


MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke   
Executive Director

DATE: June 2, 1998

SUBJECT: Halibut Discard Mortality Rates

ESTIMATED TIME 6 HOURS (for all D-1 items)
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**ACTION REQUIRED**

Consider changes in halibut discard mortality rates for BSAI Pacific cod fishery for second half of 1998.

**BACKGROUND**

Halibut discard mortality rates (DMRs) are used to monitor the halibut mortality PSC limits for individual fisheries. These DMRs are estimated from viability data collected by NMFS observers. DMRs for individual groundfish fisheries are generally established pre-season during the annual specification process each December. For 1998, the Council recommended a DMR of 12% for the BSAI Pacific cod hook-and-line fishery. It scheduled this agenda item to review an analysis prepared by International Pacific Halibut Commission staff on 1998 in-season observer data for this fishery. This analysis (Item D-1(d)(1)) indicates a DMR of 11% for the first half of the 1998 Pacific cod hook-and-line fishery. This is the third year that the Council has considered a mid-year retroactive adjustment of the halibut DMR for this fishery only.

# **HALIBUT DISCARD MORTALITY RATES (DMRs) IN THE 1997 BSAI HOOK & LINE PACIFIC COD FISHERY, WITH A RECOMMENDATION FOR 1998 MANAGEMENT**

By

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May 31, 1998

## **Summary**

At its December 1997 meeting, the North Pacific Fishery Management Council (NPFMC) agreed to a request by the Bering Sea Pacific cod hook & line industry to monitor halibut bycatch in the 1998 fishery with a discard mortality rate (DMR) of 11.5 % until 1997 observer data can be analyzed by International Pacific Halibut Commission (IPHC). The results of the analysis would be the basis for a revised DMR for 1998 management and applied retroactively. (The standard approach used in the analysis presented in September 1997 resulted in a DMR of 12% for 1998.) This report provides the NPFMC with the results of the analysis of the 1997 data, which shows a DMR of 11% for that year. The BSA Pacific cod hook & line industry agreed to use the 1997 DMR as the assumed DMR for 1998. **Therefore, it is recommended that halibut bycatch in the 1998 BSAI Pacific cod hook & line fishery be monitored with a DMR of 11%.**

## **Introduction**

This analysis was initiated by actions taken by the Council at the December, 1997 meeting. At that meeting, IPHC recommendations for DMRs for 1998 bycatch monitoring included a value of 12% for the Bering Sea/Aleutian hook-&-line fishery for Pacific cod (Williams 1997). This was based on data for 1996, the most recent year for which data were available at that time, and followed an approach for deriving preseason assumed DMRs used for the past few years.

Industry representatives, however, suggested that data for 1997 should be used for the 1998 preseason assumed DMR on the basis that an industry monitoring program in 1997 showed even lower DMRs than in 1996. The industry representatives suggested using 11.5% for 1998 until the 1997 observer data could be analyzed, at which time the 1997 value would replace the 11.5% DMR. The Council concurred with this request and this report provides the results of the analysis of the 1997 data.

## **Data and Methods**

The same procedures were followed as in previous DMR analyses (e.g., Williams 1997). Haul-by-haul observer data for the 1997 BSA hook & line cod fishery were obtained from the NMFS Domestic Observer Program. These data included catch by species and halibut length/viability

information. Observers take samples of release viability, or condition, up to a maximum of 20 fish on certain sets. Condition is determined as excellent, poor, or dead, based on a set of predetermined criteria (Table 1). For each sampled set, the number of excellent, poor, and dead halibut was extrapolated to the total number of halibut estimated to have been caught on the set. The extrapolated values were then summed across all sampled sets. A DMR is calculated using the following general model for halibut caught by gear  $g$ :

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

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

The mortality rates vary among the gear types (Clark et al. 1992, Williams 1996) 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 for hook & line caught fish, based on tagging and pen holding experiments, are 0.035 for fish in excellent condition, 0.518 for poor condition, and 1.0 for dead condition.

At the December, 1997 NPFMC meeting, the SSC requested that standard errors on the DMRs be reported "to aid the comparison of estimates over time or among gear types". To accomplish this, it was assumed 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  $DMR_i$  = observed DMR on vessel  $i$   
 $p_i$  = proportion of total number of halibut caught on vessel  $i$

Then  $\overline{DMR} = \sum_{i=1}^n p_i \times DMR_i$

Standard errors of the weighted mean DMR were estimated as:

$$V(\overline{DMR}) = \sum_{i=1}^n p_i^2 \times V(DMR_i)$$

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

where  $V(DMR_i)$  is the sample variance of all the  $DMR_i$ , and  $V(\overline{DMR})$  and  $SD(\overline{DMR})$  are the variance and standard deviation of  $\overline{DMR}$ , respectively.

## Results

Data were collected from 3,355 hauls made by 37 vessels fishing Pacific cod in the BSA in 1997 (Table 2). Over 31,000 halibut were examined for release viability. Fishery-wide release viability was 88% in excellent condition, 9% poor, and 3% dead, all improvements from the 1996 fishery (Table 2).

DMRs were calculated for each vessel/year. The number of vessels in this fishery has ranged from 32 to 45, with 37 being recorded in 1996 and 1997. The distribution of individual vessel DMRs by year is shown in Figure 1 as a series of box plots. The plots indicate that although the overall range in DMRs remains fairly wide, the median has been declining and the middle 50% of data points (the box) has also declined. This suggests that vessel performance is improving with respect to the discard condition of halibut.

The fishery DMR estimated for each year is given in Table 2. Being a weighted estimate, greater emphasis is given to vessels with high bycatches of halibut. Thus, a vessel which had a high amount of halibut bycatch but a low DMR had greater effect on the mean DMR than a vessel with a low amount of bycatch and a low DMR. The cod fishery DMR has been declining since a high of 0.23 in 1991 to the 0.11 estimated for 1997. Standard deviations were also estimated for the fishery DMRs and are shown in Table 2. Figure 2 depicts mean DMRs ( $\pm 1$  standard deviation) for each year.

The difference between 1996 and 1997 DMRs was tested for significance using a 2-sample independent test of means ( $\alpha = 0.05$ ). The null hypothesis that the two means were equal ( $\mu_1 = \mu_2$ ) was rejected based on a calculated z-value of 2.061 against the test value of 1.96. Thus, the decline from 1996 to 1997 represents a real decline in the DMR, rather than being due to sampling variability.

The same test was performed on the 1995 and 1996 DMRs.  $H_0$  was rejected, based on a calculated z-value of 6.083 against the test value of 1.96.

## Discussion

The 1997 results continue the downward trend in the DMR for this fishery that began in 1991, when the DMR was at a high of 0.23 (Table 2). Better handling practices by vessel crews and in-season monitoring by the fleet has apparently paid off, as release condition has improved and the fishery's DMR has been cut in half, to 11% for 1997.

The box plots in Figure 1 provide some insight into these data. First, DMRs among vessels in any given year vary considerably, although the range appears to have narrowed in recent years. Also, these annual distributions tend to be positively skewed, which indicate that most vessels have relatively low DMRs and few have excessively high DMRs. This pattern appears to have been especially true in 1996. Lastly, although the median values appear to have changed only slightly since 1993, the decline in the DMR for the fishery (Table 2) must be attributed to improvements made by vessels that catch significant amounts of halibut bycatch.

## **Recommendation**

Recommendations for an assumed DMR are usually based on data from previous years. In this case, the BSA Pacific cod hook & line industry agreed to use the 1997 DMR as the assumed DMR for 1998. Therefore, it is recommended that halibut bycatch in the 1998 BSAI Pacific cod hook & line fishery be monitored with a DMR of 11%.

## **References**

- Clark, W. G., S. H. Hoag, R. J. Trumble, and G. H. Williams. 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.
- Williams, Gregg H. 1997. Appendix B: Pacific halibut discard mortality rates in the 1990-1996 Alaskan groundfish fisheries, with recommendations for monitoring in 1998. [IN] *Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions*. North Pacific Fishery Management Council, Anchorage. AK. 559 p.

**Table 1. Description of halibut release conditions for hook & line gear.**

Excellent: No sign of stress

1. Hook injuries are minor (limited to the hook entrance/exit hole, torn lip) and located in the jaw or cheek.
2. Bleeding, if present, is minor and limited to jaw area.
3. No penetration of the body by sand fleas (check eyes, fins, anus).
4. Muscle tone or physical activity is strong.
5. Gills are deep red.

Poor: Alive but showing signs of stress

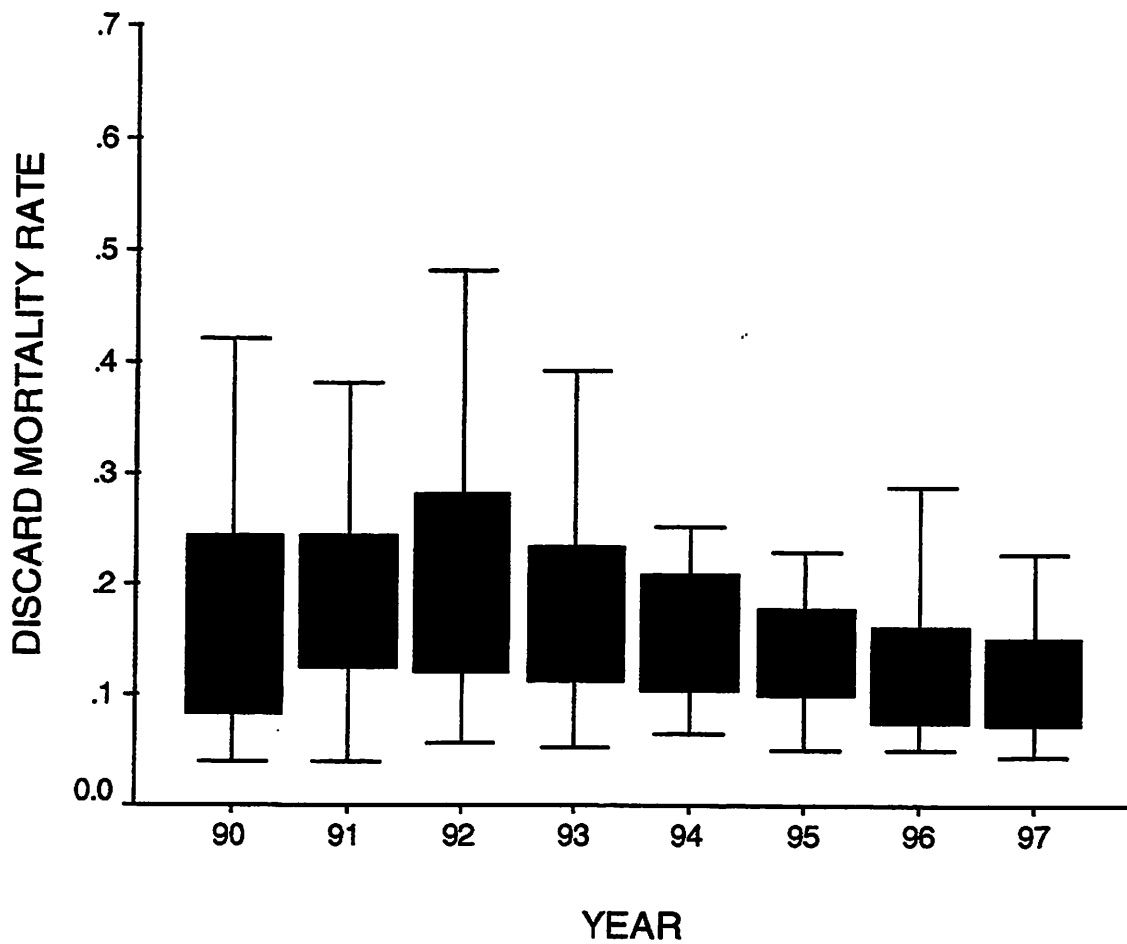
1. Hook injuries may be severe: broken jaw; punctured eye.
2. Vital organs are not injured.
3. Bleeding may be moderate but not from gills.
4. No penetration of the body by sand fleas (check eyes, fins, anus).
5. Muscle tone or physical movement may be weak or intermittent; little, if any, response to stimuli.
6. Gills are red.

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

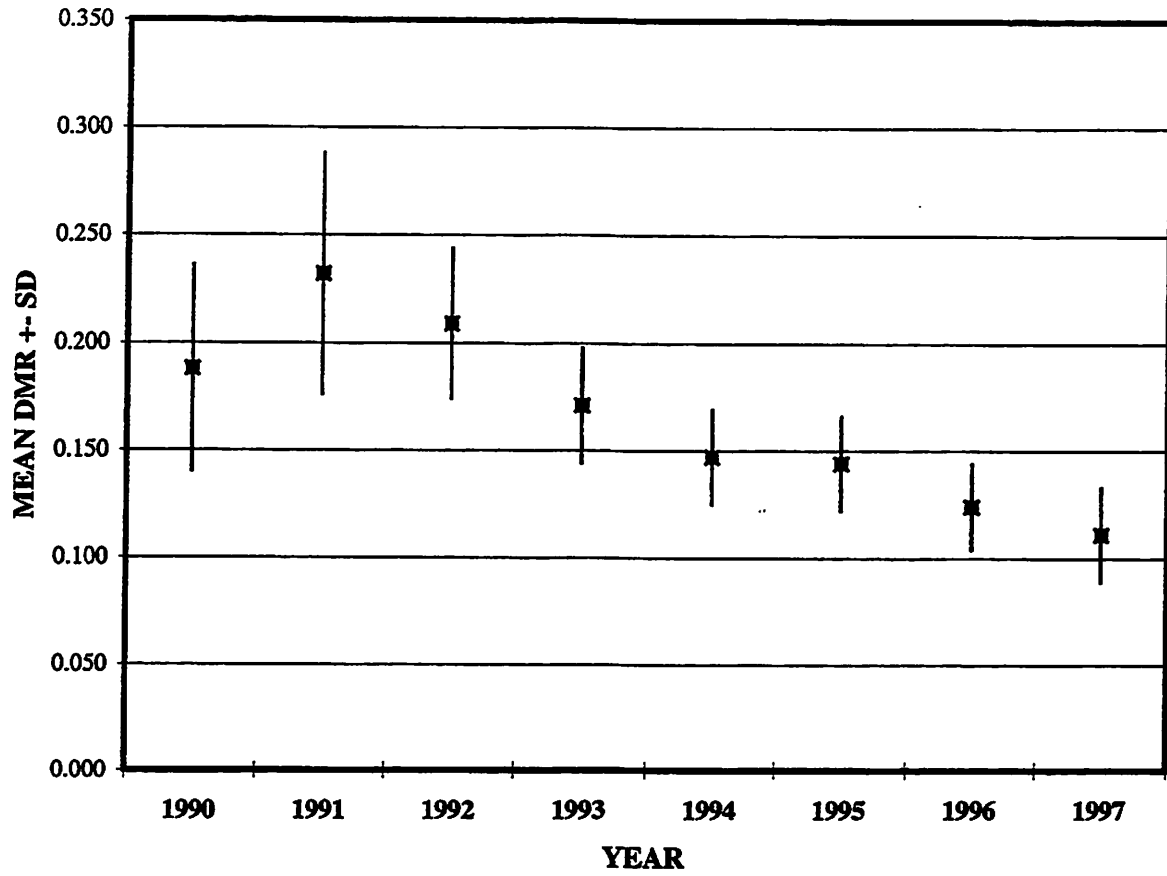
1. Vital organs may be damaged: torn gills; gaff wound to head or body; jig injury to viscera; side of face torn loose or missing jaw.
2. Sand fleas have penetrated the body (they usually attack the eyes first, but also fins and anus).
3. Severe bleeding may occur, especially from the gills.
4. No sign of muscle tone; physical activity absent or limited to fin ripples or twitches.
5. Gills may be red, pink, or white.

**Table 2. Summary of halibut viability sampling data for the BSAI hook & line fishery for Pacific cod.**

Year	No. of Vessels Observed	No. of Hauls Sampled	No. of Halibut Examined	Mean DMR	Std. Dev.	% Exc	% Poor	% Dead
1990	32	2,795	48,547	0.188	0.048	76	18	6
1991	45	3,437	55,038	0.232	0.056	65	29	6
1992	44	2,980	35,389	0.209	0.035	72	21	7
1993	44	2,602	28,836	0.171	0.027	79	15	6
1994	40	3,212	45,964	0.147	0.022	82	13	5
1995	36	3,389	40,788	0.144	0.022	80	14	6
1996	37	3,464	42,156	0.124	0.020	85	11	4
1997	37	3,355	31,721	0.111	0.022	88	9	3



**Figure 1.** Boxplot of discard mortality rate (DMR) distributions for the BSAI hook-&-line fishery for Pacific cod for 1990-1997. Boxes show median DMR (heavy line) and 25<sup>th</sup> and 75<sup>th</sup> percentiles. The whiskers indicate the minimum and maximum values for vessels which fished at least 10 sets in the cod fishery during the year in question.



**Figure 2.** Mean DMR of the BSAI Pacific cod hook & line fishery since 1990. Bars represent 1 standard deviation; midpoints indicate the mean DMR.