APPENDIX B

Pacific Halibut Discard Mortality Rates (DMRs) in the 1990-1998 Alaskan Groundfish Fisheries, with Recommendations for Monitoring in 2000

by

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Relative to the report presented in September, 1999, this document includes the following:

1) Viability data and DMRs for open access fisheries;
2) Results of analyses of separating the GOA trawl flathead sole fishery DMR by processing sector;
3) Results of analyses of separating the GOA trawl deep water flatfish fishery DMR by season; and
4) Viability data and DMRs for MSCDQ fisheries.
5) Recommendations for IFQ fishery DMRs.
6) Overview of anticipated changes in data collection in the year 2000.
7) Discussion of minimum sample size requirements.
8) Recommendations for Preseason Assumed DMRs for 2000.

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Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability data collected by NMFS observers. Analysis by staff of the International Pacific Halibut Commission (IPHC) results in recommendations to the North Pacific Fishery Management Council (NPFMC) for managing halibut bycatch in the upcoming season. This paper describes the results from an analysis of data collected from the 1998 fishery and includes recommendations for Preseason Assumed DMRs for 2000.

Data Used and Methods

Observer haul-by-haul data from the NMFS NORPAC data base were used for this analysis. The data records included the catch of groundfish by species or species group, estimates of the number and weight of halibut bycatch, and the number of halibut sampled for viability by category (excellent/poor/dead). Records for all hauls sampled by observers in 1998 were obtained and appended to data currently on hand for 1990-1997. Hauls not sampled for species composition were excluded.

The first task was to partition the records into target fishery categories, which was accomplished using a "retained catch" approach, using the catch composition for sampled hauls summed during a reporting week. The target is then assigned based on the percentage of particular species within the weekly catch composition (Williams 1997).

The targeting determination was based on a series of assumptions about the total catch and retained catch within a reporting week. Midwater pollock hauls were split out if that species comprised 95% of the total catch. A similar approach was used for an Arrowtooth flounder target in the Gulf of Alaska (GOA), but the assignment was made at 65% of the total catch. The determination for the remaining targets assumes that all arrowtooth flounder caught in a haul were discarded; the remaining species are assumed retained. Target determination was based on the species/species group comprising the greatest percentage of the "retained" catch. Flatfish targets in the Bering Sea/Aleutian Islands (BSAI) were determined in a succession of comparisons of individual flatfish species compositions in the catch. Table 1 shows the target codes and definitions used in this analysis.

The approach was modified slightly for Multispecies Community Development Quota (MSCDQ) fisheries. Hauls had been recorded by observers as CDQ. Because of the nature of the MSCDQ operations, vessels can potentially move from one target to another on every haul, rendering a "weekly" approach meaningless. So a target was assigned to each haul, using the same species composition criteria employed for open access fisheries.

NMFS observers examine halibut for the release viability upon return to the sea. Each fish is judged according to a set of criteria (Tables 2-4), which seek to detect internal and external injuries, and body damage from predators (e.g., sand fleas and others). Observers record the number of excellent, poor and dead condition halibut for each haul/set sampled. Viability samples are only collected on hauls 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 are instructed to limit the number of fish examined to a maximum of 20, although this is occasionally exceeded by enthusiastic observers.

Next, the viability distribution is calculated. First, for each haul, the proportion of halibut in each category is extrapolated up to the total number of halibut caught. The extrapolated numbers of excellent, poor and dead halibut are then summed within each region/gear/target/vessel strata.

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

$$DMR_g = \sum_{i=1}^{3} \left(m_{i,g} \times P_i \right)$$

where ***m*** is the mortality rate for gear ***g***, and ***P*** is the proportion of halibut in condition ***i***, where 1 is excellent, 2 is poor, and 3 is dead.

The mortality rate ***m*** varies among gear types (see Clark et al. 1992 for trawls, Williams 1996 for other gears) and represent the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods. There can be many sources of injuries, which vary by gear type. For longlines, injuries are most frequently caused by improper release methods practiced by vessel crews. Other significant factors include the length of the soak time, which can exacerbate the mortality caused by hooking injuries and also increase the potential for amphipod predation. Halibut mortality rates by gear and condition are shown in the following table:

Gear (*g*)	m_{exc}	M_{poor}	m_{dead}
Longline	0.035	0.518	1.00
Trawl	0.20	0.55	0.90
Pot	0.00	1.00	1.00

Mean fishery DMRs and associated standard errors were estimated by assuming that each vessel was a separate sampling unit, enabling a DMR to be calculated for each individual vessel in a target fishery. The DMR for a target fishery is then estimated as the mean of vessel DMRs, where the vessel's proportion of the total number of bycaught halibut is 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 $\overline{DMR} = \sum_{v=1}^{n} (p_v \times DMR_v)$

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_v, and $V(\overline{DMR})$ and $SE(\overline{DMR})$ are the variance and standard error of $\overline{DMR}$, respectively.

Results for 1998

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Information on the number of vessels and hauls where halibut viability data were collected is summarized in Table 5. The three major BSAI trawl fisheries (bottom and midwater pollock, cod) had over 80 vessels with observers, with 1,000 hauls or more sampled in each fishery. The flatfish fisheries had between 21 and 27 vessels observed. The smaller trawl fisheries for atka mackerel and rockfish had 12 and 5 vessels observed, respectively. The pot fishery for cod had a greater number of vessels observed than the longline cod fishery (42 vs. 39).

In the GOA, the number of trawl vessels observed varied considerably, with the cod fishery the highest with 64 vessels. The number of observed vessels (50) was also quite high in the midwater pollock fishery. Fewer vessels were observed in the bottom trawl pollock, rockfish, and shallow water flatfish, ranging from 25 to 31 in each. Both flathead sole and deep water flatfish had 9 vessels each, and 7 vessels were observed fishing rex sole. Thirteen trawl vessels targeted Arrowtooth flounder, up from 10 in 1997 and 8 in 1996. As in the BSAI, the cod pot fishery had more vessels observed (22) than the longline fishery (9).

There were two instances where only one vessel was observed in a target fishery. This occurred in the BSAI and GOA rockfish longline targets. This fishery is traditionally prosecuted by smaller vessels, i.e., vessels less than 60'. Observer coverage of these fisheries is usually dependant on a large observed vessel fishing targeting on rockfish for a few hauls while actually conducting its primary fishing on other targets. The resulting coverage is sporadic at best and the amount of data collected minimal. At these levels, it is unlikely that the data compiled are representative of the overall fishery.

The number of halibut examined by observers was, in most cases, substantial: over 13,000 fish in the BSAI cod trawl fishery and more than 35,000 fish in the BSAI cod hook-&-line fishery (Table 5). GOA fisheries with large numbers of halibut examined include trawl cod (over 6,800 fish). Several had 1,000-1,800 halibut examined, including shallow water flatfish, bottom trawl pollock, and rockfish. All other GOA fisheries had less than 1,000 fish examined.

A summary of the number of actual observations and the extrapolated number of halibut for the 1998 open access fisheries is in Table 6. In addition, the estimated DMR and its standard error is reported for each fishery. The entire historical set of DMRs and standard errors by year, area, gear, and target fishery are shown in Table 7 and Figures 1-3.

In general, the DMRs calculated in this analysis were consistent with past analyses. Trawl fishery DMRs ranged from 0.50 to 0.90, with DMRs generally higher in the BSAI. Longline fishery DMRs ranged from 0.10 to 0.18 (with one exception); pot fisheries for cod were the highest since 1995.

Trawl DMRs showed mixed results when compared to 1997 estimates. For the BSAI, decreases were noted for Atka mackerel (0.85 to 0.77), cod (0.67 to 0.66), rockfish (0.71 to 0.56), and pelagic trawl pollock (0.87 to 0.86). All others increased. In the GOA, decreased DMRs were estimated for bottom trawl pollock (0.66 to 0.55), deep water flatfish (0.61 to 0.51), shallow water flatfish (0.71 to 0.67), and flathead sole (0.74 to 0.39).

For longline targets, cod fishery DMRs dropped by 50% in the GOA and remained unchanged in the BSAI. The GOA fishery DMR dropped from an abnormally high level in 1997 (0.22) to a level more consistent with the long term history for the fishery. The BSAI rockfish fishery DMR exhibited a large increase (from 0.04 to 0.52), but this is likely the product of low sampling coverage. DMRs for this fishery have been quite volatile since 1990 as a consequence of sporadic observer coverage.

Pot fishery DMRs increased in both regions, from 0.04 to 0.13 in the BSAI and from 0.11 to 0.16 in the GOA. Soak time usually has the biggest effect on halibut mortality with pots, so we checked the data on soak time to see if corresponding changes had occurred in recent years. We found that mean soak time increased about 10% from 1997 in the BSAI, but actually decreased in the GOA during the same period. We also found that the proportion of the pots with long soaks increased from 1997. DMRs in previous years tended to be higher when a larger portion of the gear soaks more than 48 hours.

The effect of 48+ hour soak times did not seem as pronounced in the GOA fishery, so we looked for other factors. In past discussions with industry, new vessels entering the fishery has been suggested as one likely cause of DMR fluctuations. In fact, the number of vessels increased from 10 in 1997 to 22 in 1998, supporting this hypothesis.

	BSAI Pot Fishery			**GOA Pot Fishery**		
Year	**Mean Soak Time (hr)**	**% of Hauls > 48 hr Soak**	**DMR**	**Mean Soak Time (hr)**	**% of Hauls > 48 hr Soak**	**DMR**
1990	30.5	13.7	0.12	29.4	18.3	0.12
1991	23.7	6.3	0.04	29.9	16.1	0.07
1992	29.1	11.7	0.12	24.8	9.6	0.16
1993	24.4	9.5	0.04	23.4	11.3	0.24
1994	42.9	22.2	0.10	42.1	22.0	0.17
1995	47.0	30.2	0.10	50.3	33.5	0.21
1996	24.5	9.7	0.07	29.6	15.9	0.07
1997	28.0	14.8	0.04	47.4	31.1	0.11
1998	31.3	17.3	0.13	30.0	18.9	0.16

GOA Flathead Sole Fishery

GOA trawl industry representatives requested an analysis of DMRs by processing sector in the shallow water trawl fishery for flathead sole. The hypothesis is that the catcher/processor fleet has a higher DMR than the catcher vessel fleet that delivers shoreside. The data for this fishery for 1995-1998 were aggregated by sector and are reported in Table 8.

Vessel effort has been relatively low in this fishery, i.e., less than 8 vessels from either sector have participated in any given year. All vessels in the fishery carried observers, although only one vessel (a catcher/processor) was large enough to require 100% observer coverage. In 1998, the fishery took place primarily in March and April, with a small amount of effort in July by the catcher vessel fleet.

The fishery has been moving to shorter tows and smaller catches in recent years, particularly by the catcher/processor fleet. From 1997 to 1998, the catcher/processor fleet dropped their mean tow duration by roughly 30 minutes (18%) and the mean catch size was cut about in half (Table 9). This appears to have had a direct effect on their halibut DMR, as halibut condition improved and the DMR fell to 0.47 from 0.79.

The catcher vessel fleet has been less "directional" in its operation over the 4-year period. Hauls have averaged 6.2 mt during 1995-1998, with 1998 slightly below this average at 5.2 mt. The mean tow duration has been increasing over the past 3 years, from 94 minutes in 1996 to 170 minutes in 1998, much higher than the 4-year mean of 141 minutes. Despite these minor changes to the conduct of the fishery, the DMR declined to 0.33 in 1998 from 0.59 in 1997. Many vessels in the catcher fleet had a high proportion of halibut in excellent condition, which contributed to an overall 75% excellent condition for the fleet. This is a much higher level than is usually seen in trawl fisheries.

We next tested the mean DMRs among years and between sectors for each year. The results are shown in the table to the right. First, the tests indicated that only in one year (1995) was the mean DMR significantly different between the catcher vessel and catcher/processor sector. When we tested the mean DMRs between sectors across years, the results were not as strong (p = 0.100), but still indicated the mean DMR were statistically different. Thus, it appears that, although the catcher vessel fleet has had lower DMRs than the catch/processor fleet each year, sufficient variability exists both between sectors and among vessels within each sector that there is little statistical difference in DMRs between the sectors. However, differences are difficult to detect in fisheries with a small number of vessels, such as flathead sole, so the possibility of differences in DMRs between catcher/processors and catcher vessels cannot be ruled out.

T test results: mean and (SE)

Year	CVs	C/Ps	*p*
1995	0.495 (0.102)	0.873 (0.017)	***0.000***
1996	0.568 (0.193)	0.682 (0.095)	0.230
1997	0.594 (0.101)	0.791 (0.161)	0.856
1998	0.331 (0.099)	0.467 (0.151	0.853
Mean	0.497 (0.059)	0.703 (0.088)	0.100

GOA Trawl Deep Water Flatfish Fishery

The GOA trawl industry requested a separate analysis of seasonal DMRs in the deep water flatfish fishery. The working hypothesis is that mortality is higher during the summer months, when weather is warmer and less overcast, and the deck was not as awash as during the cooler winter months. The hauls were then assigned to one of two seasons: (1) Spring/Summer, comprised of April through September, and (2) Fall/Winter, comprised of January through March and October through December.

We first examined the distribution of fishing effort by month (Table 10), which showed that almost all fishing since 1994 has taken place during the summer season. Although seasonal differences may exist in halibut DMRs, this fishery appears to operate only during one season. Thus, seasonal DMRs are not necessary.

CDQ Fisheries

On October 1, 1998, the multi-species CDQ (MSCDQ) program started in the BSAI, incorporating the CDQ pollock program which had been fishing since January. In general, most of the vessel effort from October 1 to the end of the year was targeted towards cod, whereas pollock was the focus earlier in the year. As expected, most of the vessel effort was by trawls early in the year, and a mix of trawls and longlines during the last quarter. One vessel fished pots during June, principally for sablefish.

A summary of observer coverage, sampling, and halibut viability data is shown in Table 11. Applying the target algorithm on the haul species composition resulted in hauls being identified for about all possible targets. However, the amount of data collected was very low for all but the pelagic and bottom pollock trawl and cod longline targets. No halibut viability data were collected on the one pot cruise.

For the pollock trawl targets, almost all halibut (99%) were dead when sampled by the observer. The large proportion classified as dead is very similar to the sample collected in the open access pelagic pollock fishery, but much higher than the open access bottom pollock fishery. The difference is primarily an artifact of the targeting determination, where hauls with =95% pollock are assigned as a pelagic target; less than 95% would fall into the bottom pollock target or even possibly another target. In reality, most of the hauls in the bottom pollock target were comprised of at least 75% pollock and are being fished midwater and not on the bottom (i.e., fishing depth is less than bottom depth). Observer data on halibut viability resulted in DMRs of 0.90 for both pelagic and bottom pollock fisheries.

Longline CDQ fishing in 1998 consisted of a small amount of deep water fishing in June for sablefish and a major effort by 13 vessels in December for cod. Distribution of halibut viability in the CDQ cod fishery was slightly better than that observed in the open access cod fishery, resulting in a lower DMR for the CDQ fishery (0.096 vs. 0.113). Standard error estimates indicated no statistically significant difference, however.

Observers were carried on board two vessels that targeted sablefish during June and July. Viability data were collected on both vessels, although the samples came from less than half of the hauls containing halibut. Additionally, only a small fraction of the halibut were sampled for viability. Thus, not enough information was collected to provide suitable estimates of DMRs for these targets. One positive note, though, was that practically all the halibut sampled were in excellent condition, which is something not observed in the same open access fishery target. Typically, halibut condition is somewhat worse, and DMRs higher, in these deep water targets than seen in the more shallow cod fishery.

IFQ Fishery

Analysis of IFQ fishery data has been complicated by two serious problems: (1) the inability to determine if an IFQ set was either a directed halibut or groundfish set, based on the data recorded by an observer, and (2) if halibut were retained, the inability to determine how much halibut was discarded for proper extrapolation of viability data. For all other fisheries, the inherent assumption is that all halibut are discarded; the DMR model is based on that assumption. The IFQ fishery violates that assumption, in that not only can a vessel retain both sablefish and halibut (assuming the operator possesses quota shares), but vessels targeting cod, rockfish, or turbot may carry IFQ to enable retention of any bycatch of legal-size halibut.

Observers are instructed to only take viability samples from halibut discarded from IFQ sets. To estimate a DMR, the viability sample is extrapolated to the total number of halibut discarded. Unfortunately, this number is not available from observer sampling; only the total catch of halibut is recorded.

IPHC and North Pacific Groundfish Observer Program (NPGOP) staff have been working on solutions to these problems, but it is doubtful that solutions will be ready in time for the 2000 fishery. In the interim, we propose using a DMR of 0.23 to estimate mortality in the IFQ fishery, based on an average of the 1990-1994 BSAI and GOA sablefish fishery DMRs. This DMR value is somewhat high, but represents a conservative approach relative to the DMRs estimated for most other hook & line fisheries, which have been generally less than 0.18 since the IFQ program began in 1995.

Anticipated Changes in Halibut Viability Data Collection in the Year 2000

A recent study of hooking location and survival of halibut bycatch from small circle hook longline fisheries such as those for sablefish and Pacific cod (Kaimmer and Trumble 1998) demonstrated that halibut with moderate and severe hooking or hook removal injuries survive better than had been assumed previously. The IPHC staff realized that the criteria used by the NPGOP to determine halibut viability from longline discards required major revisions. The IPHC staff developed new viability criteria based on severity of injuries to replace the more subjective criteria based on condition factors, which had been in use in their present form for 1998-1999. The proposed criteria underwent scientific review by the NPGOP and the Scientific and Statistical Committee of the NPFMC during 1999. During the review, we received a suggestion to convert the criteria into a dichotomous key, which would standardize the observer evaluation process.

As we examined the dichotomous key concept, the IPHC staff agreed that the key format would give a more consistent application of the criteria. With initial input from the NPGOP, the longline criteria were rewritten with the most obvious and important distinctions, so that at each step, an observer must place a fish into a category or move to another step. This process had an additional benefit of defining the criteria in the most objective manner so that observers could make a “yes” or “no” decision at each step. Following completion of the longline key, the IPHC staff converted the trawl and pot viability criteria into dichotomous keys. The dichotomous keys will go into effect with the NPGOP during the 2000 fishing year. The longline key is shown as an example in Table 12.

The new longline injury codes are accompanied by a new schedule of mortality rates (Trumble et al. u*npublished*). These are: minor injuries - 0.035, moderate injuries – 0.363, severe injuries – 0.662, and dead/sand fleas/bleeding – 1.00. Longline DMRs will be calculated using these mortality rates beginning in 2000.

Minimum Sample Size Requirements

During discussions at the September, 1999 Plan Team meetings, questions arose about the adequacy of the number of samples collected by observers in some fisheries. Not infrequently, very few halibut are sampled for length and viability (L/V), perhaps less than 50 (Table 5). The number of vessels sampled also appears low, e.g., less than five. Are these amounts acceptable? Should sampling be increased in certain fisheries? The answers are confounded by the size of some fisheries and the amount of halibut bycatch taken. Some fisheries, such as that for GOA trawl flathead sole, are pursued by less than 10 vessels. Having samples taken on 7 vessels represents a fairly large sample, yet if the samples are collected disproportionately from the sampled vessels or if the variability among vessels is high, then the samples require closer scrutiny prior

to use. IPHC staff have employed a threshold of 100 sampled fish as a minimum, although this was not statistically derived. In the coming year, we expect to work on the question of a minimum sample size.

Recommendations for Year 2000 Preseason Assumed DMRs

The results from this analysis are used to determine a DMR for in-season management of halibut bycatch by NMFS. In 1993, two procedures were adopted for determining appropriate DMRs to use as Preseason Assumed DMRs during the upcoming season, based on data from previous years:

A. Existence of a Trend Where a trend (increasing or decreasing) exists across the most recent 4 years, the rate from the most recent year was to be used.

A trend is determined by comparing the first and last values for the 4-year period in question for an increase or decrease, i.e., $\mathbf{DMR_Y}$ vs. $\mathbf{DMR_{Y+4}}$. Additionally, the intermediate values must follow the direction of the change between the last value to the first in a linear fashion. Any deviation from the linear pattern by the intermediate values indicates no trend in the data.

B. No Trend For fisheries that demonstrated no clear trend in DMRs as described above, a two-year averaging procedure would be used. This approach softens the effects of an increase, but also delays any benefits of a decrease until a clear pattern is demonstrated. For 2000, rates from 1997 and 1998 would be averaged to obtain a Preseason Assumed DMR.

Historical DMR information is summarized for all fisheries during 1990-1998 in Tables 13 (BSAI) and 14 (GOA). The tables also show the 1997-98 averages and the DMRs used in 1999. Rates for 1997 and 1998 were lacking for some fisheries, so rates from the most recent years were used in some cases.

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Recommendations for 2000 halibut bycatch monitoring are shown in the far right column in Tables 13 and 14. The 1997-1998 average is recommended for most fisheries. The DMR from the most recent year is recommended for the following fisheries: BSAI trawl cod and BSAI trawl rock sole.

Recommendations are also provided for the 'other species' target. The analysis did not identify any hauls as an 'other species' target, so the recommendations shown are based on the recommendations for the gear/target fishery in each region that takes the predominant amount of bycatch. In the BSAI and GOA, these are the fisheries for Pacific cod.

GOA Trawl Flathead Sole

The analysis indicated that, while the estimated DMRs have been consistently lower during 1995-1998 for the catcher vessel fleet, the variability is too great within 1998 and also among years to be able to detect statistically significant differences between sectors. Since the analysis does not support sector-specific DMRs, we recommend a single annual DMR of 0.57 for mortality management in 2000 (Table 14).

GOA Trawl Deep Water flatfish

Since the fishery has essentially operated during one season, there is no justification for seasonal DMRs for this fishery. We recommend that a single annual DMR of 0.56 be used for mortality management in 2000 (Table 14).

MSCDQ Fisheries

MSCDQ trawl effort in 1998 was focused almost exclusively on pollock; effort at other targets was so low as to result in too few halibut sampled. We recommend that the 2000 MSCDQ fisheries use the 1998 MSCDQ DMRs of 0.90 for pelagic and bottom pollock (Table 11), with the remaining targets using the open access recommendations found in Table 13.

MSCDQ longline fishing in 1998 was directed primarily at cod and resulted in a DMR of 0.10 (Table 11). We recommend that this DMR be used in 2000. Other longline and pot targets should use the open access DMRs recommended in Table 13.

IFQ Fishery

Data collection and analysis of IFQ sets is problematical because of the data problems outlined earlier. For this reason, we are recommending using an assumed DMR of 0.23 for calculating mortality until such time that appropriate data can be collected and analyzed.

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Table 1. 1998 groundfish target definitions and target determination method used to classify NORPAC hauls in the halibut viability and discard mortality rate analysis.

BSAI		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
Y	Yellowfin sole	X	Rex sole
Z	No retained catch		

OPEN ACCESS and CDQ TARGET DETERMINATION

Retained Catch = Total Groundfish Catch - Arrowtooth Flounder

Bering Sea/Aleutians

P if Pollock ≥ 95% of total groundfish catch, or

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, Y, R, L or F, then target is whichever species or species group (A, B, C, K, O, S, T) forms the largest part of the **retained catch**.

Gulf of Alaska

P if Pollock ≥ 95% of total groundfish catch, or

W if Arrowtooth flounder ≥ 65% of total groundfish 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, X) forms the largest part of the **retained catch**.

Table 2. Definition of Pacific halibut discard condition codes for trawl gear in 1998.

EXCELLENT: No sign of stress

- Injuries, if any, are minor, limited to superficial nicks or cuts on body. Minor fin fraying. Hemorrhaging of skin on white side limited to 5-10% of surface area.
- Fish closes operculum (gill cover) tightly for at least 5-10 seconds.
- Muscle tone or physical activity is strong. Jaw may be tightly clenched.
- No bleeding observed.
- Gills are deep red in color, indicating no loss of blood.

POOR: Alive, but showing signs of stress

- Moderate injuries may be present. Moderate severity to any abrasions or cuts that may be present. Severe fin fraying. Slight bleeding from fin edges. Approximately 25% of skin on white side of fish shows hemorrhaging.
- Fish closes operculum weakly and not sustained.
- Muscle tone or physical activity is weak. Intermittent movement. May respond if stimulated. Body appears limp.
- Bleeding from gill area may be occurring, but not profusely.
- Gills are deep to bright red, indicating some loss of blood.

DEAD: No sign of life or, if alive, likely to die from severe injuries or suffocation

- Vital internal organs may be damaged. Body or body cavity may be ripped open. Severe skin lacerations. Sediment in mouth. Hemorrhaging in skin on 50% or more of white side.
- Fish does not close operculum, jaw may be open.
- No sign of muscle tone. Physical activity absent or limited to fin ripples or twitches. Little, if any, response to stimuli.
- Severe bleeding may be occurring from gill area.
- Gills appear washed out, e.g., dull red, pink, or white in color, indicating a substantial loss of blood.

Table 3. Definition of Pacific halibut discard condition codes for hook and line gear in 1998.

EXCELLENT: No sign of stress

- Hook injuries are minor (limited to the hook entrance/exit hole, torn lip) and located in the jaw or cheek. Jaw is in one piece, not split or separated from head. Eye socket may be torn, but eyeball is undamaged.
- Vital internal organs are undamaged.
- Bleeding, if present, is minor and limited to jaw area.
- No penetration of the body by sand fleas, even though they may be present in small numbers on body surface. No external damage to fins or skin by sand fleas.
- Muscle tone or physical activity is strong.
- Gills are deep red in color, indicating no loss of blood.

POOR: Alive but showing signs of stress

- Hook injuries to jaw are minor to moderate. Lower jaw may be split at snout (i.e., the anterior point), but all jaw parts are present. Or, one side of the upper or lower jaw may be separated from the head at the hinge, but still remains. Eyeball is punctured, but eye socket may or may not be torn. Rest of head is undamaged.
- Vital internal organs are not injured.
- Bleeding may be light to moderate, but not from gills.
- Sand fleas may be present on body, but no penetration of the eyes, fins, anus is noticed. Any damage is limited to small marks on skin or near fins.
- Muscle tone or physical movement may be weak or intermittent; little, if any, response to stimuli.
- Gills are deep to bright red, indicating some loss of blood.

DEAD: No signs of life or, if alive, likely to dies from severe injuries

- Severe injuries to jaw and/or head. Gills may be torn. Gaff wound to head or body. Side of face or part of the head may be missing or only loosely attached. Either a portion of the lower jaw is missing or the entire lower jaw is completely missing.
- Vital internal organs may be damaged. A jig-hook injury to viscera may have occurred.
- Sand fleas have penetrated the body (they usually attack the eyes first, but also fins and anus). This may be very noticeable, but closely examine the fish. Other predators may have damaged the fish, including sea lions and orca whales, which will take an obvious bit out of the fish, to lampreys, which leave a hole in the side of the fish.
- Severe bleeding may occur, especially from the gills.
- No sign of muscle tone. Physical activity absent or limited to fin ripples or twitches.
- Gills appear washed out, e.g., dull red, pink, or white in color, indicating a substantial loss of blood.

Table 4. Definition of Pacific halibut discard condition codes for pot gear in 1998.

EXCELLENT: No sign of stress

- Injuries, if any, are minor. Hemorrhaging of skin on white side limited to 5-10% of surface area.
- Fish closes operculum (gill cover) tightly for at least 5-10 seconds.
- Muscle tone or physical activity is strong. Jaw may be tightly clenched, very difficult to open.
- Minor fin fraying, but no bleeding. Superficial nicks or cuts, perhaps from crabs in the pot or from the pot itself, but no bleeding.
- No penetration of the body by sand fleas, even though they may be present in small numbers on body surface. No external damage to fins or skin by sand fleas.
- Gills are deep red in color, indicating no loss of blood.

POOR: Alive, but showing signs of stress

- Moderate injuries may be present. Approximately 25% of skin on white side of fish shows hemorrhaging. Severe fin fraying.
- Fish closes operculum weakly and not sustained.
- Muscle tone or physical activity is weak. Intermittent body movement. May respond if stimulated. Body appears limp.
- Slight bleeding from fin edges or body. Moderate abrasions or cuts, perhaps from crabs in the pot or from the pot itself.
- Sand fleas may be present on body, but no penetration of the eyes, fins, anus is noticed. Any damage is limited to small marks on skin or near fins.
- Gills are deep to bright red, indicating some loss of blood.

DEAD: No sign of life or, if alive, likely to dies from severe injuries

- Vital internal organs may be damaged. Body tissue or body cavity may be ripped open. Hemorrhaging in skin on 50% or more of white side.
- Fish does not close operculum. Jaw may be open and slack.
- No sign of muscle tone. Physical activity absent or limited to fin ripples or twitches. Little, if any, response to stimuli.
- Severe bleeding may be occurring from fin edges or body. Severe abrasions or cuts, some of which may penetrate the body cavity. Severe skin lacerations.
- Sand fleas have penetrated the body (they usually attack the eyes first, but also fins and anus). This may be very noticeable, but closely examine the fish. Crabs in the pot may also have attacked and eaten the “dead” fish.
- Gills appear washed out, e.g., dull red, pink, or white in color, indicating a substantial loss of blood.

Table 5. Information on observer coverage, sampling, and size composition of the halibut bycatch in 1998.

Gear and Target	No. of Vessels Observed	No. of Hauls Sampled	No. of Fish Measured	Extrap. # of fish	Mean Lgth. (cm)	Percent <65 cm	Percent <82 cm
BSAI Trawl							
Atka mackerel	12	93	353	8,576	80.4	21.7	64.8
Bottom pollock	91	999	4,875	155,336	44.2	87.6	95.4
Pacific cod	94	1,638	13,535	326,243	47.8	86.6	97.0
Other Flatfish	26	376	1,302	39,780	70.0	39.7	67.7
Rockfish	5	14	34	2,552	77.9	46.9	56.2
Flathead sole	21	470	1,425	45,912	67.3	44.8	81.2
Pelagic pollock	83	1,104	4,485	9,953	66.7	40.3	75.7
Rock sole	27	841	5,725	335,045	42.1	93.5	98.0
Turbot	3	13	39	1,907	75.8	7.5	81.6
Yellowfin sole	27	1,146	3,675	120,707	63.0	54.4	77.9
BSAI Pot							
Pacific cod	42	316	993	2,075	73.6	19.3	79.0
BSAI Longline							
Pacific cod	39	3,944	35,856	460,660	73.4	27.6	74.1
Rockfish	1	1	11	315	101.6	0.0	0.0
Turbot	20	98	594	10,159	92.9	1.6	26.2
GOA Trawl							
Atka mackerel	0	0	0	0	---	---	---
Bottom pollock	31	100	1,363	6,009	56.0	79.0	94.8
Pacific cod	64	851	6,832	111,548	62.7	57.7	91.5
Dp wtr. flatfish	9	51	217	3,493	82.0	17.7	44.1
Shall wtr. flatfish	25	173	1,774	31,599	53.9	70.1	91.8
Rockfish	30	235	1,057	24,714	91.4	10.2	39.1
Flathead sole	9	63	275	2,459	75.6	34.4	62.8
Pelagic pollock	50	179	293	306	78.3	17.8	63.1
Arrowtooth flndr	13	84	526	11,318	67.0	45.8	88.1
Rex sole	7	149	826	17,275	71.1	28.3	81.9
GOA Pot							
Pacific cod	22	151	588	1,299	79.5	10.3	61.4
GOA Longline							
Pacific cod	9	48	1,361	25,083	78.7	10.6	64.1
Rockfish	1	1	17	534	83.2	5.9	52.9

Table 6. Distribution of halibut viability data by condition factor and target fishery during 1998.

	Raw Data				Extrapolated Data				
Target	**Exc.**	**Poor**	**Dead**	**DMR**	**Exc.**	**Poor**	**Dead**	**DMR**	**SE**
BSAI Trawl									
Atka mackerel	24	54	275	**0.80**	874	1,559	6,143	**0.77**	**0.084**
Bottom pollock	487	379	4,009	**0.80**	17,075	11,268	126,993	**0.80**	**0.060**
Pacific cod	3,231	3,127	7,177	**0.65**	73,377	79,542	173,324	**0.66**	**0.030**
Other flatfish	136	184	982	**0.78**	3,561	6,652	29,566	**0.78**	**0.053**
Rockfish	11	10	13	**0.57**	1,093	329	1,130	**0.56**	**0.144**
Flathead sole	260	449	716	**0.66**	7,423	12,030	26,459	**0.70**	**0.068**
Pelagic pollock	126	136	4,223	**0.87**	246	508	9,199	**0.86**	**0.024**
Rock sole	675	1,391	3,659	**0.73**	27,116	51,723	256,205	**0.79**	**0.050**
Sablefish	0	0	0	**---**	0	0	0	**---**	**---**
Turbot	0	6	33	**0.85**	0	235	1,672	**0.86**	**0.062**
Yellowfin sole	207	614	2,854	**0.80**	5,877	15,173	99,657	**0.82**	**0.041**
BSAI Pot									
Pacific cod	836	82	75	**0.16**	1,799	143	133	**0.13**	**0.057**
BSAI Longline									
Pacific cod	31,545	3,290	1,021	**0.11**	401,173	45,283	14,204	**0.11**	**0.018**
Rockfish	3	5	3	**0.52**	86	143	86	**0.52**	**---**
Turbot	486	73	35	**0.15**	7,953	1,366	840	**0.18**	**0.054**
GOA Trawl									
Atka mackerel	0	0	0	**---**	0	0	0	**---**	**---**
Bottom pollock	319	355	689	**0.65**	2,006	1,931	2,072	**0.55**	**0.114**
Pacific cod	2,041	1,741	3,050	**0.60**	30,464	22,394	58,690	**0.64**	**0.062**
Dpwtr flatfish	126	53	38	**0.41**	1,321	1,279	893	**0.51**	**0.108**
Shwtr. flatfish	545	468	761	**0.59**	6,217	8,590	16,792	**0.67**	**0.080**
Rockfish	368	205	484	**0.59**	5,603	4,086	15,025	**0.68**	**0.090**
Flathead sole	194	43	38	**0.35**	1,662	258	538	**0.39**	**0.078**
Pelagic pollock	33	23	237	**0.79**	33	24	249	**0.80**	**0.040**
Arrowtooth flndr	161	194	171	**0.56**	3,054	3,101	5,163	**0.62**	**0.119**
Rex sole	276	212	338	**0.58**	5,798	4,394	7,083	**0.58**	**0.169**
GOA Pot									
Pacific cod	486	35	67	**0.17**	1,097	83	118	**0.16**	**0.080**
GOA Longline									
Pacific cod	1,191	124	46	**0.11**	21,789	2491	804	**0.11**	**0.121**
Rockfish	36	2	6	**0.19**	631	12	29	**0.09**	**---**

Table 7. Historical set of halibut DMRs with standard errors.

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
90	BSAI	H&L	Pacific cod	32	0.188	0.048
90	BSAI	H&L	Rockfish	1	0.166	-
90	BSAI	H&L	Sablefish	11	0.141	0.163
90	BSAI	H&L	Turbot	12	0.150	0.100
90	BSAI	POT	Pacific cod	7	0.117	0.110
90	BSAI	TWL	Atka mackerel	21	0.662	0.069
90	BSAI	TWL	BT Pollock	75	0.677	0.058
90	BSAI	TWL	Pacific cod	69	0.680	0.034
90	BSAI	TWL	Other Flatfish	21	0.801	0.122
90	BSAI	TWL	Rockfish	26	0.649	0.040
90	BSAI	TWL	MWT Pollock	59	0.852	0.079
90	BSAI	TWL	Rock sole	26	0.635	0.058
90	BSAI	TWL	Sablefish	4	0.460	0.162
90	BSAI	TWL	Turbot	20	0.689	0.083
90	BSAI	TWL	Yellowfin sole	20	0.829	0.085
90	GOA	H&L	Pacific cod	10	0.145	0.134
90	GOA	H&L	Rockfish	2	0.059	0.017
90	GOA	H&L	Sablefish	47	0.170	0.077
90	GOA	POT	Pacific cod	14	0.119	0.029
90	GOA	TWL	Atka mackerel	4	0.667	0.134
90	GOA	TWL	BT Pollock	46	0.509	0.074
90	GOA	TWL	Pacific cod	82	0.604	0.036
90	GOA	TWL	Deep water Flats	24	0.607	0.073
90	GOA	TWL	Shallow wtr. Flats	17	0.658	0.101
90	GOA	TWL	Rockfish	27	0.648	0.058
90	GOA	TWL	MWT Pollock	20	0.709	0.105
90	GOA	TWL	Sablefish	13	0.695	0.085
91	BSAI	H&L	Pacific cod	45	0.232	0.056
91	BSAI	H&L	Rockfish	2	0.547	0.283
91	BSAI	H&L	Sablefish	10	0.318	0.155
91	BSAI	H&L	Turbot	15	0.295	0.085
91	BSAI	POT	Pacific cod	14	0.040	0.102
91	BSAI	TWL	Atka mackerel	31	0.767	0.088
91	BSAI	TWL	BT Pollock	93	0.743	0.037
91	BSAI	TWL	Pacific cod	103	0.635	0.027
91	BSAI	TWL	Other Flatfish	42	0.747	0.057
91	BSAI	TWL	Rockfish	19	0.672	0.100
91	BSAI	TWL	MWT Pollock	81	0.818	0.034
91	BSAI	TWL	Rock sole	49	0.786	0.029
91	BSAI	TWL	Sablefish	2	0.661	0.203
91	BSAI	TWL	Turbot	28	0.554	0.062
91	BSAI	TWL	Yellowfin sole	48	0.879	0.033
91	GOA	H&L	Pacific cod	13	0.176	0.036
91	GOA	H&L	Sablefish	50	0.273	0.061
91	GOA	POT	Pacific cod	19	0.069	0.042
91	GOA	TWL	Atka mackerel	6	0.887	0.105
91	GOA	TWL	BT Pollock	41	0.621	0.058

Table 7 (cont'd).

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
91	GOA	TWL	Pacific cod	85	0.617	0.039
91	GOA	TWL	Deep water Flats	32	0.582	0.062
91	GOA	TWL	Shallow wtr. Flats	9	0.710	0.092
91	GOA	TWL	Rockfish	25	0.746	0.069
91	GOA	TWL	MWT Pollock	36	0.816	0.077
91	GOA	TWL	Sablefish	11	0.600	0.061
92	BSAI	H&L	BT Pollock	4	0.086	0.027
92	BSAI	H&L	Pacific cod	44	0.209	0.035
92	BSAI	H&L	Sablefish	4	0.137	0.049
92	BSAI	H&L	Turbot	12	0.111	0.231
92	BSAI	POT	Pacific cod	38	0.116	0.031
92	BSAI	POT	Sablefish	1	0.654	-
92	BSAI	TWL	Atka mackerel	28	0.710	0.060
92	BSAI	TWL	BT Pollock	107	0.782	0.037
92	BSAI	TWL	Pacific cod	79	0.688	0.034
92	BSAI	TWL	Other Flatfish	28	0.760	0.080
92	BSAI	TWL	Rockfish	26	0.694	0.063
92	BSAI	TWL	MWT Pollock	81	0.847	0.037
92	BSAI	TWL	Rock sole	45	0.776	0.037
92	BSAI	TWL	Turbot	1	0.550	-
92	BSAI	TWL	Yellowfin sole	49	0.834	0.036
92	GOA	H&L	Pacific cod	22	0.133	0.132
92	GOA	H&L	Sablefish	43	0.282	0.066
92	GOA	POT	Pacific cod	49	0.157	0.056
92	GOA	TWL	Atka mackerel	9	0.815	0.030
92	GOA	TWL	BT Pollock	31	0.662	0.056
92	GOA	TWL	Pacific cod	81	0.661	0.034
92	GOA	TWL	Deep water Flats	29	0.703	0.076
92	GOA	TWL	Shallow wtr. Flats	17	0.683	0.054
92	GOA	TWL	Rockfish	24	0.793	0.051
92	GOA	TWL	MWT Pollock	23	0.719	0.105
92	GOA	TWL	Sablefish	4	0.682	0.090
93	BSAI	H&L	Pacific cod	44	0.171	0.027
93	BSAI	H&L	Rockfish	3	0.075	0.452
93	BSAI	H&L	Sablefish	10	0.132	0.071
93	BSAI	H&L	Turbot	26	0.235	0.103
93	BSAI	POT	Pacific cod	12	0.031	0.061
93	BSAI	TWL	Atka mackerel	20	0.712	0.079
93	BSAI	TWL	BT Pollock	98	0.776	0.036
93	BSAI	TWL	Pacific cod	92	0.678	0.029
93	BSAI	TWL	Other Flatfish	28	0.645	0.053
93	BSAI	TWL	Rockfish	22	0.703	0.071
93	BSAI	TWL	MWT Pollock	64	0.852	0.044
93	BSAI	TWL	Rock sole	41	0.725	0.050
93	BSAI	TWL	Sablefish	1	0.265	-
93	BSAI	TWL	Yellowfin sole	26	0.803	0.035

Table 7 (cont'd).

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
93	GOA	H&L	Pacific cod	12	0.081	0.018
93	GOA	H&L	Rockfish	2	0.046	0.017
93	GOA	H&L	Sablefish	52	0.326	0.093
93	GOA	POT	Pacific cod	17	0.234	0.083
93	GOA	TWL	Atka mackerel	13	0.618	0.093
93	GOA	TWL	BT Pollock	16	0.601	0.114
93	GOA	TWL	Pacific cod	63	0.582	0.029
93	GOA	TWL	Deep water Flats	37	0.592	0.050
93	GOA	TWL	Shallow wtr. Flats	25	0.657	0.041
93	GOA	TWL	Rockfish	20	0.766	0.091
93	GOA	TWL	MWT Pollock	36	0.591	0.149
93	GOA	TWL	Sablefish	4	0.594	0.148
94	BSAI	H&L	Pacific cod	40	0.147	0.022
94	BSAI	H&L	Rockfish	1	0.232	-
94	BSAI	H&L	Sablefish	7	0.376	0.166
94	BSAI	H&L	Turbot	10	0.135	0.150
94	BSAI	POT	Pacific cod	25	0.100	0.031
94	BSAI	TWL	Atka mackerel	10	0.729	0.068
94	BSAI	TWL	BT Pollock	85	0.795	0.031
94	BSAI	TWL	Pacific cod	75	0.644	0.030
94	BSAI	TWL	Other Flatfish	9	0.617	0.135
94	BSAI	TWL	Rockfish	8	0.756	0.074
94	BSAI	TWL	Flathead sole	8	0.671	0.095
94	BSAI	TWL	MWT Pollock	80	0.802	0.044
94	BSAI	TWL	Rock sole	29	0.765	0.056
94	BSAI	TWL	Sablefish	1	0.200	-
94	BSAI	TWL	Turbot	16	0.577	0.062
94	BSAI	TWL	Yellowfin sole	37	0.806	0.035
94	GOA	H&L	Pacific cod	10	0.113	0.043
94	GOA	H&L	Sablefish	19	0.220	0.058
94	GOA	POT	Pacific cod	10	0.164	0.050
94	GOA	TWL	Atka mackerel	5	0.531	0.195
94	GOA	TWL	BT Pollock	11	0.481	0.113
94	GOA	TWL	Pacific cod	43	0.533	0.045
94	GOA	TWL	Deep water Flats	11	0.597	0.046
94	GOA	TWL	Shallow wtr. Flats	21	0.617	0.051
94	GOA	TWL	Rockfish	20	0.584	0.074
94	GOA	TWL	Flathead sole	9	0.542	0.087
94	GOA	TWL	MWT Pollock	31	0.607	0.083
94	GOA	TWL	Sablefish	13	0.668	0.119
94	GOA	TWL	Rex sole	11	0.563	0.067
95	BSAI	H&L	Pacific cod	36	0.144	0.023
95	BSAI	H&L	Turbot	15	0.077	0.028
95	BSAI	POT	Pacific cod	45	0.102	0.032
95	BSAI	TWL	Atka mackerel	11	0.733	0.118
95	BSAI	TWL	BT Pollock	71	0.735	0.056

Table 7 (cont'd).

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
95	BSAI	TWL	Pacific cod	93	0.714	0.032
95	BSAI	TWL	Other Flatfish	16	0.677	0.097
95	BSAI	TWL	Rockfish	5	0.681	0.122
95	BSAI	TWL	Flathead sole	11	0.624	0.109
95	BSAI	TWL	MWT Pollock	87	0.791	0.041
95	BSAI	TWL	Rock sole	41	0.733	0.049
95	BSAI	TWL	Turbot	37	0.745	0.061
95	BSAI	TWL	Yellowfin sole	44	0.776	0.069
95	GOA	H&L	Pacific cod	16	0.127	0.029
95	GOA	H&L	Rockfish	1	0.035	-
95	GOA	POT	Pacific cod	38	0.213	0.073
95	GOA	TWL	BT Pollock	33	0.660	0.074
95	GOA	TWL	Pacific cod	74	0.645	0.050
95	GOA	TWL	Deep water Flats	13	0.562	0.095
95	GOA	TWL	Shallow wtr. Flats	23	0.698	0.063
95	GOA	TWL	Rockfish	26	0.710	0.047
95	GOA	TWL	Flathead sole	10	0.638	0.141
95	GOA	TWL	MWT Pollock	40	0.511	0.122
95	GOA	TWL	Sablefish	7	0.573	0.180
95	GOA	TWL	Rex sole	13	0.760	0.123
96	BSAI	H&L	Pacific cod	38	0.123	0.020
96	BSAI	H&L	Rockfish	1	0.035	-
96	BSAI	H&L	Turbot	12	0.137	0.106
96	BSAI	POT	Pacific cod	73	0.066	0.026
96	BSAI	TWL	Atka mackerel	15	0.834	0.028
96	BSAI	TWL	BT Pollock	111	0.786	0.024
96	BSAI	TWL	Pacific cod	116	0.704	0.022
96	BSAI	TWL	Other Flatfish	14	0.673	0.067
96	BSAI	TWL	Rockfish	10	0.717	0.104
96	BSAI	TWL	Flathead sole	14	0.661	0.080
96	BSAI	TWL	MWT Pollock	95	0.830	0.021
96	BSAI	TWL	Rock sole	36	0.743	0.052
96	BSAI	TWL	Sablefish	1	0.550	-
96	BSAI	TWL	Turbot	4	0.702	0.103
96	BSAI	TWL	Yellowfin sole	35	0.763	0.051
96	GOA	H&L	Pacific cod	9	0.099	0.019
96	GOA	POT	Pacific cod	28	0.070	0.008
96	GOA	TWL	Atka mackerel	7	0.600	0.166
96	GOA	TWL	BT Pollock	21	0.785	0.094
96	GOA	TWL	Pacific cod	70	0.680	0.040
96	GOA	TWL	Deep water Flats	9	0.713	0.089
96	GOA	TWL	Shallow wtr. Flats	30	0.713	0.060
96	GOA	TWL	Rockfish	32	0.643	0.061
96	GOA	TWL	Flathead sole	8	0.675	0.130
96	GOA	TWL	MWT Pollock	16	0.814	0.111
96	GOA	TWL	Sablefish	6	0.761	0.083

Table 7 (cont'd).

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
96	GOA	TWL	Arrowtooth Flndr.	8	0.641	0.117
96	GOA	TWL	Rex sole	15	0.631	0.076
97	BSAI	H&L	Pacific cod	38	0.111	0.023
97	BSAI	H&L	Rockfish	1	0.035	-
97	BSAI	H&L	Turbot	11	0.223	0.120
97	BSAI	POT	Pacific cod	46	0.036	0.026
97	BSAI	TWL	Atka mackerel	8	0.845	0.112
97	BSAI	TWL	BT Pollock	113	0.723	0.038
97	BSAI	TWL	Pacific cod	93	0.666	0.031
97	BSAI	TWL	Other Flatfish	25	0.705	0.101
97	BSAI	TWL	Rockfish	7	0.709	0.107
97	BSAI	TWL	Flathead sole	13	0.565	0.074
97	BSAI	TWL	MWT Pollock	95	0.874	0.014
97	BSAI	TWL	Rock sole	38	0.768	0.054
97	BSAI	TWL	Turbot	3	0.754	0.003
97	BSAI	TWL	Yellowfin sole	35	0.797	0.035
97	GOA	H&L	Pacific cod	6	0.216	0.054
97	GOA	POT	Pacific cod	10	0.107	0.036
97	GOA	TWL	BT Pollock	22	0.662	0.105
97	GOA	TWL	Pacific cod	63	0.621	0.040
97	GOA	TWL	Deep water Flats	15	0.611	0.063
97	GOA	TWL	Shallow wtr. Flats	25	0.708	0.058
97	GOA	TWL	Rockfish	33	0.625	0.070
97	GOA	TWL	Flathead sole	11	0.735	0.121
97	GOA	TWL	MWT Pollock	33	0.698	0.103
97	GOA	TWL	Sablefish	2	0.606	0.153
97	GOA	TWL	Arrowtooth Flndr.	10	0.475	0.113
97	GOA	TWL	Rex sole	6	0.446	0.089
98	BSAI	H&L	Pacific cod	39	0.113	0.018
98	BSAI	H&L	Rockfish	1	0.519	-
98	BSAI	H&L	Turbot	20	0.180	0.054
98	BSAI	POT	Pacific cod	42	0.134	0.057
98	BSAI	TWL	Atka mackerel	12	0.765	0.084
98	BSAI	TWL	BT Pollock	91	0.797	0.060
98	BSAI	TWL	Pacific cod	94	0.657	0.030
98	BSAI	TWL	Other Flatfish	26	0.779	0.053
98	BSAI	TWL	Rockfish	5	0.555	0.144
98	BSAI	TWL	Flathead sole	21	0.695	0.068
98	BSAI	TWL	MWT Pollock	83	0.869	0.024
98	BSAI	TWL	Rock sole	27	0.789	0.050
98	BSAI	TWL	Turbot	3	0.857	0.062
98	BSAI	TWL	Yellowfin sole	27	0.822	0.041
98	GOA	H&L	Pacific cod	9	0.116	0.121
98	GOA	H&L	Rockfish	1	0.035	-
98	GOA	POT	Pacific cod	22	0.156	0.080
98	GOA	TWL	BT Pollock	31	0.554	0.114

Table 7 (cont'd).

Year	Area	Gear	Target	No. of Vsls.	Mean DMR	SE
98	GOA	TWL	Pacific cod	64	0.638	0.062
98	GOA	TWL	Deep water Flats	9	0.506	0.108
98	GOA	TWL	Shallow wtr. Flats	25	0.670	0.080
98	GOA	TWL	Rockfish	30	0.682	0.090
98	GOA	TWL	Flathead sole	9	0.390	0.078
98	GOA	TWL	MWT Pollock	50	0.796	0.040
98	GOA	TWL	Arrowtooth Flndr.	13	0.616	0.119
98	GOA	TWL	Rex sole	7	0.576	0.169

Table 8. Sampling information and halibut viability data from 1995-1998 GOA trawl fishery for flathead sole.

CATCHER/PROCESSORS

Year	No. of Vessels	# hauls w/ hbt	# hauls w/ L/V data	No. of Halibut	% Exc.	% Poor	% Dead	DMR	SE
1995	4	13	13	570	0.0	9.4	90.6	**0.873**	**0.017**
1996	5	33	33	1,986	16.0	54.9	29.0	**0.682**	**0.095**
1997	4	60	60	7,968	1.7	12.8	85.5	**0.791**	**0.161**
1998	3	45	20	1,073	57.3	9.0	33.7	**0.467**	**0.151**
1995-98 Mean		-	-	-	-	-	-	**0.703**	**0.088**
1997-98 Mean		-	-	-	-	-	-	**0.629**	**-**

CATCHER VESSELS

Year	No. of Vessels	# hauls w/ hbt	# hauls w/ L/V data	No. of Halibut	% Exc.	% Poor	% Dead	DMR	SE
1995	6	23	23	732	33.2	30.7	36.2	**0.495**	**0.102**
1996	3	11	11	150	18.2	60.4	21.4	**0.568**	**0.193**
1997	7	33	33	1,014	21.8	49.9	28.3	**0.594**	**0.101**
1998	6	51	43	1,386	75.5	11.7	12.8	**0.331**	**0.099**
1995-98 Mean		-	-	-	-	-	-	**0.497**	**0.059**
1997-98 Mean		-	-	-	-	-	-	**0.463**	**-**

Table 9. Characteristics of the 1995-1998 GOA trawl fishery for flathead sole.

	Mean Tow Duration (min.)		Mean Haul Size (t)	
Year	Catcher/Processor	Catcher Vessel	Catcher/Processor	Catcher Vessel
1995	148	159	9.0	8.6
1996	165	94	10.1	4.7
1997	160	140	8.6	6.2
1998	132	170	4.4	5.2

Table 10. Distribution of fishing effort (# of hauls) by month in the GOA deepwater flatfish trawl fishery where halibut viability sampling occurred.

		Year									
Month	**Season**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**Total**
Jan.	2	-	7	-	-	-	-	-	-	-	7
Feb.	2	12	12	11	40	-	-	-	-	-	75
Mar.	2	7	37	50	526	10	11	2	4	-	647
Apr.	1	144	199	366	365	9	33	36	55	48	1,255
May	1	60	89	43	-	-	-	-	-	-	192
June	1	-	-	-	14	-	-	-	-	-	14
July	1	-	36	90	122	-	31	29	4	3	315
Aug.	1	10	62	12	10	35	-	-	-	-	129
Sep.	1	27	23	2	6	-	-	-	-	-	58
Oct.	2	30	43	33	22	5	1	-	-	-	134
Nov.	2	28	-	-	24	-	-	-	-	-	52
Dec.	2	-	-	-	-	-	-	-	-	-	0
Total	**-**	**318**	**508**	**607**	**1,129**	**59**	**76**	**67**	**63**	**51**	**2,878**

Season key: 1 = Spring/Summer, 2 = Fall/Winter.

Table 11. Observer coverage, sampling, and halibut viability data on 1998 Bering Sea/Aleutian CDQ/MSCDQ hauls.

Gear & Fishery	# Vsls Observed	# Hauls Observed	# Hauls with hbt	# Vsls. w/ L/V samples	# Hauls w/ L/V samples	Raw Data exc	poor	Dead	DMR	Extrapolated Data xexc	xpoor	xdead	DMR	SE
CDQ Trawl														
Atka mackerel	4	48	27	3	21	6	3	79	**0.840**	269	101	742	**0.699**	**0.163**
BT pollock	20	87	36	9	30	0	2	139	**0.895**	0	5	691	**0.898**	**0.086**
Pacific cod	6	36	28	3	14	14	10	3	**0.407**	382	206	77	**0.390**	**0.245**
Other Flats	2	5	2	0	0	0	0	0	--	0	0	0	--	--
Rockfish	4	20	7	3	6	0	0	13	**0.900**	0	0	254	**0.900**	--
Flathead sole	2	30	27	0	0	0	0	0	--	0	0	0	--	--
Other sp.	5	9	7	1	2	0	3	1	**0.638**	0	39	15	**0.648**	--
Pelagic pollock	34	1,153	165	21	152	0	5	360	**0.895**	0	7	659	**0.896**	**0.009**
Rocksole	1	2	2	0	0	0	0	0	--	0	0	0	--	--
Sablefish	1	1	1	0	0	0	0	0	--	0	0	0	--	--
Turbot	4	61	53	1	8	1	6	8	**0.713**	34	128	189	**0.704**	--
CDQ Longline														
Pacific cod	13	318	315	13	228	1,925	169	48	**0.095**	31,615	2,786	852	**0.096**	**0.011**
Rockfish	1	4	2	1	1	6	0	0	**0.035**	12	0	0	**0.035**	--
Sablefish	2	43	15	2	4	13	0	0	**0.035**	96	0	0	**0.035**	--
Turbot	2	52	28	1	12	22	1	0	**0.056**	82	16	0	**0.114**	--

Table 12. Key to longline injury codes for Pacific halibut. For data collection beginning in the year 2000.

1a. Fish is alive ..... **Go to 2a**

1b. Fish is dead when brought to the surface on the gear ..... **Code DEAD**
Fish is in rigor and lifeless, even if no apparent injuries. Gills appear completely devoid of blood (light pink or white in color).

2a. No penetration of the body or head by sand fleas ..... **Go to 3a**
Membranes surrounding eyes and anus are intact, without any holes from sand fleas. A few sand fleas may be seen on body and can be wiped off with your hand. Typically, no penetration has occurred when only a few (e.g., <10) sand fleas are found on the body.

2b. Sand fleas have penetrated the body via the eyes, fins, or anus ..... **Code DEAD**
Membrane surrounding eye may be partially or completely missing. Dorsal and/or anal fin membranes may be eaten away, leaving fin rays exposed. Skin on the body is separated from tissue where sand fleas have eaten.

3a. No wounds of any kind to abdominal organs. Abdominal wall not punctured ..... **Go to 4a**

3b. Abdominal organs are damaged, possibly by a gaff ..... **Code DEAD**
Abdominal cavity wall is punctured or torn. Viscera are visible and exposed, and may be protruding.

4a. Fish is not bleeding from gills (but may be bleeding from elsewhere) ..... **Go to 5a**

4b. Fish is bleeding from gills ..... **Code DEAD**
Bleeding is occurring from a torn or severed gill arch.

5a. Fish is not bleeding at all, or bleeding is minor to moderate (not from gills) ..... **Go to 6a**
Blood may be seen around mouth and/or jaw. Blood may be oozing continuously, or bleeding may be continuing very slowly a few drops at a time, or bleeding may have stopped.

5b. Bleeding is severe ..... **Code DEAD**
Blood from any source is flowing freely and continuously in large quantity.

6a. Injuries to head and/or jaw are minor to moderate, but no structures are missing ..... **Go to 7a**

6b. Major injuries to head and jaw, resulting in missing pieces ..... **Code SEVERE**
Side of the head, possibly including the jaw, has been torn loose and missing from the fish, and/or lower jaw has been torn away and is missing.

7a. Bleeding, if any, is stopped or few drops ..... **Go To 8a**

7b. Bleeding is not flowing profusely but is oozing continuously ..... **Code MODERATE**

8a. Wounds to the head (forward of preopercle and above cheek and jaw) are only surface scratches on the skin..... **Go to 9a**

8b. Skin on head (forward of preopercle) is ripped and torn deeply..... **Code SEVERE**
Internal organs are likely exposed.

9a. Eye or eye socket is not punctured ..... **Go to 10a**

9b. Eye or eye socket is punctured..... **Code MODERATE**

10a. No wounds to the body are evident..... **Go to 11a**

10b. Wounds in body consist of puncture holes in skin, with possibly a flesh tear .... **Code MODERATE**

11a. Lower jaw is significantly damaged..... **Code MODERATE**
Lower jaw may be broken into 2 pieces at the snout, but each is still attached at the base of the jaw. Jaw may be torn on one side or the other, possibly extending through the cheek.

11b. Damage to lower jaw, if any, is slight ..... **Code MINOR**
Injuries include the hook entrance/exit hole around the jaw or in the cheek, or a tear in the cheek. A piece of the lip may be torn and hanging from the jaw. If gangion was cut, the hook and some length of residual gangion may be hanging from the mouth.

Table 13. Summary of halibut discard mortality rates (DMRs) in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries during 1990-1998 and recommendations for Preseason Assumed DMRs in monitoring halibut bycatch mortality in 2000.

Gear and Target	1990	1991	1992	1993	1994	1995	1996	1997	1998	Trend?	2-Year Mean	Used in 1999	Recommendations for 2000
Trawl													
Atka mackerel	66	77	71	69	73	73	83	85	77	No	81	85	81
Bottom pollock	68	74	78	78	80	73	79	72	80	No	76	76	76
Pacific cod	68	64	69	67	64	71	70	67	66	Yes/dn	67	69	66
Other Flatfish	80	75	76	69	61	68	67	71	78	No	75	69	75
Rockfish	65	67	69	69	75	68	72	71	56	No	64	72	64
Flathead sole	-	-	-	-	67	62	66	57	70	No	64	62	64
Other species	-	-	-	-	-	-	-	-	-	-	-	69	66
Pelagic pollock	85	82	85	85	80	79	83	87	86	No	87	85	87
Rock sole	64	79	78	76	76	73	74	77	79	Yes/up	78	76	79
Sablefish	46	66	-	26	20	-	-	-	-	No	23	23	23
Turbot	69	55	-	-	58	75	70	75	86	No	81	73	81
Yellowfin sole	83	88	83	80	81	77	76	80	82	No	81	78	81
Pot													
Pacific cod	12	4	12	4	10	10	7	4	13	No	9	4	9
Other species	-	-	-	-	-	-	-	-	-	-	-	4	9
Longline													
Pacific cod	19	23	21	17	15	14	12	11	11	No	11	11	11
Rockfish	17	55	-	6	23	-	20	4	52	No	28	12	28
Other species	-	-	-	-	-	-	-	-	-	-	-	11	11
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	No	20	19	20
CDQ Trawl													
Bottom pollock	-	-	-	-	-	-	-	-	90	-	-	76	90
Pelagic pollock	-	-	-	-	-	-	-	-	90	-	-	81	90
CDQ Longline													
Pacific cod	-	-	-	-	-	-	-	-	10	-	-	11	10

Table 14. Summary of halibut discard mortality rates (DMRs) in the Gulf of Alaska (GOA) groundfish fisheries during 1990-1998 and recommendations for Preseason Assumed DMRs in monitoring halibut bycatch mortality in 2000.

Gear and Target	1990	1991	1992	1993	1994	1995	1996	1997	1998	Trend?	2-Year Mean	Used in 1999	2000 Recommendation
Trawl													
Atka mackerel	67	89	81	67	53	-	60	-	-	No	57	57	57
Bottom pollock	51	62	66	57	48	66	79	66	55	No	61	73	61
Pacific cod	60	62	66	59	53	64	70	62	64	No	63	66	63
Deep wtr flats	61	58	70	59	60	56	71	61	51	No	56	66	56
Shallow wtr flats	66	71	69	65	62	70	71	71	67	No	69	71	69
Rockfish	65	75	79	75	58	71	65	63	68	No	66	64	66
Flathead sole	-	-	-	-	54	64	67	74	39	No	57	**	57
Other species	-	-	-	-	-	-	-	-	-	-	-	66	66
Pelagic pollock	71	82	72	63	61	51	81	70	80	No	75	76	75
Sablefish	70	60	68	59	67	58	80	61	-	No	71	71	71
Arrowtooth fldr	-	-	-	-	-	-	66	48	62	No	55	57	55
Rex sole	-	-	-	-	56	76	63	47	58	No	53	55	53
Pot													
Pacific cod	12	7	16	24	17	21	7	11	16	No	14	6	14
Other species	-	-	-	-	-	-	-	-	-	-	-	6	14
Longline													
Pacific cod	15	18	13	7	11	13	11	22	11	No	17	16	17
Rockfish	6	-	-	7	-	4	13	-	9	No	11	9	11
Other species	-	-	-	-	-	-	-	-	-	-	-	16	17
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-

**Catcher vessel fleet = 58%; Catcher/Processor fleet = 74%.

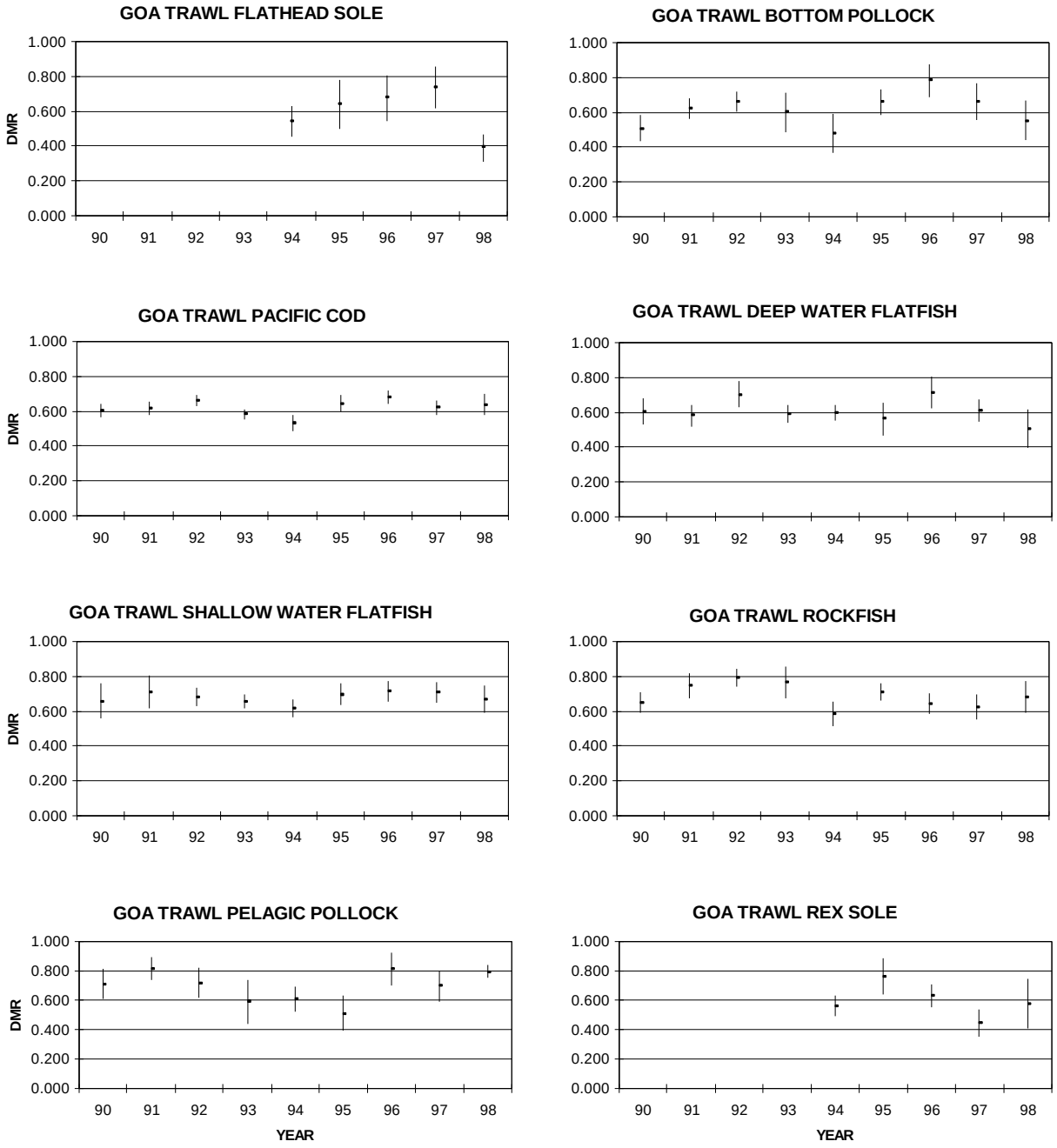

Figure 1. Plots of the historical trend in halibut discard mortality rates for Gulf of Alaska trawl fisheries. Data points indicate mean annual DMR ± standard error.

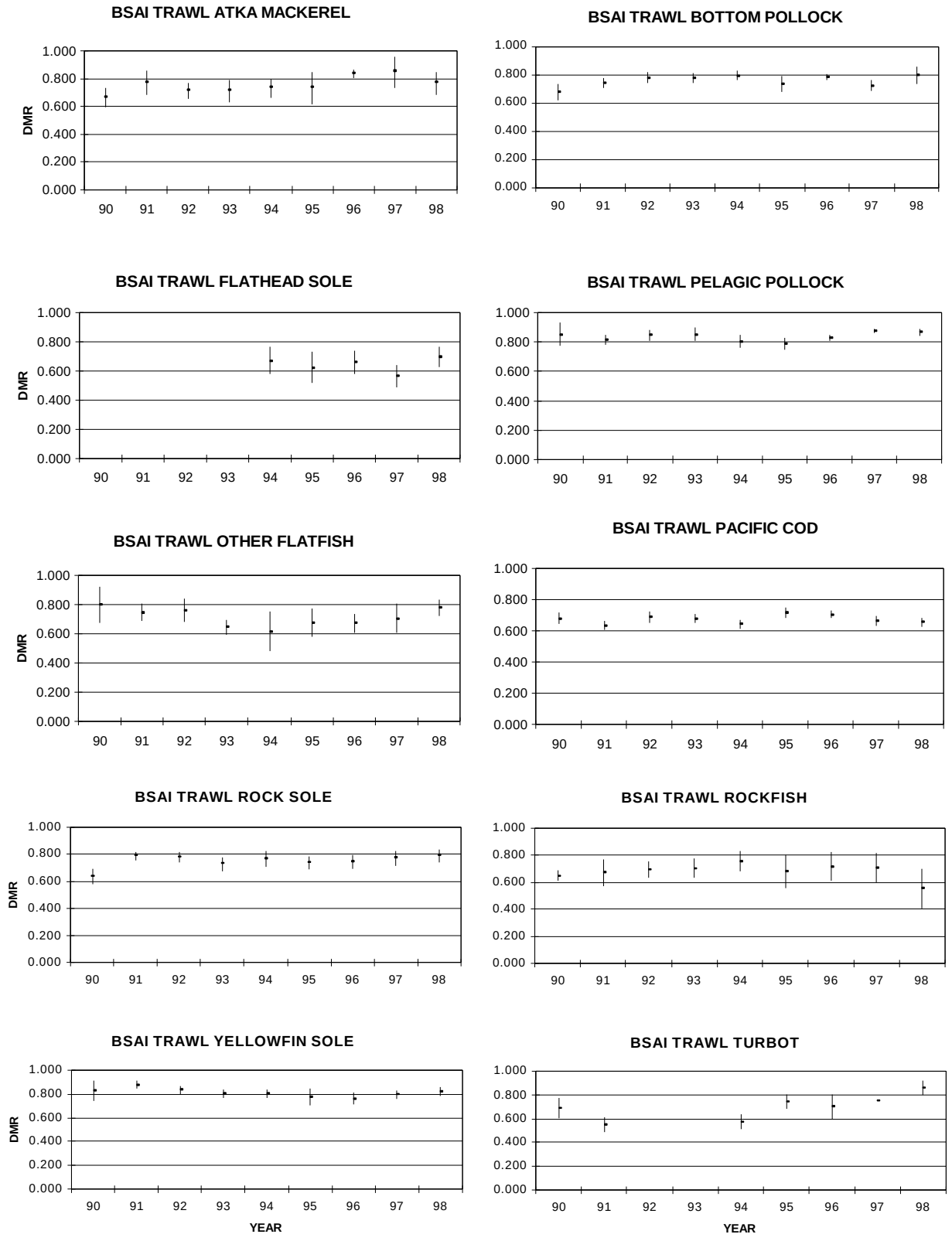

Figure 2. Plots of the historical trend in halibut discard mortality rates for Bering Sea/Aleutians trawl fisheries. Data points indicate mean annual DMR ± standard error.

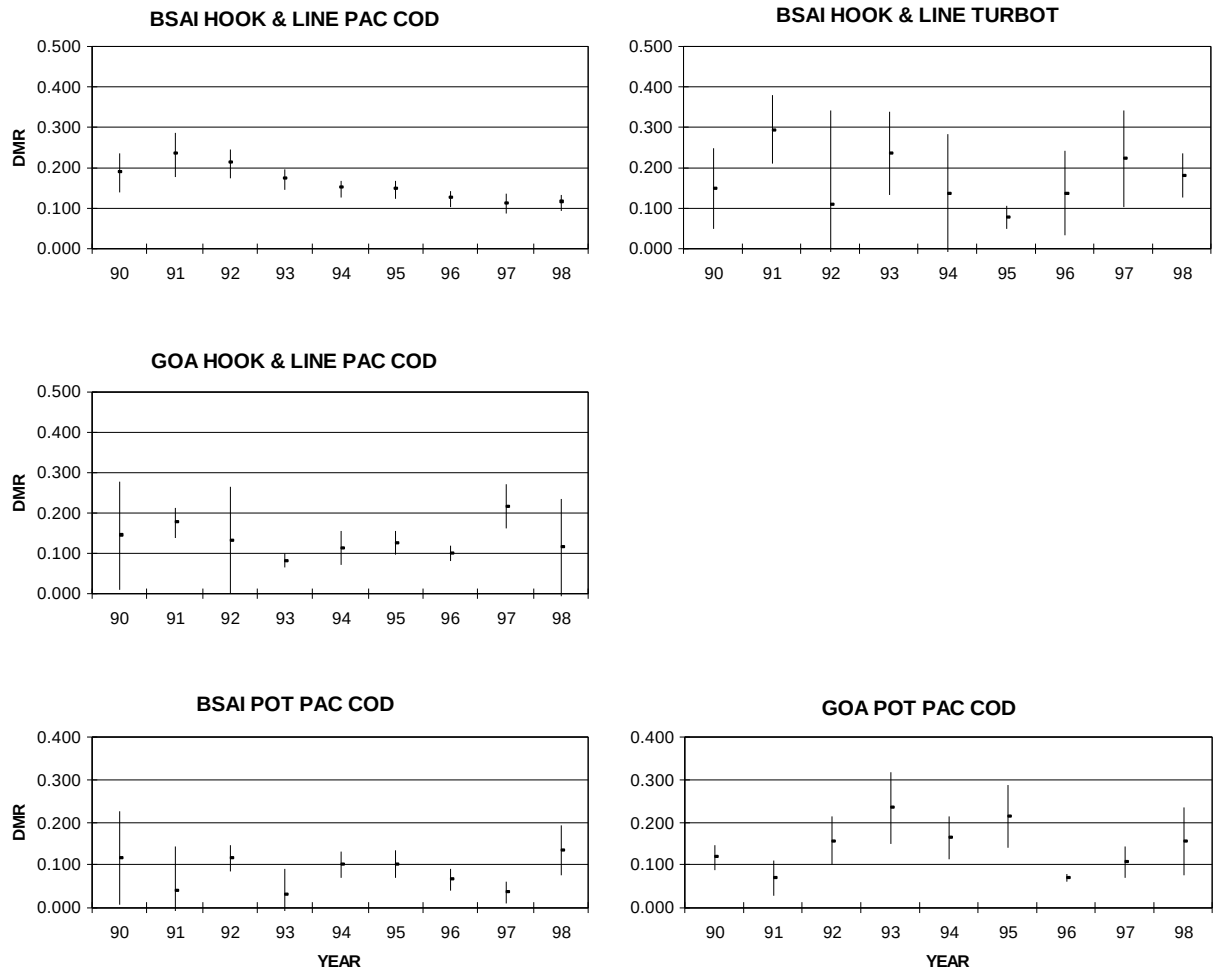

Figure 3. Plots of the historical trend in halibut discard mortality rates for Bering Sea/Aleutians (BSAI) and Gulf of Alaska (GOA) fixed gear fisheries. Data points indicate mean annual DMR ± standard error.