pollock, and rock sole and yellowfin sole during 2010-2011. Pacific cod were targeted by longline, and sablefish by pots. Sampling levels and injury/viability data for CDQ operations are summarized in Table 6; the time series of mean annual DMRs is shown in Table 7.

Almost all halibut caught in the trawl operations were dead when examined. Typically this is caused by a larger haul size and/or longer haul duration.

Of the 13 DMRs calculated for the 2009-2011 CDQ trawl targets, all but two were either 0.89 or 0.90. These results are generally higher than what is seen in non-CDQ fishing for the same target, which suggests there are other variables which are negatively affecting the condition of the released halibut. For example, different catch processing or handling methods for CDQ hauls may contribute to poorer release viability.

Longline CDQ fishing consisted of 14-17 vessels targeting cod. In previous analyses, the distribution of release injuries to halibut in the CDQ longline cod fishery has been similar to that observed in the non-CDQ cod fishery. However, the results for 2010 were much higher than the non-CDQ results (0.18 in CDQ vs. 0.09 in non-CDQ).

The pot fishery targeted sablefish, with either two or three vessels observed. Very few halibut were examined by observers, but not many halibut were caught. The fishery DMR (0.50) was unchanged during 2009-2010, but dropped quite a bit (0.31) in 2011, more in line with the long term mean. Halibut mortality is positively correlated with longer pot soak time; long soaks increase the potential for amphipod predation of captured fish in the pot.

Recommendations for 2013-15

The Council is using a plan in which the DMRs used to monitor halibut bycatch are an average of data from the most recent 10-year period. These 10-year mean DMRs for each fishery are used for a 3-year period, with the justification being two-fold: 1) interannual variability of fishery DMRs is relatively small, and 2) to provide stability for the industry to better plan their operations. The following table outlines the range of data used for the specific years of application:

10-Year Basis Period	Years of application
1990-1999	2001 - 2003
1993-2002	2004 – 2006
1996-2005	2007 - 2009
1999-2008	2010 - 2012
2002-2011	2013 - 2015

As shown, information from 2002-2011 is the basis for the DMR recommendations for 2013-2015. The 10-year mean DMRs for 2013-2015 are shown in Table 8. For some targets, a full ten years of data is not available, so the recommended DMR is based on whatever data are available from the 2002-2011 basis period.

For CDQ targets with no past observations or data, such as longline turbot, and pot cod, DMRs derived from non-CDQ fisheries data are recommended. For the 'other species' and any

other target not explicitly noted here in the non-CDQ fisheries, the DMR for the cod fishery in that region/gear stratum is recommended.

References

Clark, W.G., Hoag, S.H., Trumble, R.J., and Williams, G.H. 1992. 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.

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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* 1996:211-228.

Williams, G.H. and Chen, D. 2004. Pacific halibut discard mortality rates in the 1990-2002 Alaskan groundfish fisheries, with recommendations for monitoring in 2004-2006. *Int. Pac. Halibut Comm. Report of Assessment and Research Activities* 2003:227-244.

Table 1. Groundfish target definitions and target determination criteria for observer sampled hauls.

BSA		GOA	
Target	Definition	Target	Definition
A	Atka mackerel	A	Atka mackerel
B	Bottom pollock	B	Bottom pollock
C	Pacific cod	C	Pacific cod
F	Other flatfish	D	Deep water flatfish
K	Rockfish	H	Shallow water flatfish
L	Flathead sole	K	Rockfish
O	Other spp.	L	Flathead sole
P	Midwater pollock	O	Other spp.
R	Rock sole	P	Midwater pollock
S	Sablefish	S	Sablefish
T	Greenland turbot	W	Arrowtooth flounder
W	Arrowtooth flounder	X	Rex sole
Y	Yellowfin sole		

CDQ and Non-CDQ TARGET FISHERY DETERMINATION

Bering Sea/Aleutians

P	if pollock ≥ 95% of total catch, or
W	if arrowtooth flounder ≥ 65% of total catch.
Y/R/L/F	if (rock sole + other flatfish + yellowfin sole + flathead) is the largest component of the retained catch using this rule:
Y	if yellowfin sole is ≥ 70% of (rock sole + other flatfish + yellowfin sole + flathead sole), or
R	if rock sole > other flatfish and rock sole > flathead sole, or
L	if flathead sole > other flatfish and flathead sole > rock sole, or
F	if none of the three conditions above are met.

Note: If target is not P, W, Y, R, L or F, then target is whichever species or species group (A, B, C, K, O, S, or T) forms the largest part of the total catch.

Gulf of Alaska

P	if pollock ≥ 95% of total catch, or
W	if arrowtooth flounder ≥ 65% of total catch.

Note: If target is not P or W, then target is whichever species or species group (A, B, C, D, H, K, L, O, S, or X) forms the largest part of the total catch.

Table 2. Summary information on fishery effort, observer sampling, and halibut bycatch size composition in nonCDQ fisheries.

2009						
Area/Gear /Target	No. of vsls Sampled	No. of sampled hauls	No. of fish Measured	Mean length (cm)	Percent <65 cm	Percent < 82 cm
<i>BSA Longline</i>						
Pacific cod	37	5723	9372	66.3	50	88
Turbot	2	40	2	77.5	0	50
<i>BSA Pot</i>						
Pacific cod	22	434	57	69.1	0	13
<i>BSA Trawl</i>						
Atka mackerel	7	1149	190	118.7	8	33
Bottom pollock	103	3901	12286	46.7	93	98
Pacific cod	57	2306	3711	54.4	77	93
Other flatfish	0	0	0	--	--	--
Rockfish	10	407	245	65.2	52	80
Flathead sole	12	1165	1883	58.6	71	92
Midwtr pollock	84	5576	4237	69.1	47	78
Rock sole	23	2510	14449	40.5	95	98
Sablefish	0	0	0	--	--	--
Turbot	6	618	149	97.4	11	48
Arrowtooth flndr	3	225	214	67.3	45	92
Yellowfin sole	28	4132	11050	45.4	87	95
<i>GOA Longline</i>						
Pacific cod	21	509	1395	66.9	48	88
<i>GOA Pot</i>						
Pacific cod	15	140	78	71.6	27	76
<i>GOA Trawl</i>						
Bottom pollock	33	289	178	59.5	73	97
Pacific cod	33	293	1582	53.6	84	99
Dp wtr flatfish	0	0	0	--	--	--
Shall wtr flatfish	26	380	1677	54.7	75	93
Rockfish	41	1259	587	73.3	33	75
Flathead sole	11	86	254	54.2	77	94
Midwtr pollock	32	189	9	67.3	22	100
Sablefish	11	76	44	86.8	7	39
Arrowtooth flndr	16	94	281	61.1	70	90
Rex sole	8	352	1088	58.1	72	96

Table 2. (cont'd)

2010						
Area/Gear /Target	No. of vsls Sampled	No. of sampled hauls	No. of fish Measured	Mean length (cm)	Percent <65 cm	Percent < 82 cm
<i>BSA Longline</i>						
Pacific cod	35	5019	8737	66.7	51	90
Turbot	5	202	17	81.1	17	88
<i>BSA Pot</i>						
Pacific cod	34	571	453	67.2	38	95
<i>BSA Trawl</i>						
Atka mackerel	7	1209	172	99.1	23	51
Bottom pollock	73	1805	3301	54.2	84	96
Pacific cod	45	1042	3640	48.2	91	98
Other flatfish	1	18	187	54.9	82	95
Rockfish	9	428	365	70.1	49	75
Flathead sole	12	1137	1611	63.0	62	88
Midwtr pollock	85	6344	4231	64.4	58	85
Rock sole	19	4091	15310	45.9	90	98
Sablefish	0	0	0	--	0	0
Turbot	6	792	270	106.0	14	31
Arrowtooth flndr	1	32	11	81.3	9	55
Yellowfin sole	26	5089	7905	54.8	79	95
<i>GOA Longline</i>						
Pacific cod	19	781	2048	70.3	31	85
<i>GOA Pot</i>						
Pacific cod	10	143	215	78.9	5	68
<i>GOA Trawl</i>						
Bottom pollock	35	266	547	61.2	66	91
Pacific cod	37	421	1940	54.8	84	97
Dp wtr flatfish	1	13	29	51.9	83	100
Shall wtr flatfish	18	251	901	54.9	77	94
Rockfish	43	1194	751	71.7	30	78
Flathead sole	14	182	431	64.6	57	82
Midwtr pollock	31	202	49	62.8	65	94
Sablefish	9	47	27	69.7	26	89
Arrowtooth flndr	1	5	19	63.0	58	74
Rex sole	8	357	1744	60.5	66	95

Table 2. (cont'd)

2011						
Area/Gear /Target	No. of vsls Sampled	No. of sampled hauls	No. of fish Measured	Mean length (cm)	Percent <65 cm	Percent < 82 cm
<i>BSA Longline</i>						
Pacific cod	31	6094	11536	64.5	56	91
Turbot	7	212	21	71.3	38	81
<i>BSA Pot</i>						
Pacific cod	32	768	1087	64.6	49	97
<i>BSA Trawl</i>						
Atka mackerel	7	1045	521	74.0	39	72
Bottom pollock	101	4241	5881	50.8	85	97
Pacific cod	44	1373	4320	49.5	90	98
Other flatfish	0	0	0	--	--	--
Rockfish	15	646	465	71.7	48	78
Flathead sole	10	599	1009	65.8	55	84
Midwtr pollock	98	11555	5115	58.8	69	92
Rock sole	20	2681	8422	43.1	89	97
Sablefish	0	0	0	--	--	--
Turbot	9	435	245	90.7	17	45
Arrowtooth flndr	5	215	379	67.0	36	92
Yellowfin sole	29	6279	6608	58.3	70	92
<i>GOA Longline</i>						
Pacific cod	16	941	2379	69.5	37	84
<i>GOA Pot</i>						
Pacific cod	16	386	1343	76.0	6	80
<i>GOA Trawl</i>						
Bottom pollock	31	260	563	63.0	59	89
Pacific cod	40	518	2751	60.0	69	97
Dp wtr flatfish	2	19	5	55.8	100	100
Shall wtr flatfish	8	59	257	60.0	65	94
Rockfish	39	1126	825	72.0	34	73
Flathead sole	15	147	309	59.0	76	90
Midwtr pollock	39	328	5	76.2	40	80
Sablefish	12	65	42	74.8	31	74
Arrowtooth flndr	14	208	268	66.3	53	87
Rex sole	6	255	1008	61.7	64	95

Table 3. Distribution of halibut viability/injury data by target fishery.

2009								
Target	Sample totals			Projected fishery totals				
	Exc	Poor	Dead	Exc	Poor	Dead	DMR	SE
<i>BSA Trawl</i>								
Atka mackerel	0	0	15	0	0	1035	0.900	0.0000
Bottom pollock	29	54	10924	3229	2859	206254	0.881	0.0108
Pacific cod	252	166	986	8363	4724	39002	0.764	0.0134
Other flatfish	0	0	0	0	0	0	--	--
Rockfish	16	16	103	284	599	5333	0.826	0.0107
Flathead sole	77	62	249	1646	1539	5858	0.753	0.0317
Midwtr pollock	28	40	4078	844	113	17307	0.842	0.0183
Rock sole	48	280	4873	1839	12810	291328	0.881	0.0180
Arrowtooth flounder	0	0	0	0	0	0	--	--
Yellowfin sole	86	129	3991	2132	4345	314938	0.874	0.0131
<i>BSA Pot</i>								
Pacific cod	51	4	2	161	15	6	0.113	0.1283
<i>GOA Trawl</i>								
Bottom pollock	34	30	49	3493	679	1997	0.574	0.0690
Pacific cod	334	186	560	14418	6779	25036	0.621	0.0465
Shall wtr flatfish	226	310	462	5539	10740	17238	0.635	0.0478
Rockfish	93	88	138	1732	598	4101	0.670	0.0419
Flathead sole	20	4	10	529	121	319	0.452	0.0100
Midwtr pollock	0	0	0	0	0	0	--	--
Arrowtooth fldr	37	49	153	2785	2680	11634	0.690	0.0559
Rex sole	32	67	399	876	1680	21925	0.841	0.0396
<i>GOA Pot</i>								
Pacific cod	55	16	7	178	72	30	0.306	0.1552

Target	Sample totals				Projected fishery totals					
	Minor	Mod	Severe	Dead	Minor	Mod	Severe	Dead	DMR	SE
<i>BSA Longline</i>										
Pacific cod	8319	705	111	124	243517	20620	3353	3992	0.084	0.0181
Turbot	1	0	1	0	0	29	0	29	0.349	--
<i>GOA Longline</i>										
Pacific cod	1230	94	15	56	53024	4597	727	2634	0.103	0.0397

Table 3. (cont'd)

2010								
Target	Sample totals			Projected fishery totals				
	Exc	Poor	Dead	Exc	Poor	Dead	DMR	SE
BSA Trawl								
Atka mackerel	0	1	19	0	83	971	0.871	0.0265
Bottom pollock	45	78	2376	2220	2945	31493	0.776	0.0058
Pacific cod	540	507	1377	16693	16084	34176	0.626	0.0069
Other flatfish	0	0	0	0	0	0	--	--
Rockfish	1	0	3	103	0	366	0.667	0.0057
Flathead sole	3	18	173	49	568	4282	0.822	0.0010
Midwtr pollock	7	13	3772	487	117	17254	0.867	0.0030
Rock sole	49	135	5045	2048	5543	228545	0.878	0.0035
Arrowtooth flounder	0	0	0	0	0	0	--	--
Yellowfin sole	188	226	2083	5831	6276	94215	0.847	0.0062
BSA Pot								
Pacific cod	384	48	10	1158	113	36	0.119	0.0536
GOA Trawl								
Bottom pollock	137	130	140	4814	6285	4457	0.535	0.0188
Pacific cod	226	282	705	4852	7487	20411	0.695	0.0089
Shall wtr flatfish	193	194	254	7136	6925	9676	0.555	0.0377
Rockfish	51	90	79	850	1605	2527	0.662	0.0065
Flathead sole	30	68	137	754	1414	6284	0.731	0.0490
Midwtr pollock	0	0	0	0	0	0	--	--
Arrowtooth fldr	0	0	10	0	0	585	0.900	0.0000
Rex sole	49	23	378	1155	1001	22087	0.803	0.273
GOA Pot								
Pacific cod	194	9	9	704	39	54	0.130	0.0618

Target	Sample totals				Projected fishery totals					
	Minor	Mod	Severe	Dead	Minor	Mod	Severe	Dead	DMR	SE
BSA Longline										
Pacific cod	6753	736	99	186	219512	17264	2270	6453	0.089	0.0097
Turbot	16	1	0	0	376	17	0	0	0.062	0.0000
GOA Longline										
Pacific cod	1823	157	13	55	51683	5121	223	2152	0.093	0.0157

Table 3. (cont'd)

2011								
Target	Sample totals			Projected fishery totals				
	Exc	Poor	Dead	Exc	Poor	Dead	DMR	SE
BSA Trawl								
Atka mackerel	12	6	19	514	258	1455	0.667	0.0420
Bottom pollock	70	68	4501	3762	4233	95067	0.848	0.0087
Pacific cod	560	1062	1502	13653	24350	29397	0.646	0.0354
Other flatfish	0	0	0	0	0	0	---	---
Rockfish	14	15	60	381	206	3305	0.874	0.0120
Flathead sole	21	16	32	357	349	821	0.551	0.0142
Midwtr pollock	13	32	4297	819	1533	26690	0.860	0.0137
Rock sole	74	39	650	2281	1718	51253	0.840	0.0315
Arrowtooth fldr	0	0	0	0	0	0	---	---
Yellowfin sole	119	94	967	3871	4379	57537	0.785	0.0373
BSA Pot								
Pacific cod	997	37	50	3326	134	158	0.128	0.1670
GOA Trawl								
Bottom pollock	115	75	156	3753	3814	6399	0.566	0.0396
Pacific cod	416	371	382	19808	13203	16978	0.515	0.0324
Shall wtr flatfish	77	81	65	2486	1443	2856	0.524	0.0954
Rockfish	64	152	121	1547	4913	4220	0.629	0.0514
Flathead sole	33	31	195	713	724	5790	0.691	0.0913
Midwtr pollock	0	0	0	0	0	0	--	--
Sablefish	22	5	4	143	49	22	0.370	0.0086
Arrowtooth fldr	3	8	15	105	209	623	0.807	0.0152
Rex sole	35	102	257	1428	3243	10483	0.818	0.0205
GOA Pot								
Pacific cod	1015	84	104	3063	357	210	0.103	0.0721

Target	Sample totals				Projected fishery totals					
	Minor	Mod	Severe	Dead	Minor	Mod	Severe	Dead	DMR	SE
BSA Longline										
Pacific cod	9285	849	121	250	291669	23754	3877	10531	0.089	0.0259
Turbot	19	1	1	0	690	92	44	0	0.090	0.0087
GOA Longline										
Pacific cod	2010	205	31	53	62782	4753	682	1604	0.082	0.0324

Table 4. Summary of halibut discard mortality rates (DMRs) in the non-CDQ Bering Sea/Aleutian (BSA) groundfish fisheries during 1990-2011.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
<i>BSA Trawl</i>																						
Atka mackerel	66	77	71	69	73	73	83	85	77	81	77	73	85	67	63	67	64	89	90	90	87	67
Bottom pollock	68	74	78	78	80	73	79	72	80	74	67	74	78	65	73	79	74	69	79	88	78	85
Pacific cod	68	64	69	67	64	71	70	67	66	69	69	69	69	67	70	81	77	78	61	76	63	65
Other Flatfish	80	75	76	69	61	68	67	71	78	63	76	81	77	79	80	65	82	-	41	-	-	-
Rockfish	65	67	69	69	75	68	72	71	56	81	89	85	73	84	68	79	90	87	73	83	67	87
Flathead sole	-	-	-	-	67	62	66	57	70	79	74	69	60	69	70	83	75	80	79	75	82	55
Midwtr pollock	85	82	85	85	80	79	83	87	86	87	88	89	90	89	88	90	90	90	85	84	87	86
Rock sole	64	79	78	76	76	73	74	77	79	81	75	77	83	82	85	84	83	83	86	88	88	84
Sablefish	46	66	-	26	20	-	-	-	-	90	60	-	-	-	-	-	-	-	-	-	-	-
Turbot	69	55	-	-	58	75	70	75	86	70	74	68	75	67	31	82	-	-	-	-	-	-
Arrowtooth fldr	-	-	-	-	-	-	-	-	-	-	-	-	-	67	67	90	-	-	78	-	-	-
Yellowfin sole	83	88	83	80	81	77	76	80	82	78	77	74	77	81	86	85	87	77	87	87	85	79
<i>BSA Pot</i>																						
Pacific cod	12	4	12	4	10	10	7	4	13	9	13	6	5	6	7	3	8	15	4	11	12	13
<i>BSA Longline</i>																						
Pacific cod	19	23	21	17	15	14	12	11	11	12	12	12	10	8	10	8	10	9	8	8	9	9
Rockfish	17	55	-	6	23	-	20	4	52	-	12	10	4	-	-	-	-	-	-	-	-	-
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	17	14	6	23	7	4	6	8	-	17	35	6	9

Table 5. Summary of halibut discard mortality rates (DMRs) in the Gulf of Alaska (GOA) groundfish fisheries during 1990-2011.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
<i>GOA Trawl</i>																						
Atka mackerel	67	89	81	67	53	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bottom pollock	51	62	66	57	48	66	79	66	55	55	52	58	55	47	73	45	70	69	70	57	54	57
Pacific cod	60	62	66	59	53	64	70	62	64	54	57	67	59	69	63	66	56	61	63	62	70	52
Deep wtr flats	61	58	70	59	60	56	71	61	51	51	62	49	48	31	49	-	-	-	-	-	-	-
Shall wtr flats	66	71	69	65	62	70	71	71	67	81	67	62	66	80	71	77	70	71	66	64	56	52
Rockfish	65	75	79	75	58	71	65	63	68	74	71	61	64	65	73	66	48	77	75	67	66	63
Flathead sole	-	-	-	-	54	64	67	74	39	51	69	68	74	49	62	57	63	83	78	45	73	69
Midwtr pollock	71	82	72	63	61	51	81	70	80	86	80	89	90	34	88	62	66	87	-	-	-	-
Sablefish	70	60	68	59	67	58	80	61	-	68	38	66	62	-	79	-	89	52	-	-	-	-
Arrowtooth fldr	-	-	-	-	-	-	66	48	62	73	75	86	76	70	65	66	76	64	73	69	90	81
Rex sole	-	-	-	-	56	76	63	47	58	70	71	62	57	69	67	61	45	57	85	84	80	82
<i>GOA Pot</i>																						
Pacific cod	12	7	16	24	17	21	7	11	16	13	8	33	19	21	22	13	15	17	10	31	13	10
<i>GOA Longline</i>																						
Pacific cod	15	18	13	7	11	13	11	22	11	17	16	11	11	13	16	8	13	7	10	10	9	8
Rockfish	6	-	-	7	-	4	13	-	9	-	9	-	-	-	-	-	-	-	-	-	-	-
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6. Summary of vessel sampling and halibut viability/injury data from the Bering Sea/Aleutian Community Development Quota (CDQ) fisheries.

2009												
Target	# of Vsls	# of Hauls	Sample totals				Projected fishery totals				DMR	SE
			E	P	D		E	P	D			
CDQ Trawl												
Atka m	3	195	0	0	0	0	0	0		--	--	
B poll	16	116	8	4	249	763	454	3465		0.738	0.091	
P cod	5	28	0	0	3	0	0	27		0.900	0.000	
Rckfsh	3	41	0	0	0	0	0	0		--	--	
M poll	14	897	0	0	955	0	0	4635		0.900	0.000	
R sole	3	56	0	0	0	0	0	0		--	--	
Turbot	2	114	0	0	31	0	0	417		0.900	0.000	
YF sole	3	53	0	0	0	0	0	0		--	--	
CDQ Pot												
Sable	3	95	15	8	6	46	26	20		0.503	0.3591	
CDQ Longline												
			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	17	2096	1740	154	43	32	46952	4818	1151	665	0.080	0.0348
2010												
CDQ Trawl												
Atka m	2	181	0	0	0	0	0	0		--	--	
B poll	14	98	0	0	162	0	0	1202		0.900	0.000	
P cod	4	31	0	0	0	0	0	0		--	--	
Rckfsh	3	49	0	0	0	0	0	0		--	--	
M poll	12	806	1	0	474	1	0	1653		0.894	0.0304	
R sole	4	122	0	0	4	0	0	158		0.900	0.0000	
Turbot	3	15	0	0	0	0	0	0		--	--	
YF sole	5	183	0	0	0	0	0	0		--	--	
CDQ Pot												
Sable	3	145	29	8	8	93	26	25		0.499	0.1633	
CDQ Longline												
			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	16	2209	1731	170	19	35	40409	5094	306		0.183	0.0448
2011												
CDQ Trawl												
Atka m	3	96	0	0	3	0	0	196		0.900	---	
B poll	20	216	18	11	657	488	213	4824		0.824	0.0260	
P cod	7	31	0	0	21	0	0	1290		0.900	0.0000	
Rckfish	5	61	0	0	0	0	0	0		---	---	
M poll	15	1138	1	0	1652	1	0	8052		0.900	0.0041	
R sole	9	264	1	3	99	23	65	4136		0.891	0.0029	
Turbot	4	14	0	0	0	0	0	0		---	---	
YF sole	9	717	0	4	171	0	134	11248		0.897	0.0017	
CDQ Pot												
Sable	2	99	60	8	14	171	17	37		0.313	0.3972	
CDQ Longline												
			Mi	Mo	Sev	De	Mi	Mo	Sev	De	DMR	SE
P cod	14	1596	1524	210	32	41	40637	6967	1503	1145	0.100	0.0418

Table 7. Summary of halibut discard mortality rates (DMRs) in the Community Development Quota (CDQ) Bering Sea/Aleutian (BSA) groundfish fisheries during 1998-2011.

Gear/Target	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<i>CDQ Trawl</i>														
Atka mackerel	-	82	89	80	90	86	87	89	80	79	90	-	-	90
Bottom pollock	90	88	90	90	66	-	84	90	88	83	90	74	90	82
Pac cod	-	-	-	-	-	-	-	-	-	-	90	90	-	90
Rockfish	-	88	-	90	-	-	-	-	69	82	89	-	-	-
Flathead sole	-	-	83	90	-	-	-	-	-	79	-	-	-	-
Midwtr pollock	90	90	88	89	89	90	90	90	90	90	89	90	89	90
Rock sole	-	-	-	-	-	-	-	-	86	89	86	-	90	89
Turbot	-	-	-	-	-	-	-	-	-	-	88	90	-	-
Yellowfin sole	-	83	-	-	81	89	88	88	73	87	89	-	-	90
<i>CDQ Pot</i>														
Sablefish	-	-	38	46	25	22	18	56	40	24	22	50	50	31
<i>CDQ Longline</i>														
Pacific cod	10	10	13	11	9	9	9	10	10	8	9	8	18	10
Turbot	-	-	4	-	-	-	-	-	-	-	-	-	-	-

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2013-2015 CDQ and non-CDQ groundfish fisheries off Alaska.

I. Non-CDQ

Bering Sea/Aleutians			Gulf of Alaska		
Gear/Target	Used in 2010-2012	2013-2015 Recommendation	Gear/Target	Used in 2010-2012	2013-2015 Recommendation
<i>Trawl</i>			<i>Trawl</i>		
Atka mack	76	77	Bottom poll	59	60
Bottom poll	73	77	Pacific cod	62	62
Pacific cod	71	71	Dpwtr flats	48	43
Other Flats	72	71	Shallwtr flats	71	67
Rockfish	81	79	Rockfish	67	66
Flathead sole	74	73	Flathead sole	65	65
Midwtr poll	89	88	Midwtr poll	76	71
Rock sole	82	85	Sablefish	65	71
Sablefish	75	75	Arr. fldr	72	73
Turbot	67	64	Rex sole	64	69
Arr. fldr	76	76			
YF sole	81	83			
<i>Pot</i>			<i>Pot</i>		
Pacific cod	8	8	Pacific cod	17	17
<i>Longline</i>			<i>Longline</i>		
Pacific cod	10	9	Pacific cod	12	11
Rockfish	9	4	Rockfish	9	9
Turbot	11	13			

II. Bering Sea/Aleutians CDQ

Gear/Target	Used in 2010-2012	2013-2015 Recommendation
<i>Trawl</i>		
Atka mackerel	85	86
Bottom pollock	85	83
Pacific cod	90	90
Rockfish	84	80
Flathead sole	84	79
Midwtr pollock	90	90
Rock sole	87	88
Turbot	88	89
Yellowfin sole	85	86
<i>Pot</i>		
Sablefish	32	34
<i>Longline</i>		
Pacific cod	10	10
Turbot	4	4