# Calculating halibut discard mortality rates for the Alaska groundfish fisheries

Discussion draft for internal working group, June 2015[1]



## 1 Introduction

In 2000, the Council adopted a plan in which the DMRs used for in-season management of halibut PSC mortality in the BSAI and GOA groundfish fisheries are based on the most recent 10-year average for each target fishery. The DMRs are not re-estimated every year, but instead are kept constant for 3 years, with the justification being: 1) inter-annual variability of fishery DMRs has been relatively small, and 2) a three-year period provides stability for the industry to better plan their operations. In 2015, the Council is in the third year of using DMRs that were adopted using the 2002 to 2011 basis period, and the Council is due to adopt DMRs for the next three-year period during the December 2015 annual harvest specifications process.

In preparation for this, we need to calculate discard mortality rates for the fisheries from 2012 to 2014, so that the most recent 10-year average can be determined. In the past, these calculations were made by Gregg Williams at the IPHC, and presented to the groundfish Plan Teams. Given Gregg's retirement, we have suggested that AKFIN could take over the responsibility of calculating DMRs on an annual basis, using a process to be agreed on by IPHC, NMFS Alaska Region, NMFS Observer Program, AKFIN, and Council staff. The most recent DMRs could be made available annually to the IPHC for inclusion in the stock assessment, and triennially, Council staff could take responsibility for shepherding the DMRs through the Plan Team and Council specifications process.

In trying to replicate Gregg's DMR calculations, we have run into some challenges with the data, in particular because the number of halibut viabilities taken by observers has substantially decreased in recent years. The rest of this discussion draft highlights some of the issues that we have encountered, and potential solutions. **We suggest that it would be useful to schedule a meeting with representatives of all the agencies listed above to agree on a process for annually calculating DMRs.** As a separate part of that discussion, it may also be useful to consider two other issues that have been raised in the Council arena with respect to DMRs. First, there has been discussion about changing the Council process for adopting DMRs for inseason management, to instead rely more on recent years rather than the 10-year average, with the objective of encouraging sectors to improve handling. Second, the Council has been asked to investigate the reasons for the difference between CDQ and non-CDQ DMRs; while this is not an immediate priority, it may be appropriate to fold that evaluation into the discussion of the DMR calculation process.

[1] Prepared by: Jim Armstrong (NPFMC), Diana Evans (NPFMC), and Mike Fey (AKFIN).

## 2 Current DMR Estimation Methods

The description of estimation methods provided here was compiled by Council staff based on review of the annual IPHC Reports of Assessment and Research Activities (RARAs). To the extent that this description is not complete, it reflects a need for a clarification, so that exact replication of methods can be carried out and specific modifications and improvements can be made, as needed.

The calculation of annual DMRs has not changed significantly since the approach was established by Williams (1997). Central to this approach, each halibut sampled for viability on qualifying observed hauls (i.e., hauls where species catch composition was sampled) is assigned a survival probability based on gear type and the observer's assessment of condition factor upon release. A finite number of condition categories are used (excellent, poor, and dead for trawl and pot gear, and minor, moderate, severe, dead for longline gear) and specific survival probability is based on Clark et al. (1992), Williams (1997), and Kaimmer and Trumble (1998) (Table 1). A guided key for assigning halibut to condition is used by the observers. Total halibut mortalities in the sample are calculated as a product of the number of sampled halibut within each condition and the condition's corresponding mortality probability, summed. Total halibut mortalities in the haul are a simple expansion of the distribution of halibut among the condition categories to the total halibut catch.

The fleet-wide expansion of haul-level mortalities takes into account that the BSAI and GOA groundfish fisheries are comprised of a number of smaller target (single or mixed-species) fisheries conducted with different gear types, for which DMRs vary. The assignment of vessels to target fisheries is outcome-based, using the proportions of various species in a given vessel's sampled catch. In other words, catches at or above a threshold percentage for a given species, place that catch in a given target fishery. For CDQ vessels, target fishery is assigned on a haul by haul basis. For non-CDQ vessels, target fishery is based on sampled hauls that are summed over the reporting week. Vessel-specific DMRs for a given target fishery are determined based on the ratio of a vessel's total halibut mortalities to total vessel halibut catch. Hauls are not combined across vessels, rather individual vessels are treated as the sampling unit – vessel DMRs are what is expanded to the target fishery level (Williams 1997).

Overall target fishery DMRs and standard errors are calculated as the mean of vessel-specific DMRs within those target fisheries, weighted in the averaging by each vessel's proportional contribution to total halibut catch. A hypothetical target fishery DMR is calculated based on haul level catches from three vessels in Table 2.

This process can be summarized as consisting of four steps:

1. Calculate halibut mortalities and total catch for each qualifying observed haul on every individual vessel.
2. Assign a target fishery, split out by gear type, FMP region, and CDQ/non-CDQ.
    a. For CDQ, a target is assigned to each haul.
    b. For non-CDQ, all hauls within a reporting week are aggregated to produce a reporting week trip target for an individual vessel
3. Calculate a vessel-specific DMR for each target fishery by aggregating halibut mortalities and catches
4. Calculate an overall target fishery DMR by averaging vessel DMRs (weighted by their contribution to total halibut catch)

## 3 Concerns about the Current Process

There are several issues about current DMR estimation methods that should be discussed.

1. *Current calculation methods:*
    a. *Replication:* Although methods are fairly clearly described in IPHC reports and above, attempts by AKFIN staff to replicate historic estimates have not been completely successful (Table 3 and Table 4). Longline estimates have been replicated, but trawl and pot estimates remain problematic. It is likely internal details about calculation methods may have changed over time. In particular, the expansion exercise to target fishery DMR for these gear types is not working well.
    b. *Definition of Target Fishery:* There is also a question about whether it is appropriate to assign target fisheries to vessels based on haul-by-haul observer data, when the DMR is applied to the trip-level extrapolated totals.
    c. *Weighting:* It may not be appropriate to weight DMR by extrapolating the sample to the extrapolated number of halibut in a haul or target.

2. *CP and CV Vessels:* Although differences in halibut DMRs may exist between CP and CV vessels (Table 5), these vessel types are not differentiated under current methods.

3. *Length of reference timeframe:* Improvement in halibut viability for some fleet components appears to have occurred and is likely tied to changes in management structure, such as fishery rationalization. The continued use of ten-year averaging, which would use DMRs for the basis years 2005-2014 to establish the 2016-2018 DMRs, may not be appropriate under those conditions.

4. *Reduced observer sampling:* There has been a reduction in observer sampling of trawl-caught halibut, and a substantial reduction in halibut viability sampling, starting in about 2012 (Table 6 through Table 8, and Figure 1 and Figure 2). This substantially reduces the number of qualifying hauls and vessels that form the basis for the expansion exercise under current methods. A more general grouping of fleet components may be more appropriate.

5. *Alternative vessel aggregation methods:* The approach of using species composition may be problematic in that it may not reflect behavior of the target fisheries that is tied to halibut mortality. This is especially true where flatfish species may be unnecessarily separated out into six different fisheries.

6. *Reconciling different DMRs for CDQ/non-CDQ vessels:* As stated above, the basis for differences in calculated DMRs between CDQ and non-CDQ vessels is not explained under current reporting, although there are differences in the calculation methods for the two fleets. It will need to be investigated whether the different DMRs are based on differences in vessels operations, so as to rule out that the difference is a byproduct of the different calculation methods.

## 4 Potential solutions

These are just general directions and initial thoughts intended to kick off inter-agency discussion. The enumerated solutions below match the issues in the preceding section.

1. *Current calculation methods:*

    a. *Replication:* Since alternative methods may be explored, it will be essential to be able to provide estimates using status quo methods as well. Can we get the source code for calculations used by IPHC so that the details of the calculations can be applied with certainty?

    b. *Definition of Target Fishery:* Explore trip-level, rather than haul-level grouping for defining target fishery.

    c. *Weighting:* Explore alternative weighting methods, or alternative definitions of sampling unit.

2. *CP and CV Vessels:* Explore separate calculations of DMRs for CP and CV vessels, and discuss reasons for differences and effects on appropriate reference timeframes if these vessels should be separated.

3. *Length of reference timeframe:* Explore DMR calculations for shorter, more recent time periods, and discuss pros and cons for alternative time frames for various fleet components.

4. *Reduced observer sampling:* There are a number of alternative fishery aggregations that could be explored that may be more appropriate under the current lower levels of viability sampling. Additionally, there is a possibility that we could link the level at which to group vessels to sample size, which may be more statistically robust. An alternative approach would be to aggregate all targets for each individual vessel or to aggregate to a few targets for each vessel where possible.

5. *Alternative vessel aggregation methods:* Rather than aggregate by target, vessels could be aggregated by sector/area, perhaps based on how PSC limits are assigned

6. *Reconciling different DMRs for CDQ/non-CDQ vessels:* Investigate whether the different DMRs are based on differences in vessels' operations, to rule out that the difference is a byproduct of the differences in calculation methods under current practices.

# 5 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. Pacific halibut discard mortality rates in the 1990-1995 Alaskan groundfish fisheries, with recommendations for monitoring in 1997. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 1996: 173-183.

Kaimmer, S. M. and R. J. Trumble. 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. 2009. Appendix 2: Pacific halibut discard mortality rates in the 2008 CDQ and non-CDQ groundfish fisheries, and recommendations for 2010-2012. In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region. North Pacific Fishery Management Council, Anchorage AK. November 2009.

# 6 Figures and Tables

**Figure 1** **Number of halibut viabilities for BSAI and GOA trawl CP and CV vessels, from 2000-2015.**

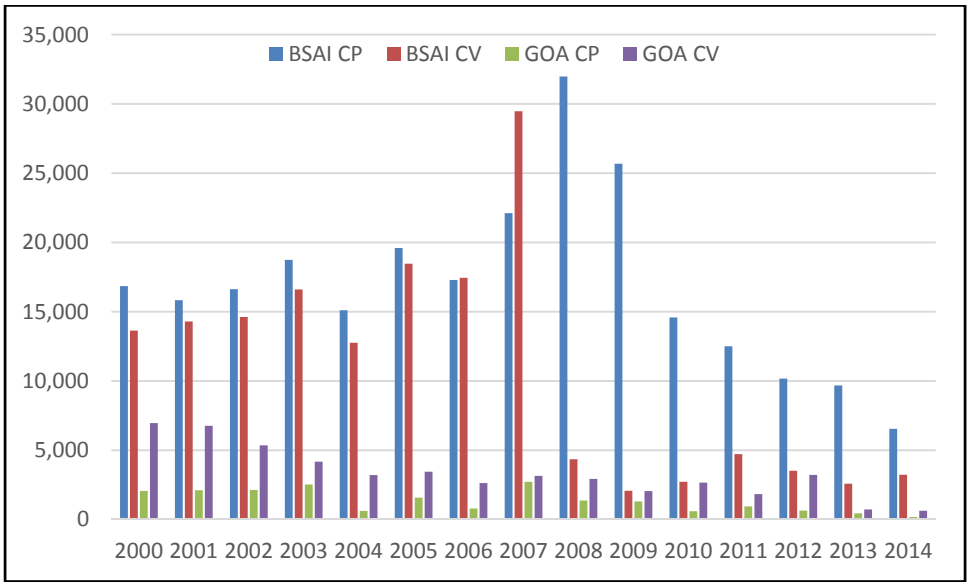


**Figure 2** **Number of halibut samples and viabilities for BSAI and GOA longline vessels from 2001 to 2015.**

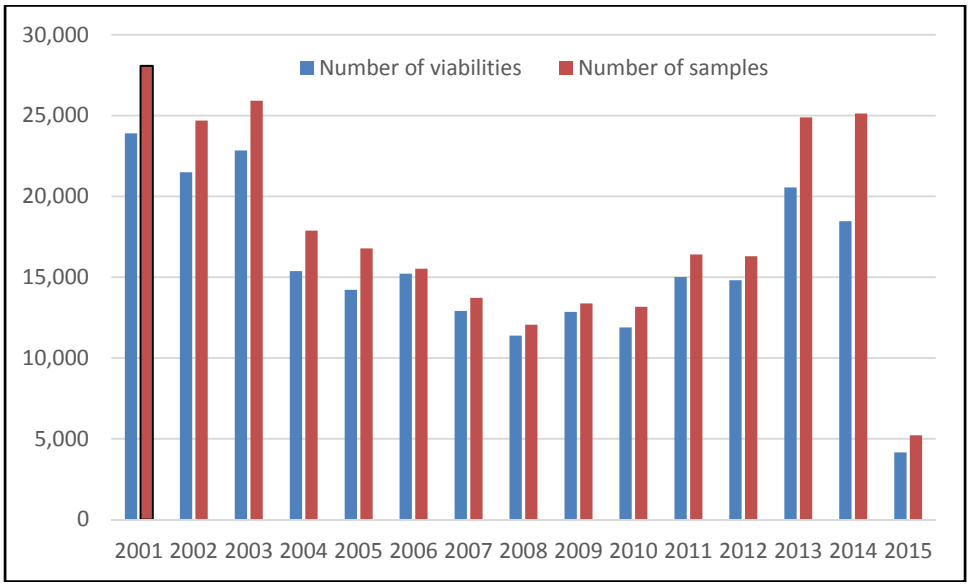


**Table 1** **Assumed gear/condition-specific mortality probabilities for halibut in calculating annual DMRs.**

| | | Condition | | | |
|---|---|---|---|---|---|
| | | **Excellent** | **Poor** | **Dead** | |
| **Gear** | **Trawl**[a] | 0.20 | 0.55 | 0.90 | |
| | **Pot**[b] | 0.00 | 1.00 | 1.00 | |
| | | **Minor** | **Moderate** | **Serious** | **Dead** |
| | **Longline**[c] | 0.035 | 0.363 | 0.662 | 1.000 |

From [a] Clark et al. (1992), [b] Williams (1996), and [c] Kaimmer and Trumble (1998)

**Table 2 Hypothetical example calculating the overall target fishery DMR, where there are three total vessels that have fished in that target during the year, each during a single week.**

| | m | 0.20 | 0.55 | 0.90 | | | | |
|---|---|---|---|---|---|---|---|---|
| **Vessel 1** | | Excellent | Poor | Dead | Total Samp | Total Catch | Exp factor | Total Mortality |
| Haul 1 | N in samp | 0 | 8 | 43 | 51 | 153 | 0.85 | 129 |
| | N Mort | 0.00 | 4.40 | 38.70 | 43.1 | | | |
| Haul 2 | N in samp | 2 | 11 | 24 | 37 | 111 | 0.76 | 84 |
| | N Mort | 0.40 | 6.05 | 21.60 | 28.05 | | | |
| Haul 3 | N in samp | 3 | 7 | 23 | 33 | 99 | 0.76 | 75 |
| | N Mort | 0.60 | 3.85 | 20.70 | 25.15 | | | |
| | | | | | **Sum Hal Catch** | 363 | **Sum Hal Mort** | 289 |
| | | | | | **Averaging Weight** | 0.2115 | **Vessel DMR** | 0.796 |

| | m | 0.20 | 0.55 | 0.90 | | | | |
|---|---|---|---|---|---|---|---|---|
| **Vessel 2** | | Excellent | Poor | Dead | Total Samp | Total Catch | Exp factor | Total Mortality |
| Haul 1 | N in samp | 3 | 12 | 39 | 54 | 162 | 0.78 | 127 |
| | N Mort | 0.60 | 6.60 | 35.10 | 42.3 | | | |
| Haul 2 | N in samp | 0 | 14 | 51 | 65 | 195 | 0.82 | 161 |
| | N Mort | 0.00 | 7.70 | 45.90 | 53.6 | | | |
| Haul 3 | N in samp | 4 | 11 | 38 | 53 | 159 | 0.77 | 123 |
| | N Mort | 0.80 | 6.05 | 34.20 | 41.05 | | | |
| Haul 4 | N in samp | 1 | 14 | 53 | 68 | 204 | 0.82 | 167 |
| | N Mort | 0.20 | 7.70 | 47.70 | 55.6 | | | |
| | | | | | **Sum Hal Catch** | 720 | **Sum Hal Mort** | 578 |
| | | | | | **Averaging Weight** | 0.4196 | **Vessel DMR** | 0.802 |

| | m | 0.20 | 0.55 | 0.90 | | | | |
|---|---|---|---|---|---|---|---|---|
| **Vessel 3** | | Excellent | Poor | Dead | Total Samp | Total Catch | Exp factor | Total Mortality |
| Haul 1 | N in samp | 2 | 13 | 36 | 51 | 153 | 0.78 | 120 |
| | N Mort | 0.40 | 7.15 | 32.40 | 39.95 | | | |
| Haul 2 | N in samp | 4 | 7 | 26 | 37 | 111 | 0.76 | 84 |
| | N Mort | 0.80 | 3.85 | 23.40 | 28.05 | | | |
| Haul 3 | N in samp | 2 | 7 | 29 | 38 | 114 | 0.80 | 91 |
| | N Mort | 0.40 | 3.85 | 26.10 | 30.35 | | | |
| Haul 4 | N in samp | 3 | 15 | 21 | 39 | 117 | 0.71 | 83 |
| | N Mort | 0.60 | 8.25 | 18.90 | 27.75 | | | |
| Haul 5 | N in samp | 4 | 13 | 29 | 46 | 138 | 0.74 | 102 |
| | N Mort | 0.80 | 7.15 | 26.10 | 34.05 | | | |
| | | | | | **Sum Hal Catch** | 633 | **Sum Hal Mort** | 480 |
| | | | | | **Averaging Weight** | 0.3689 | **Vessel DMR** | 0.759 |
| | | | | | | | **Target Fishery DMR** | 0.785 |

**Table 3** **AKFIN's replication of the annual DMR calculation process, for select target fisheries, compared to IPHC calculations**

| Year | Trawl | | | | | | | | Longline | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pacific cod | | Yellowfin sole | | Rock sole | | Flathead sole | | Pacific cod | |
| | IPHC | AKFIN | IPHC | AKFIN | IPHC | AKFIN | IPHC | AKFIN | IPHC | AKFIN |
| 2000 | 69% | 67.50% | 77% | 75.25% | 75% | 69.64% | 74% | 66.98% | 12% | 12.26% |
| 2001 | 69% | 64.69% | 74% | 71.71% | 77% | 72.57% | 69% | 64.59% | 12% | 12.23% |
| 2002 | 69% | 71.28% | 77% | 75.52% | 83% | 79.93% | 60% | 61.84% | 10% | 10.82% |
| 2003 | 67% | 63.69% | 81% | 77.89% | 82% | 80.70% | 69% | 67.55% | 8% | 8.50% |
| 2004 | 70% | 69.78% | 86% | 82.54% | 85% | 83.84% | 70% | 62.44% | 10% | 10.10% |
| 2005 | 81% | 76.73% | 85% | 85.30% | 84% | 82.82% | 83% | 76.97% | 8% | 9.00% |
| 2006 | 77% | 70.43% | 87% | 85.02% | 83% | 82.07% | 75% | 68.71% | 10% | 10.42% |
| 2007 | 78% | 71.17% | 77% | 86.83% | 83% | 82.95% | 80% | 80.71% | 9% | 8.85% |
| 2008 | 61% | 61.19% | 87% | 86.92% | 86% | 88.06% | 79% | 71.24% | 8% | 8.35% |
| 2009 | 76% | 71.68% | 87% | 88.12% | 88% | 87.71% | 75% | 71.53% | 8% | 8.05% |
| 2010 | 63% | 66.50% | 85% | 82.61% | 88% | 87.98% | 82% | 85.78% | 9% | 9.81% |
| 2011 | 65% | 65.41% | 79% | 83.52% | 84% | 78.80% | 55% | 52.67% | 9% | 9.13% |
| 2012 | | 69.62% | | 79.59% | | 87.57% | | 20.00% | | 9.02% |
| 2013 | | 44.16% | | 84.31% | | 86.61% | | 84.34% | | 8.68% |
| 2014 | | 55.58% | | 84.17% | | 87.39% | | 88.75% | | 8.29% |

**Table 4** **Halibut DMRs for trawl, non-CDQ target fisheries, based on previous ten-year average, as adopted (IPHC calculation) for 2010 to 2015, and as estimated (by AKFIN) for 2016 to 2018, with and without weighting individual vessels for their overall proportion of total halibut catch**

| FMP area | Fishery | DMR (%) | | | |
|---|---|---|---|---|---|
| | | 2010-2012, as adopted | 2013-2015, as adopted | 2016-2018 estimate, without weighting | 2016-2018 estimate, including weighting |
| **BSAI** | Alaska plaice | | 71 | | |
| | Arrowtooth flounder | 76 | 76 | 70 | 72 |
| | Atka mackerel | 76 | 77 | 80 | 80 |
| | Flathead sole | 74 | 73 | 78 | 80 |
| | Greenland turbot | 67 | 64 | 61 | 56 |
| | Non-pelagic pollock | 73 | 77 | 88 | 84 |
| | Pelagic pollock | 89 | 88 | 90 | 90 |
| | Other flatfish | 72 | 71 | 81 | 83 |
| | Other species | 71 | 71 | 75 | 81 |
| | Pacific cod | 71 | 71 | 68 | 71 |
| | Rockfish | 81 | 79 | 82 | 82 |
| | Rock sole | 82 | 85 | 86 | 86 |
| | Sablefish | 75 | 75 | 81 | 84 |
| | Yellowfin sole | 81 | 83 | 87 | 86 |
| **GOA** | Arrowtooth flounder | 72 | 73 | 71 | 73 |
| | Deep-Water Flatfish | 48 | 43 | 43 | 25 |
| | Flathead sole | 65 | 65 | 69 | 64 |
| | Non-pelagic pollock | 59 | 60 | 68 | 64 |
| | Pacific cod | 62 | 62 | 58 | 60 |
| | Pelagic pollock | 76 | 71 | 80 | 65 |
| | Other species | 62 | 62 | 67 | 73 |
| | Rex sole | 64 | 69 | 73 | 68 |
| | Rockfish | 67 | 66 | 61 | 67 |
| | Shallow-Water Flatfish | 71 | 67 | 67 | 69 |
| | Sablefish | 65 | 71 | 52 | 51 |

**Table 5 Estimated DMRs for CP and CV vessels in BSAI and GOA trawl target fisheries, average of 2005-2014.**

| | BSAI | | GOA | |
|---|---|---|---|---|
| **Target** | **CP** | **CV** | **CP** | **CV** |
| Arrowtooth Flounder | 70.38% | | 75.88% | 59.76% |
| Atka Mackerel | 80.18% | 90.00% | 71.36% | |
| Bottom Pollock | 87.77% | 88.07% | 67.73% | 68.31% |
| Deep-Water Flatfish | | | | 43.33% |
| Flathead Sole | 78.24% | 90.00% | 76.95% | 52.69% |
| Greenland Turbot | 61.18% | | | |
| Midwater Pollock | 89.78% | 89.30% | | 79.93% |
| 'Other' Flatfish | 80.87% | 90.00% | | |
| 'Other' Species | 73.31% | 90.00% | 78.05% | 62.35% |
| Pacific Cod | 76.73% | 64.13% | 68.40% | 57.57% |
| Rex Sole | | | 74.30% | 59.76% |
| Rock Sole | 86.23% | 88.63% | | |
| Rockfish | 81.83% | 63.75% | 70.58% | 49.50% |
| Sablefish | 80.87% | | 71.97% | 50.76% |
| Shallow-Water Flatfish | | | 68.33% | 67.37% |
| Yellowfin Sole | 86.53% | 62.00% | | |

**Table 6 Total (BSAI and GOA) trawl and longline halibut samples and viabilities, 2000-2015**

| Year | Trawl | | | Longline | | |
|---|---|---|---|---|---|---|
| | **Number of halibut sampled** | **Number of halibut viabilities taken** | **Percent of sampled halibut on which viabilities are taken** | **Number of halibut sampled** | **Number of halibut viabilities taken** | **Percent of sampled halibut on which viabilities are taken** |
| 2001 | 46,366 | 38,987 | 84.1% | 23,902 | 28,081 | 85.1% |
| 2002 | 43,646 | 38,730 | 88.7% | 21,495 | 24,697 | 87.0% |
| 2003 | 51,289 | 42,031 | 81.9% | 22,849 | 25,927 | 88.1% |
| 2004 | 41,764 | 31,675 | 75.8% | 15,377 | 17,881 | 86.0% |
| 2005 | 51,632 | 43,079 | 83.4% | 14,225 | 16,788 | 84.7% |
| 2006 | 44,092 | 38,143 | 86.5% | 15,222 | 15,528 | 98.0% |
| 2007 | 66,980 | 57,455 | 85.8% | 12,911 | 13,726 | 94.1% |
| 2008 | 61,756 | 40,607 | 65.8% | 11,386 | 12,062 | 94.4% |
| 2009 | 56,301 | 31,097 | 55.2% | 12,851 | 13,381 | 96.0% |
| 2010 | 45,464 | 20,569 | 45.2% | 11,891 | 13,175 | 90.3% |
| 2011 | 43,621 | 19,985 | 45.8% | 15,010 | 16,405 | 91.5% |
| 2012 | 39,500 | 17,541 | 44.4% | 14,817 | 16,304 | 90.9% |
| 2013 | 34,963 | 13,416 | 38.4% | 20,555 | 24,895 | 82.6% |
| 2014 | 32,919 | 10,571 | 32.1% | 18,465 | 25,136 | 73.5% |
| 2015 | 17,184 | 4,485 | 26.1% | 4,162 | 5,223 | 79.7% |

**Table 7 Proportion of extrapolated trawl-intercepted halibut that have viability taken, averaged over 2005 to 2014, by FMP area, target fishery, and operational type**

| Target fishery | BSAI | | GOA | |
|---|---|---|---|---|
| | CP | CV | CP | CV |
| Midwater Pollock | 1.23% | 4.24% | 0.00% | 2.38% |
| Deep-Water Flatfish | | | | 0.72% |
| Sablefish | 0.21% | | 0.50% | 0.80% |
| Bottom Pollock | 0.22% | 0.87% | 0.10% | 0.47% |
| Shallow-Water Flatfish | | | 0.13% | 0.24% |
| Rockfish | 0.10% | 0.17% | 0.24% | 1.83% |
| Greenland Turbot | 0.18% | | | |
| 'Other' Species | 0.11% | 16.15% | 0.12% | 0.39% |
| Pacific Cod | 0.14% | 0.20% | 0.11% | 0.16% |
| 'Other' Flatfish | 0.17% | 0.00% | | |
| Arrowtooth Flounder | 0.09% | 0.00% | 0.14% | 0.23% |
| Atka Mackerel | 0.12% | 0.15% | 0.18% | 0.00% |
| Rex Sole | | | 0.08% | 0.30% |
| Yellowfin Sole | 0.08% | 0.00% | | |
| Flathead Sole | 0.07% | 0.03% | 0.11% | 0.39% |
| Rock Sole | 0.06% | 0.04% | | |

**Table 8 Proportion of extrapolated trawl-intercepted halibut that have viability taken, excluding those intercepted in the pollock fishery, annually for 2005 to 2014, by FMP area and operational type**

| Year | BSAI | | GOA | |
|---|---|---|---|---|
| | CP | CV | CP | CV |
| 2005 | 0.21% | 0.24% | 0.30% | 0.30% |
| 2006 | 0.20% | 0.28% | 0.26% | 0.34% |
| 2007 | 0.12% | 0.27% | 0.42% | 0.36% |
| 2008 | 0.09% | 0.27% | 0.21% | 0.19% |
| 2009 | 0.05% | 0.17% | 0.13% | 0.17% |
| 2010 | 0.05% | 0.25% | 0.06% | 0.21% |
| 2011 | 0.03% | 0.32% | 0.08% | 0.10% |
| 2012 | 0.02% | 0.06% | 0.07% | 0.18% |
| 2013 | 0.05% | 0.19% | 0.04% | 0.20% |
| 2014 | 0.03% | 0.26% | 0.02% | 0.16% |