Appendix 2. Pacific halibut discard mortality rates in the 2007 open access and CDQ groundfish fisheries, and recommendations for 2009

Gregg H. Williams
International Pacific Halibut Commission

Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability (injury and condition) data collected by National Marine Fisheries Service (NMFS) observers. Analysis by staff of the International Pacific Halibut Commission (IPHC) results in recommendations to the North Pacific Fishery Management Council (NPFMC or Council) for managing halibut bycatch in subsequent fishing seasons. This paper describes the results from an analysis of data collected from the 2007 open access and Community Development Quota (CDQ) groundfish fisheries, and includes DMR recommendations for monitoring halibut bycatch in the 2009 CDQ fisheries.

Data description and methods

The analysis followed the same approach that has been employed since 1996, which was 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 bycatch, and the number and length of halibut sampled for release condition or injury 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 2007 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 week (Sunday-Saturday). The determination for the flatfish targets assumed that all arrowtooth flounder caught in a haul were discarded; the remaining species were assumed to be retained. Target determination was based on the species/species group comprising the greatest percentage of the “retained” catch. Flatfish targets in the Bering Sea/Aleutians (BSA) were determined in a succession of comparisons of individual flatfish species compositions in the catch. Table 1 shows the target codes and definitions used.

NMFS observers examined halibut for their 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 internal and external injuries, and body damage from predators (e.g., amphipods and marine mammals). Beginning in 2000, a dichotomous key was introduced 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 deemed dead (longlines) 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 was calculated. First, for each haul, the proportion of halibut in each category was extrapolated upwards 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:

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

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).

The mortality rate ***m*** varies among gear types (see Clark et al. (1992) for trawls, Williams (1996) for pots, and Kaimmer and Trumble (1998) for longlines) and represents the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods or marine mammals. There can be many sources of injuries, which vary by gear type. For longlines, 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. 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}
Longlines	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

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

Standard errors of the weighted mean DMR were estimated as:

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

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

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

Results

Open access 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 almost 13,000 hauls and 27,000 halibut in the BSA midwater pollock fishery, which represents the largest sample of any target fishery in 2007. Sample sizes were also 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 past years, sampling has also occurred on rockfish and turbot vessels but only minimally, and 2007 was no exception. Pot fishing was focused on cod, as in past years.

Most of the sampling in GOA trawl fisheries occurred in the pollock, cod, rockfish, and flatfish targets, which continued patterns seen in past years. The rockfish fishery tallied the largest number of observed tows but it's not clear how the Rockfish Pilot Project might have factored into this, as hauls were not coded with any project designation. Sampling of the cod and the two pollock fisheries occurred at similar levels (26-36 vessels; ~150-300 hauls). Sampling of flatfish fishing was concentrated in the shallow water, flathead and rex sole targets. For the second year in a row, no vessel effort was noted in the deepwater flatfish target, which primarily has been directed at Dover sole. In 2005, high catches of Dover sole were most frequently associated with even greater catches of arrowtooth flounder or rex sole, and to a lesser extent flathead sole. Consequently, vessel effort was assigned to those targets and not to deepwater flatfish. The number of sampled longline and pot vessels targeting cod was similar to past years.

Data on sampling levels and release viability (condition or injury) by fishery and region are summarized in Table 3. The raw data represent the observations recorded by observers. In most cases, these raw data total less than those shown in Table 2, as the latter include 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 & 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 2007, CDQ fishing was conducted using pots, trawls, and longlines. The primary species targeted by trawl operations included pollock, rock sole and yellowfin sole. 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. The resulting DMRs ranged from 0.80 to 0.90, which are generally higher than what is seen in open

access fishing for the same target species, with the exception of pelagic pollock and yellowfin sole.

Longline CDQ fishing consisted of 15 vessels targeting cod. Distribution of release injuries to halibut in the CDQ longline cod fishery was similar to that observed in the open access cod fishery, which is reflected by very similar DMRs (0.076 in CDQ vs. 0.089 in open access).

Pot effort in 2007 was focused on sablefish, with five vessels observed, compared to four in 2006. The fishery DMR (0.244) was almost half of last year's value, and more in line with the long term mean. Pot soak time is positively correlated with halibut mortality. The long soaks increase the potential for amphipod predation and injury from hard-shell crab in the pot.

Recommendations for 2009

CDQ fisheries

In past analyses, we have provided recommendations based on averaging data from all years, because fishery effort and sampling coverage have been dynamic as the CDQ operations have grown and matured. Thus, for 2009, we again recommend a mean annual DMR for all targets using data from all years, i.e., 1998-2007. For the major species, there are at least five years of data, and up to eight years for bottom pollock and longline cod. Only pelagic pollock fishing has provided data since 1998. The recommendations, shown in Table 8, suggest only relatively small changes for 4 of the 10 CDQ fisheries examined in these ongoing analyses.

For those targets with no recent information, such as trawl flathead sole and rockfish, longline turbot, and pot cod, DMRs derived from open access fisheries data are recommended. The current open access fisheries are probably more alike the current CDQ fishing, than data from fishing conducted over five years ago or more.

Note on open access fisheries

The Council is using a plan in which the DMRs used to monitor halibut bycatch are an average of data from the preceding 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 what has been used thus far. Note that data from 1996-2005 form the basis for 2007-2009 monitoring. In September 2009, we will provide a new set of recommendations for 2010-2012.

10-Year Basis Period	Years of application
1990-1999	2001 - 2003
1993-2002	2004 – 2006
1996-2005	2007 - 2009

Regarding the small interannual variability, we have seen that DMRs generally do not change greatly from one year to the next, absent of regulations that are directed at halibut discard and handling practices. The recent introduction of fishery cooperatives and attendant allocation of bycatch to the cooperatives potentially provides opportunity to improve handling and therefore survival of discarded halibut. DMRs are an expression of fishing practices and crew handling, so the potential for tracking DMRS by cooperative should be explored.

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.

Kaimmer, S.M., and Trumble, R.J. 1998. Injury, condition, and mortality of Pacific halibut bycatch following careful release by Pacific cod and sablefish longline fisheries. Fish. Res. 38:131-144.

Williams, G.H. 1996. Pacific halibut discard mortality rates in the 1994 Alaskan groundfish fisheries, with recommendations for monitoring in 1996. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1996:173-183.

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

Table 1. Groundfish target definitions and the method used to determine target species for observer sampled hauls, as used in the halibut discard mortality rate analysis.

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	Pelagic pollock	O	Other spp.
R	Rock sole	P	Pelagic pollock
S	Sablefish	S	Sablefish
T	Greenland turbot	W	Arrowtooth flounder
W	Arrowtooth flounder	X	Rex sole
Y	Yellowfin sole		

OPEN ACCESS and CDQ TARGET 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.

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.

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. Information on observer coverage, sampling, and size composition of the halibut bycatch in 2007.

Area/Gear /Target	No. of vsls observed	No. of sampled hauls	No. of fish measured	Mean length (cm)	Percent <65 cm	Percent < 82 cm
BSA Longline						
Pacific cod	38	4,212	9,243	68.7	41.0	84.4
Turbot	4	34	0	--	--	--
BSA Pot						
Pacific cod	43	538	116	65.9	43.1	94.0
BSA Trawl						
Atka mackerel	16	1,017	641	55.8	80.7	92.2
Bottom pollock	80	1,646	8,363	57.2	65.9	94.3
Pacific cod	69	2,262	7,299	50.0	87.3	97.3
Other flatfish	0	--	--	--	--	--
Rockfish	7	221	21	107.5	19.1	19.1
Flathead sole	14	646	1,028	55.8	76.8	91.5
Other sp.	0	--	--	--	--	--
Pelagic pollock	98	12,743	27,294	59.6	63.7	92.0
Rock sole	21	1,214	5,858	41.2	93.6	97.1
Sablefish	0	--	--	--	--	--
Turbot	0	--	--	--	--	--
Arrowtooth flndr	1	2	0	--	--	--
Yellowfin sole	30	2,594	3,254	48.0	83.7	87.3
GOA Longline						
Pacific cod	11	416	1,553	67.4	44.2	89.3
GOA Pot						
Pacific cod	23	382	358	71.0	33.0	82.1
GOA Trawl						
Bottom pollock	33	286	1,117	66.0	48.8	90.1
Pacific cod	36	329	1,553	54.5	82.7	96.3
Dp wtr flatfish	0	--	--	--	--	--
Shall wtr flatfish	19	344	1,481	53.8	72.2	92.2
Rockfish	32	1,136	2,591	73.0	30.1	73.8
Flathead sole	8	64	73	66.7	52.1	80.8
Other sp.	0	--	--	--	--	--
Pelagic pollock	26	149	41	61.8	56.1	92.7
Sablefish	15	65	85	77.9	28.2	55.3
Arrowtooth flndr	18	196	389	61.6	59.1	89.2
Rex sole	7	239	731	62.5	65.3	94.1

Table 3. Distribution of 2007 halibut condition & injury data, by factor and open access target fishery.

	Raw data				Extrapolated data				
Target	**Exc**	**Poor**	**Dead**	**DMR**	**Exc**	**Poor**	**Dead**	**DMR**	**SE**
BSA Trawl									
Atka mackerel	24	16	339	0.841	628	303	21,064	**0.885**	0.0368
Bottom pollock	333	191	6,931	0.860	14,251	5,432	58,501	**0.685**	0.0737
Pacific cod	845	981	3,211	0.714	17,085	27,595	120,118	**0.777**	0.0305
Other flatfish	0	0	0	--	0	0	0	--	--
Rockfish	0	2	19	0.867	0	190	1,917	**0.868**	0.0923
Flathead sole	36	54	440	0.817	2,360	9,030	55,486	**0.804**	0.0813
Other sp.	0	0	0	--	0	0	0	--	--
Pelagic pollock	48	92	27,134	0.882	60	196	61,633	**0.898**	0.0054
Rock sole	205	404	3,618	0.833	25,070	37,804	380,083	**0.829**	0.0269
Turbot	0	0	0	--	0	0	0	--	--
Arrowtooth flounder	0	0	0	--	0	0	0	--	--
Yellowfin sole	92	91	2,418	0.863	8,681	5,818	193,844	**0.773**	0.0183
BSA Pot									
Pacific cod	103	10	2	0.104	234	32	5	**0.145**	0.0941
GOA Trawl									
Bottom pollock	108	371	616	0.712	1,696	4,418	5,508	**0.694**	0.0670
Pacific cod	381	221	458	0.575	8,241	6,326	10,077	**0.607**	0.0477
Deepwater flatfish	0	0	0	--	0	0	0	--	--
Shallow water flatfish	195	294	627	0.685	3,409	6,563	16,125	**0.710**	0.0628
Rockfish	255	216	1,502	0.771	2,934	3,453	16,608	**0.770**	0.0609
Flathead sole	10	5	19	0.643	19	27	237	**0.833**	0.0187
Other sp.	0	0	0	--	0	0	0	--	--
Pelagic pollock	2	0	39	0.866	2	0	42	**0.868**	0.0276
Sablefish	35	8	11	0.394	447	90	292	**0.517**	0.0630
Arrowtooth flounder	48	82	99	0.628	2,237	3,516	5,708	**0.635**	0.1211
Rex sole	118	79	103	0.533	8,665	6,126	6,696	**0.567**	0.0768
GOA Pot									
Pacific cod	295	30	32	0.174	930	77	103	**0.167**	0.0921

	Raw data					Extrapolated data					
Target	**Minor**	**Mod**	**Severe**	**Dead**	**DMR**	**Minor**	**Mod**	**Severe**	**Dead**	**DMR**	**SE**
BSA Longline											
Pacific cod	7,639	797	108	136	0.088	179,948	18,409	3,182	3,899	**0.089**	0.0182
Rockfish	0	0	0	0	--	0	0	0	0	--	--
Turbot	0	0	0	0	--	0	0	0	0	--	--
GOA Longline											
Pacific cod	1,345	151	33	24	0.095	56,283	4,853	1,272	570	**0.071**	0.0183

Table 4. Summary of halibut discard mortality rates (DMRs) in the open access (non-CDQ) Bering Sea/Aleutian (BSA) groundfish fisheries during 1990-2007.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	Used in bycatch mgmt 2007-9
BSA Trawl																			
Atka mackerel	66	77	71	69	73	73	83	85	77	81	77	73	85	67	63	67	64	89	76
Bottom pollock	68	74	78	78	80	73	79	72	80	74	67	74	78	65	73	79	74	69	74
Pacific cod	68	64	69	67	64	71	70	67	66	69	69	69	69	67	70	81	77	78	70
Other Flatfish	80	75	76	69	61	68	67	71	78	63	76	81	77	79	80	65	82	--	74
Rockfish	65	67	69	69	75	68	72	71	56	81	89	85	73	84	68	79	90	87	76
Flathead sole	-	-	-	-	67	62	66	57	70	79	74	69	60	69	70	83	75	80	70
Pelagic pollock	85	82	85	85	80	79	83	87	86	87	88	89	90	89	88	90	90	90	88
Rock sole	64	79	78	76	76	73	74	77	79	81	75	77	83	82	85	84	83	83	80
Sablefish	46	66	-	26	20	-	-	-	-	90	60	-	-	-	-	-	-	-	75
Turbot	69	55	-	-	58	75	70	75	86	70	74	68	75	67	31	82	-	-	70
Arrowtooth fldr	-	-	-	-	-	-	-	-	-	-	-	-	-	67	67	90	-	-	75
Yellowfin sole	83	88	83	80	81	77	76	80	82	78	77	74	77	81	86	85	87	77	80
BSA Pot																			
Pacific cod	12	4	12	4	10	10	7	4	13	9	13	6	5	6	7	3	8	15	7
BSA Longline																			
Pacific cod	19	23	21	17	15	14	12	11	11	12	12	12	10	8	10	8	10	9	11
Rockfish	17	55	-	6	23	-	20	4	52	-	12	10	4	-	-	-	-	-	17
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	17	14	6	23	7	4	6	8	-	13

Table 5 Summary of halibut discard mortality rates (DMRs) in the open access Gulf of Alaska (GOA) groundfish fisheries during 1990-2007.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	Used in bycatch mgmt 2007-9
GOA Trawl																			
Atka mackerel	67	89	81	67	53	-	60	-	-	-	-	-	-	-	-	-	-	-	60
Bottom pollock	51	62	66	57	48	66	79	66	55	55	52	58	55	47	73	45	70	69	59
Pacific cod	60	62	66	59	53	64	70	62	64	54	57	67	59	69	63	66	56	61	63
Deep wtr flats	61	58	70	59	60	56	71	61	51	51	62	49	48	31	49	-	-	-	53
Shall wtr flats	66	71	69	65	62	70	71	71	67	81	67	62	66	80	71	77	70	71	71
Rockfish	65	75	79	75	58	71	65	63	68	74	71	61	64	65	73	66	48	77	67
Flathead sole	-	-	-	-	54	64	67	74	39	51	69	68	74	49	62	57	63	83	61
Pelagic pollock	71	82	72	63	61	51	81	70	80	86	80	89	90	34	88	62	66	87	76
Sablefish	70	60	68	59	67	58	80	61	-	68	38	66	62	-	79	-	89	52	65
Arrowtooth fldr	-	-	-	-	-	-	66	48	62	73	75	86	76	70	65	66	76	64	69
Rex sole	-	-	-	-	56	76	63	47	58	70	71	62	57	69	67	61	45	57	63
GOA Pot																			
Pacific cod	12	7	16	24	17	21	7	11	16	13	8	33	19	21	22	13	15	17	16
GOA Longline																			
Pacific cod	15	18	13	7	11	13	11	22	11	17	16	11	11	13	16	8	13	7	14
Rockfish	6	-	-	7	-	4	13	-	9	-	9	-	-	-	-	-	-	-	10
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 6. Observer coverage and halibut viability/injury data collected from the 2007 Bering Sea/Aleutian Community Development Quota (CDQ) fisheries.

			Raw Data					Extrapolated data					
Target	**No. of Vsls**	**# of Hauls**	**Exc.**	**Poor**	**Dead**		**DMR**	**Exc.**	**Poor**	**Dead**		**DMR**	**SE**
CDQ Trawl													
Atka m.	4	142	5	9	38		0.772	205	666	1,931		**0.787**	0.2147
Btm pol	12	117	3	12	215		0.873	23	395	1,837		**0.834**	0.0919
Pac cod	3	27	17	23	37		0.641	233	853	1,455		**0.719**	0.2051
Rockfis	4	58	0	3	14		0.838	0	47	140		**0.815**	0.0985
Flathd	3	105	1	8	18		0.770	13	271	673		**0.792**	0.1061
Pel pol	12	1,634	5	22	1441		0.892	6	37	4,352		**0.896**	0.0095
Rocksol	4	218	2	33	540		0.877	49	884	24,604		**0.889**	0.0220
ATF	3	11	2	5	10		0.715	20	147	358		**0.776**	0.2529
YF sole	4	496	10	20	434		0.870	241	277	7,226		**0.873**	0.0419
CDQ Pot													
Sable	5	283	111	5	26		0.218	354	25	100		**0.244**	0.2218
CDQ Longline			**Minor**	**Mod.**	**Sev.**	**Dead**	**DMR**	**Minor**	**Mod.**	**Sev.**	**Dead**	**DMR**	**SE**
P cod	15	1,732	2,232	140	14	75	0.087	27,958	1,865	163	617	**0.076**	0.0286

Table 7. Summary of halibut discard mortality rates (DMRs) in the Community Development Quota (CDQ) Bering Sea/Aleutian (BSA) groundfish fisheries during 1998-2007.

Gear/Target	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	1998-2007 mean
CDQ Trawl											
Atka mackerel	-	82	89	80	90	86	87	89	80	79	**85**
Bottom pollock	90	88	90	90	66	-	84	90	88	83	**85**
Rockfish	-	88	-	90	-	-	-	-	69	82	**82**
Flathead sole	-	-	83	90	-	-	-	-	-	79	**84**
Pelagic pollock	90	90	88	89	89	90	90	90	90	90	**90**
Rock sole	-	-	-	-	-	-	-	-	86	89	**88**
Yellowfin sole	-	83	-	-	81	89	88	88	73	87	**84**
CDQ Pot											
Sablefish	-	-	38	46	25	22	18	56	40	24	**34**
CDQ Longline											
Pacific cod	10	10	13	11	9	9	9	10	10	8	**10**
Turbot	-	-	4	-	-	-	-	-	-	-	**4**

Table 8. Recommended Pacific halibut discard mortality rates (DMRs) for 2009 CDQ fisheries.

Gear/Target	2008 Discard Mortality Rate	2009 Recommendation
Trawl		
Atka mackerel	**85**	**85**
Bottom pollock	**86**	**85**
Rockfish	**82**	**82**
Flathead sole	**87**	**84**
Pelagic pollock	**90**	**90**
Rock sole	**86**	**88**
Yellowfin sole	**84**	**84**
Pot		
Sablefish	**35**	**34**
Longline		
Pacific cod	**10**	**10**
Turbot	**4**	**4**

(This page intentionally left blank)