2017 - 2018 Halibut DMR Recommendations

from the

Halibut DMR Working Group[1]

November 2016

Contents

1 Executive Summary

At the April 2016 meeting, the Council directed the Halibut Discard Mortality Rate (DMR) Working Group to investigate alternative DMR estimation methods and to report those methods back to the Council at the October 2016 meeting. The intent of the Council was to review alternative methods and associated DMRs in order to consider re-specifying DMRs for the 2017 fishing year. A discussion paper

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prepared by the working group and presented to the Council at the April meeting provided background on current DMR estimation methods as well as the shortcomings associated with those methods. The estimation methods proposed in this document in conjunction with improved sampling protocols under the restructured observer program are considered by the working group to provide more statistically coherent DMR estimates. The sampling hierarchy applied by the observer program randomizes sampling of trips within strata, sampling of hauls within trips, and sampling of biological data, such as halibut viability, within hauls. The proposed methods proceed backwards along this sampling hierarchy to allow for estimation of DMRs at the stratum level. Furthermore, within the estimation procedure, the working group has proposed to define operational groupings that represent meaningful operational differences that are linked to variability in DMRs as the unit of estimation. While previous methods estimated and applied DMRs at the target fishery level (defined by region/gear/target species), these proposed operational groupings consolidate fisheries across target fisheries which has the added benefit of increasing sample size for more robust DMR estimates. For a few operations, sample size continues to be a challenge, and further consolidation is recommended until the number of samples is increased. For other operations, such as the AFA pollock fisheries, operational factors exist that allow for an assumed 100% post-capture mortality rate (DMR).

The proposed estimation and aggregation methods were reviewed by the Joint Groundfish Plan Team at their September meeting as well as the Advisory Panel and the Council at their October meeting. All groups were supportive of both the general approach described by the Workgroup, as well as the specific application of the methods to the existing data for 2017. Specific operational questions occurred at the Council meeting and were investigated by the Working Group in preparation of this draft of this document. In accordance with the Council's practice of specifying harvest measures for two year periods, the new DMRs would be expected to be specified for 2017 and 2018. An additional year of observer sampling, and progress on methods may lead to further refinement of DMRs so that re-specification of 2018 DMRs may occur at the December 2017 meeting.

2 Introduction

Discard mortality rates are estimates of the proportion of incidentally captured Pacific halibut that do not survive after being returned to the water. DMRs apply to fisheries in the Gulf of Alaska (GOA) and in the Bering Sea and Aleutian Islands (BSAI) that are subject to the BSAI and GOA Groundfish FMPs. For fishing operations subject to these FMPs, incidentally captured halibut are defined as prohibited species catch (PSC) and "must be returned to the sea with a minimum of injury except when their retention is authorized by other applicable law". Halibut mortalities, the product of DMR and PSC, accumulate over the course of the season, and once the specified limit is reached for a given fishery, that fishery must be closed. For the in-season application of DMRs by management, DMRs are specified based on projections from historic DMR estimates. The International Pacific Halibut Commission (IPHC) also uses DMRs in halibut stock assessments, however they apply annual estimates of DMRs to account for past discard mortality. Any improvements in the accuracy of DMR estimates should benefit both of these applications.

Since the late 1990s, halibut DMRs have been calculated by the IPHC, which then provided the estimates to the National Marine Fisheries Service (NMFS) for application in managing halibut bycatch. DMRs specified through the Council process and applied by NMFS have consisted of long-term averages of annual estimates within target fisheries that are defined by region, gear, and target species. DMRs are also estimated and specified separately for fisheries operating within or outside of community development quota (CDQ) programs. Long-term averages are taken from annual estimates for the most recent ten-year period with the number of years with data to support annual DMR estimates varying among fisheries. Fishery-specific DMRs, once calculated, have generally been put in place for three-year increments. In other words, as part of the specification process, a fishery-specific DMR value is kept constant by management for three years, after which a new DMR is calculated based on the average from an updated time series.

A transition in responsibility for calculating DMRs from IPHC staff to North Pacific Fishery Management Council (Council) support staff occurred in 2015. Associated with the transition, potential improvements in the methodology for calculating DMRs as well as the application of DMRs were identified. Practical, near term, and future, long term improvements in estimation and application of DMRS are examined in a review provided by the Halibut DMR working group at the April 2016 Council meeting (NPFMC 2016 - attached). At that meeting, the Council directed the Halibut DMR working group to begin to develop alternative methods for calculating DMRs so as to provide the opportunity to revise the DMRs currently specified for 2017. NPFMC 2016 includes a forecast of the likely improvements in DMR estimation methods anticipated for the 2017 specifications cycle:

- Modified estimation units that reflect target fisheries to which they will be applied. These estimation units may be consolidations of current units in order to ensure sufficient data are available and to reflect both fishing operations (i.e. CP/CV or gear designations) and fishery (i.e. target species).
- Refinement of the estimation method including weighting alternatives with descriptions of key assumptions developed for each step.
- An abbreviated reference timeframe for smoothing. Since the challenges associated with variance estimation will be a constraining factor, variance based smoothing methods cannot be developed in the near term.
- One year specification period (2017 only). Since this is an ongoing evaluation of potential estimation methods, a single year specification period will allow for incremental changes to the estimation methods. In addition, observer program data collection methods were updated in 2016, hence data collected under these new methods will not contribute to the evaluation until 2017. Continued work on estimation methods may result in alternative DMRs for 2018 being presented in late 2017, and additional recommendations for improvements to DMR estimation being applied to later years.

These anticipated modifications are largely reflected in the alternative estimation and application methodologies that are proposed in this document. Additionally, the Council's Scientific and Statistical Committee (SSC) provided specific recommendations to the working group. This document is responsive to many of the Council's and SSC's recommendations. The SSC recommendations are listed below:

- *The SSC strongly supports using the same sampling design for viability data that is used for other species by the Observer Program. We note that this will increase transparency of the data collection and improve the representativeness of the sampled viabilities.*
    - **In 2016, the Observer Program modified selection of halibut for viability sampling to be a step in randomized biological sampling. The working group believes this is consistent with this SSC recommendation.**
- *The SSC supports the WG plan to develop a transparent DMR estimation workflow. This will decrease the potential for temporal mismatch between the estimation of DMRs and their implementation for management as predictions of DMRs, as well as ensure the repeatability of the estimation methods.*
    - **The working group agrees and workflow is outlined in this document.**

- *The SSC supports exploring a change in the unit of estimation to the haul from the vessel to the haul, depending on the amount of among-haul or between-vessel variability. Within practical constraints, the unit with the least variability should be used in estimation.*
  - **The working group explains proposed revisions to the unit of estimation in DMR Estimation Methods of this document.**
- *The SSC notes that the minimum number of viabilities needed to estimate DMRs needs to be reexamined and a statistical rationale developed for the sample size necessary. It was further noted that the goal of 20 halibut sampled daily is maintained in the new observer sampling protocol, and the SSC suggests that this goal should be evaluated as more data is collected.*
  - **The proposed aggregations avoid defining small target specific groupings with low sample size, and instead propose groupings based on operational characteristics. These operational characteristics drive both sampling methods and halibut mortality.**
- *The SSC is concerned that the recent reduction in the number of viabilities within many target fisheries may be related to both observer protocols (requirement to assess fish at the point of release) and vessel layouts, potentially leading to biased sampling. This interaction and other potential reasons for the declining sample size should be examined to determine if the sampling protocols or design need to be changed.*
  - **A large increase in viability sampling occurred in 2016 under the revised viability sampling protocol. The Observer Program will work with the DMR Working Group to evaluate the anticipated amount of halibut condition assessments on an annual basis; if needed, changes in sampling intensity will be accommodated where possible.**
- *The SSC recommends the WG explore the feasibility of having observers document the specific viability indicators assessed for each halibut (following the currently used dichotomous key) rather than just reporting the final viability category. This will allow analysts to track the specific indicators (e.g. injuries) associated with fleet and fishing factors (e.g. vessel, fishery, gear type, area, depth), towards a better understanding of mechanisms influencing viability. These mechanisms could also help identify incentives for fleets to reduce their discard mortalities.*
  - **The working group agrees that this would provide useful information, but did not address this in the current effort.**
- *The SSC recommends that the WG consider mechanisms (e.g. time on deck, depth, haul length) that may affect viability estimation, and subsequently the apportionment and expansion of DMRs. For example, partitioning the data by target species may actually be a proxy for fishing depth or area which are the factors expected to impact halibut viability or proportion in the catch. The DMR workflow should include a way to join the available fishing and environmental data related to these mechanistic factors being collected by observers.*
  - **The working group agrees and expects these issues to be addressed to some degree in the review of the basis for viability ranking that is being prepared by the IPHC. The working group also believes that the proposed operational groupings address differences in factors that affect mortality (4.8). Elaboration on this work substantiating those differences will likely be provided in the future.**

- *The SSC advises the WG to work with the Observer Program and vessel operators to explore the feasibility of documenting the target species for each haul. Comparison of these targets with those assigned by the current method based on haul catch composition may better inform the WG analysis.*
    - **The working group suggests that the proposed methods have addressed this recommendation by removing the need to assess targeting and relying on halibut handling processes directly. If the SSC recommends against the current methods, other options will be explored, including incorporation of dominant species of catch (target fisheries) as a grouping factor in estimation process for DMRs.**
- *The SSC supports the WG recommendation to reanalyze the historic viability data and possibly re-estimate DMRs retrospectively using the new methodology. We also support use of these data to examine relative variability in the variables of interest, such as gear, vessel, and target fishery. Simulations using these data could also be conducted to examine how the sampling design for assessing viabilities could be altered to take advantage of potential sampling strata where accuracy is maximized.*
    - **The working group provides re-estimated mortalities, based on the proposed revisions, for the 2015 and 2016 fishing years in Results (**DMR estimates)**. These re-estimations assume that identical discards would have occurred for the associated fisheries.**
- *The SSC considers the viability-based survival percentages to be highly uncertain. We recommend the WG examine the published literature on mortality rates within each category of viability assessment and consider using a range of mortality rates as a sensitivity exercise, based on these studies. This should be done in parallel with ongoing research being conducted on this topic by the IPHC.*
    - **The working group anticipates that the IPHC's 2016 RARA, available in December 2016, will include the comprehensive review of published literature on viability-based survival. The working group believes that it would be more appropriate to respond to the results of that review when it becomes available. Methods for estimation of variance of DMRs under the proposed changes have not been developed at this time.**
- *The SSC noted that there are problems with obtaining a representative sample of viabilities from longline vessels due to the inherent handling procedures and the sampling process (fish released at the rail versus being brought on board). Changes to the sampling protocol for obtaining these viabilities should be considered and/ or experiments conducted to assess the impacts of sampling.*
    - **The working group anticipates that this issue will be addressed directly in the 2016 RARA.**
- *The SSC supports the use of statistical methods (e.g., Kalman filter or Random Effects models) for smoothing of time series of DMRs.*
    - **The working group agrees and is looking forward to exploration of these techniques as methods continue to be improved in future iterations.**
- *The SSC also supports a shorter time period for updating DMRs, especially early on as new information from the Observer Program is brought into the estimation process.*

- **The working group agrees and recognizes that this issue has a strong association with policy choices which this working group considers to be outside of their current assignment. The working group is currently recommending that the new estimates be specified for 2017-2018, with the potential for revisions for 2018 as needed based on SSC and Council direction.**

- *The SSC supports new studies to estimate mortality rates of discarded halibut. Studies used to determine the currently used mortality rates by viability assessment category are dated and may not represent the actual mortality rates experienced by discarded halibut.*
    - **The working group understands that the need for work to replace existing mortality rates by viability assessment category will be evaluated in the 2016 RARA.**
- *The SSC suggests the WG consider the results of the ongoing deck-sorting EFP to inform future sampling methods, vessel characteristics associated with increased DMR, and current strategies to integrate sampling in the Observer Program with obtaining condition samples.*
    - **The working group understands that observers are currently assigned to deck-sorting CPs operating under the EFP and that assessed viabilities and resulting halibut mortality estimates are being incorporated as a separate data stream into total mortality accounting for the AM80 fleet. The specific sampling methods and operational characteristics associated with deck-sorting will likely be addressed as part of any analysis to support consideration of any future regulatory changes.**
- *The SSC noted that efforts to more accurately characterize discards and DMRs should not stand in the way of efforts to reduce discard mortality, particularly with regard to measurement at the point of release and operationalization of deck-sorting.*
    - **The working group agrees and notes that these proposed methods would not change sampling methodology.**

1.1 General Approach

A range of improvements along four different stages in the estimation/application process (unit of estimation, estimation method, temporal smoothing, duration of application) were outlined in NPFMC 2016. The proposed improvements are envisioned as being intrinsically **consistent with Observer Program sampling design** hence reducing the potential for bias, and also to be more **consistent with the operational causes of variation in post-capture halibut condition (viability, on which DMR estimates are based) among fisheries**.

The methods presented here represent a single step in the continued development of improved estimation procedures. Following a description of the methods and a brief presentation of results, a short series of specific questions relative to the recommendations of the Working Group were provided to the Plan Team in Section 6 below. These questions were submitted in order to solicit feedback for refining the proposed methods for further Plan Team review in November and potential adoption beginning with the 2017 fishing year. Industry representatives who attended the September Plan Team meeting and the October Council meeting also provided comments during and after the meeting. The Plan Team's recommendations and several industry recommendations are incorporated into this draft of the document and are also reflected in modifications to other document sections.

1.2 Consistency with Observer Sampling Design

The proposed estimation process follows the observer sampling hierarchy more closely than the previous method by expanding condition (viability) data from the haul, to the trip, and gear-based stratum levels.

This proposed methodology builds on a number of improvements to sampling methods (2013 restructuring of the observer program, updated 2016 halibut condition sampling protocols) and database architecture. The observer program's Annual Deployment Plan (e.g., NMFS 2015) defines strata and the sampling intensity for each stratum for the following year. Currently strata are defined by gear type, while previously strata were small and large vessels. In addition, the observer database architecture was updated in 2008 to more clearly identify each level of the sampling hierarchy, and hence allowing estimation methods to utilize this information. Since the previous estimation method did not include the trip or stratum levels of the hierarchy, differential sampling intensities may have introduced bias into the DMR estimates. Estimating within the sampling design will allow appropriate expansion and weighting at each level of the sampling hierarchy (see Cahalan et al. 2014 for a description of the sampling and estimation hierarchy). Estimating in accordance with the sampling hierarchy will also allow changes in sampling methodology to be assimilated into the DMR estimation methods.

1.3 Replacing Target Fisheries with Operational Groupings

In addition, in the proposed method, data are grouped (within each gear-based sampling stratum) according to vessel operations that impact the condition of discarded halibut (vessel operations) including sorting and handling practices, gear type, and processing sector. In the status quo methods, the calculation of DMRs grouped observer information based on the assignment of a fishery target to a trip (defined as a week on CPs and a delivery on CVs), where the fishery target is defined by the predominant landed species for the trip, regardless of the predominant species of any given haul (see Cahalan et al 2014). However, fishery targets do not necessarily characterize statistical and/or operational differences in the sampling or handling of halibut.

In some cases, limiting estimation to trip target aggregations may have reduced the quality of mortality rate estimates due to small sample sizes or by combining operations with very important differences in sampling and handling characteristics. By basing the new groupings on vessel operational characteristics and by taking into consideration the sampling intensity within strata and trips, this proposed DMR estimation method is expected to result in DMR estimates that have lower potential for bias and for which statistical properties can be estimated (i.e. variance).

Until an alternative basis for estimating DMRs is developed (e.g., model-based approaches), DMRs will continue to be based on observer assessments of halibut condition collected as a routine part of observer sampling. In assessing the proposed alternative methods, the DMR working group agreed that halibut DMR estimation should be consistent with observer sampling methods and fishery operational characteristics. Hence, the proposed approach is focused on calculating DMRs at the gear and operational level which is discussed in detail in the next section.

Finally, we note that these proposed aggregations are for the calculation of the DMRs only and do not change current PSC estimation methods in Catch Accounting System (CAS). Total halibut mortality will continue to be calculated and reported to the IPHC using CAS PSC estimation methods. The DMRs published in the harvest specifications will be applied to the CAS PSC estimates using the methods in this paper, and halibut mortality will be reported by fishery target where necessary.

1.4 Viability Categorization

DMR calculation has been and continues to be based upon the distribution of discarded halibut among condition (injury or viability) categories assessed through standardized observer program methods. The appropriateness of the current categories and associated mortalities is the basis for an IPHC comprehensive review of the underlying research associated with the current approach. Table 1, below, provides the current mortality probabilities associated with viability categories by gear type. The review document is expected to be available in December 2016 as part of the 2016 Report of Assessment and Research Activities (RARA).

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

Gear	Condition			
	Excellent		Poor	Dead
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)

3 DMR Estimation Methods

The expansion of viability assessments to larger fishery groupings involves a number of steps under both current procedures as well as proposed procedures. The approach taken under current and proposed methods is described below.

2.1 Current Estimation Method - from NPFMC (2016)

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 haul or trip into a given target fishery. CDQ and non-CDQ fishing is assessed separately. 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 on CPs and summed over the fishing trip on CVs. 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. This process can be summarized as consisting of four steps:

1. Calculate halibut mortalities and total halibut catch for each qualifying observed haul for individual vessels.
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 (CPs) or fishing trip (CVs) are aggregated to produce a weekly trip target for an individual vessel
3. Calculate a vessel-specific DMR for each target fishery by aggregating halibut mortalities and catches (within each vessel, post-stratified by target fishery)
4. Calculate an overall target fishery DMR by averaging vessel DMRs (weighted by their contribution to total halibut catch)

3.1 Proposed DMR Estimation Method

In general, this proposed estimation process expands halibut condition data collected at the haul level up through the sampling hierarchy within each sampling strata (Figure 1). These are weighted estimates, weighted by the estimated weight of discarded halibut at each level. Since sample rates (sampling intensities) vary not only at each level of the hierarchy, but between sample units (e.g. proportion of halibut assessed varies between hauls on a fishing trip), this weighting is important to ensure unbiased estimation. Overall, this method is similar to the method that the IPHC used in the past. Estimation methods (equations) and detailed description of estimation steps follow.

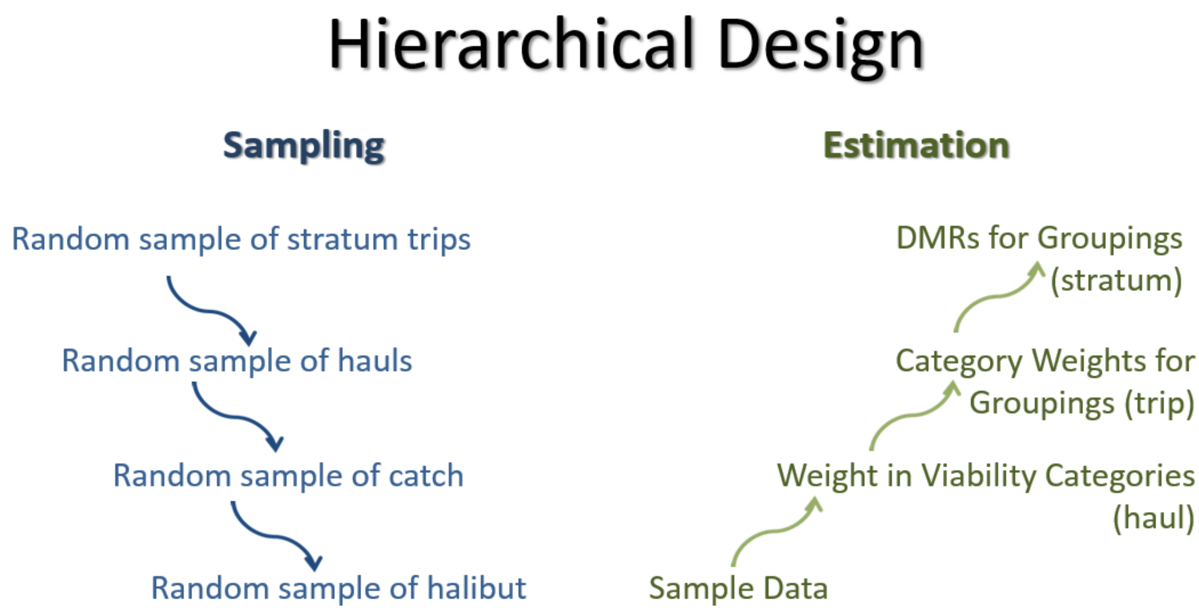

Figure 1. Observer Program sample design hierarchy (left side) and corresponding estimation step (right side), in general terms, for the proposed DMR estimation method.

For each haul, the proportion of halibut weight in each category is

$$\hat{p}_{cj} = \frac{\sum_{k=1}^{K_j} w_{cjk}}{\sum_c \sum_{k=1}^{K_j} w_{cjk}} = \frac{w_{cj}}{w_j}$$

and the weight of halibut in that category for the haul is

$$\hat{D}_{cj} = \hat{D}_j \hat{p}_{cj},$$

where *j* indexes hauls within a trip, *k* indexes the number assessed halibut, w_k is the weight of halibut *k*, *c* indexes the condition categories, *c* = {dead, poor, excellent} or {severe, moderate, minor, dead}, and *D* is the discarded weight of halibut.

The mortality for the haul is

$$\hat{M}_j = \sum_c R_c \hat{D}_{cj} = \sum_c R_c \hat{D}_j \hat{p}_{cj}.$$

The DMR for the haul is

$$D\hat{M}R_j = \frac{\hat{M}_j}{\hat{D}_j}.$$

Note that the total estimated mortality for the haul (M_j) and the estimated DMR for the haul is not needed in subsequent computations. It is presented here as ancillary information and for completeness.

For the trip, we computed the weighted mortality estimate where the weighting is by the estimated halibut discard for that haul. At this point we add subscripts identifying the covariates that define the operational groups (*g*).

For each trip (*t*) and operational grouping (*g*), the proportion of halibut weight in each category is:

$$\hat{p}_{ctg} = \frac{\sum_{j=1}^{J_t} \hat{D}_{cjtg}}{\sum_c \sum_{j=1}^{J_t} \hat{D}_{cjtg}} = \frac{\hat{D}_{ctg}}{\hat{D}_{tg}}.$$

The total discard for the trip in each category is

$$\hat{D}_{ctg} = \hat{D}_{tg}\hat{p}_{ctg}.$$

The mortality for the trip is

$$\hat{M}_{tg} = \sum_c R_c \hat{D}_{ctg} = \sum_c R_c \hat{D}_{tg} \hat{p}_{cj}.$$

The DMR for the trip is

$$D\hat{M}R_{tg} = \frac{\hat{M}_{tg}}{\hat{D}_{tg}}.$$

Note again that the total estimated mortality for the trip and the estimated DMR for the trip is not needed in subsequent computations. It is presented here for completeness.

The next step is to combine mortality estimates across trips to the operational group. Similar to previous computations, we compute the weighted mortality estimate where the weighting is by the estimated halibut discard for that trip. The proportion of halibut in each condition category is computed as

$$\hat{p}_{cg} = \frac{\sum_{t=1}^{T} \hat{D}_{ctg}}{\sum_c \sum_{t=1}^{T} \hat{D}_{ctg}} = \frac{\hat{D}_{cg}}{\hat{D}_g}.$$

The total discard for the operational grouping in each category is

$$\hat{D}_{cg} = \hat{D}_g \hat{p}_{cg}.$$

The mortality for the operational grouping is

$$\hat{M}_g = \sum_c R_c \hat{D}_{cg} = \sum_c R_c \hat{D}_g \hat{p}_{cg}.$$

The DMR for the operational grouping, within each stratum, is

$$D\hat{M}R_g = \frac{\hat{M}_g}{\hat{D}_g}.$$

The computational steps used in implementing this estimation process are detailed in the following sections.

3.1.1 Haul DMR

1. Sum the weight of assessed halibut in each viability category for each haul where halibut are assessed (A). You will end up with separate sums for each viability category.
2. Sum the total weight of assessed halibut (sum across all viability categories for that haul) (B)
3. Compute the proportion (by weight) of the assessed halibut that are in each category for the haul (A/B)
4. Apply the proportion from #3 to the total estimated weight of discarded halibut for that haul (i.e., the extrapolated weight in obs_haul_species). This gives the total estimated weight in each viability category for each sampled haul (C). ***This is the only value that is used in the next steps of the estimation process.*** *These additional steps will generate haul-specific DMR estimates that might be useful to assess potential post-stratification, domain definitions, and minimum sample sizes.*
5. For each of the viability categories, apply the mortality rate (i.e., poor = mortality rate of 0.9) to the total estimated weight in #4. This is the total mortality by viability category.
6. Total mortality for the sampled haul is the sum, across all viabilities categories, of the mortality weight from #5.
7. DMR for the haul is the haul specific mortality divided by the total discarded weight of halibut.

Estimates of DMRs for subpopulations of the fishery need to align with CAS estimation goals (monitored quotas). The subpopulations used in this analysis are the operational groupings defined by a set of covariates (e.g. gear, FMP). Hence, in addition to the haul-specific estimates of halibut discard weight for each category, each haul (or trip) is linked with the operational grouping that describes how halibut have been handled.

Note that for some hauls, only a few halibut are assessed. The minimum proportion of halibut assessed and the total number of assessed halibut should be evaluated. Prior to 2016, we should expect few halibut per haul, depending on how many hauls the vessel is fishing per day. It would not be unreasonable to have only 3 to 5 halibut assessed.

3.1.2 Trip DMR

1. Sum the total estimated weight of halibut in each viability category across all sampled hauls within a domain where halibut are assessed (A). This is the value from step #4 above. You will end up with separate values (sums) for each viability category.

2. Sum the total estimated weight of halibut across all viability categories and hauls within the same operational group. This is the sum across hauls of #2 above, but ignoring the viability category (B).
3. Divide step #1 by step #2 (i.e., A/B). This gives you the proportion of halibut by viability category for the trip for hauls with viability information collected.
4. Obtain the total estimated weight of halibut discard for the sampled trip (from CAS).
5. Multiply the ratios "A/B" (#3) by the total discard from #4. This will create an estimate of total estimated halibut for each viability category and operational group within a trip. *This is the value that will be used going forward in the analysis.*
6. For each viability category, apply the appropriate mortality to the estimate from step #5 and sum across viability categories. This gives you an estimate of operational group-specific total mortality for the trip.
7. DMR estimate for operational group for the trip is the total mortality divided by the total discarded weight of halibut

As previous, for each trip we will want to identify the set of covariates that will define the operational group, including FMP, fishing sector (vessel type), and gear type. Estimation from the sample through the trip levels is described in Figure 2.

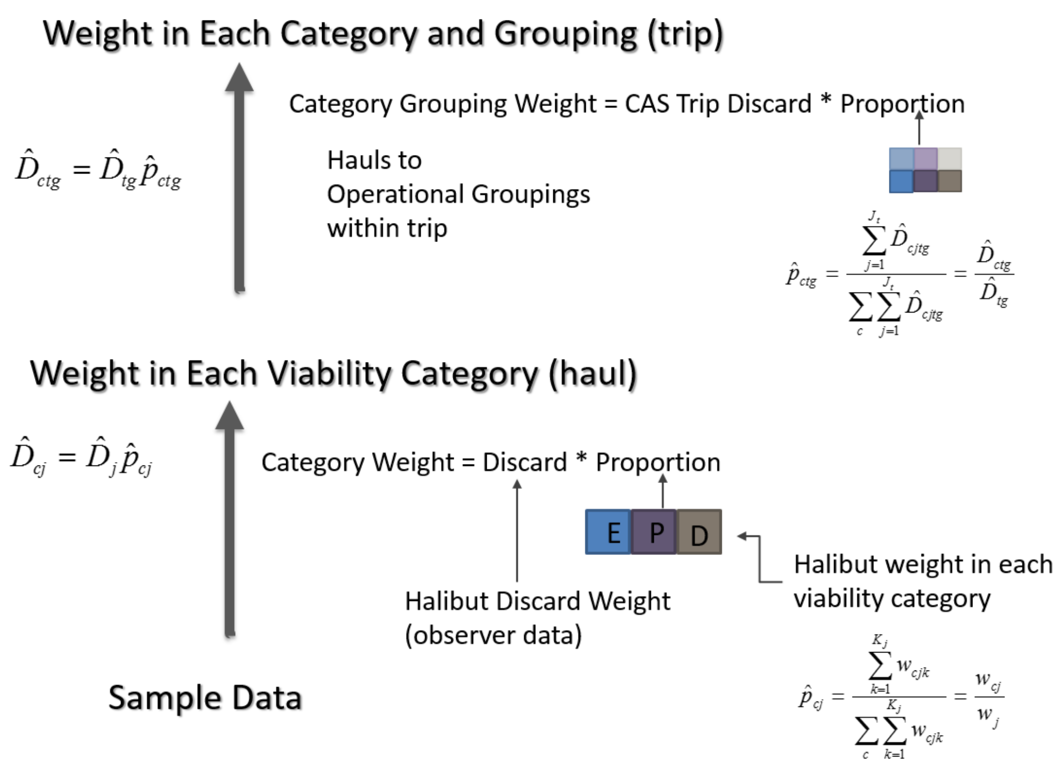

Figure 2. Estimation method: sample data expanded from haul to trip.

3.1.3 Stratum (grouping) DMR

1. Sum the total estimated weight of halibut in each viability category across all sampled trips within a domain where halibut are assessed (A). The total estimated weight is from step #5 above. You will end up with separate sums for each domain for each viability category.
2. Sum the total estimated weight of halibut across all viability categories and trips, but within the operational group. This is the sum of #5, but ignoring the viability category (B).
3. Divide step #1 by step#2 (i.e., A/B). This gives you the proportion of halibut by viability category for the operational group.
4. Obtain the total estimated weight of halibut discarded for the operational group (from CAS).
5. Multiply the ratios "A/B" by the total discard from #4. This will create an estimate of total estimated halibut for each viability category within a stratum and operational group.
6. For each viability category, apply the appropriate mortality to the estimate from step #5 and sum across viability categories. This gives you total mortality for the stratum and operational group.

DMR for the domain is the sum of the total mortality by the total discarded weight of halibut for each domain. This is the DMR that is applied to estimates of discard from CAS to generate the mortality. Estimation from the trip through the strata level is depicted in Figure 3.

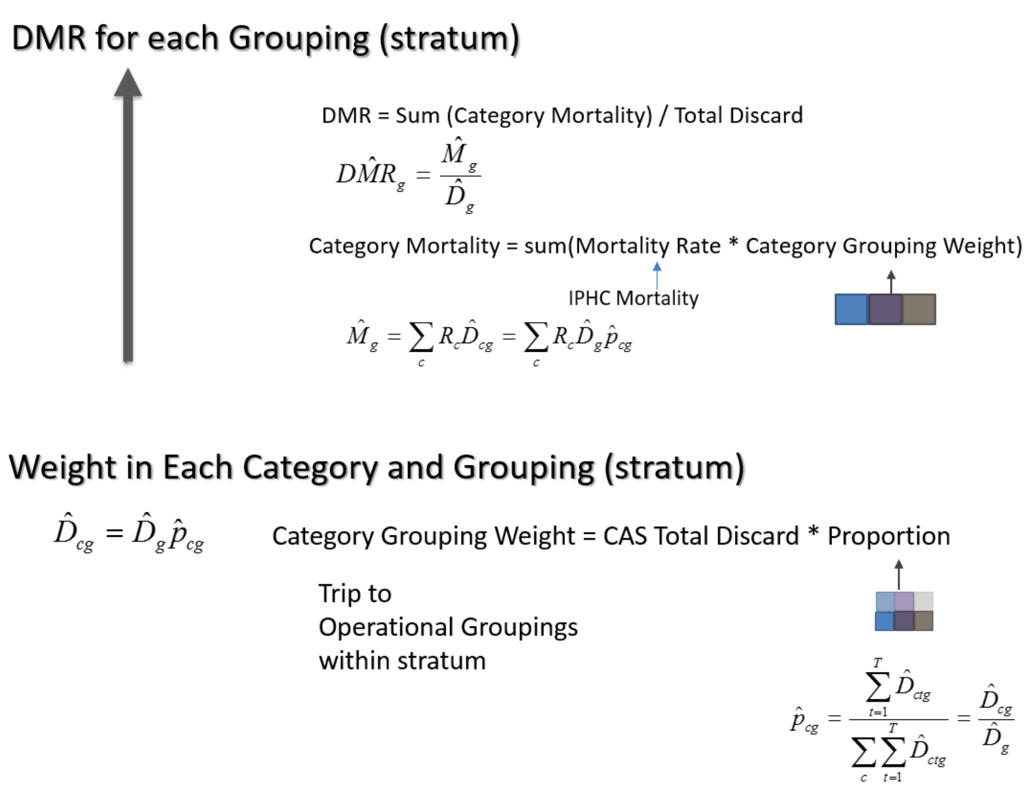

Figure 3. Estimation method: sample data expanding from the trip to the operational grouping.

3.2 Applied DMRs for Operational Groupings

In all cases, applied DMRs generated by the methods above would be, as they have been in the past, based on time series of annual estimates. As described in NPFMC (2016), current DMRs are simple annual averages for each fishery from the most recent 10-year period, with there being variability in the number of years with adequate data for annual estimates among fisheries. Until alternative smoothing procedures, such as Kalman filtering, is attempted, averages of annual DMRs may continue to be used, though, importantly, they could be applied using alternative length reference time series.

4 Operational Groupings

Among the most important influences on the viability of released halibut are the onboard methods of handling halibut, which vary depending on the type of vessel, and the gear used for capture. These operational differences drive both the sampling challenges faced by observers and the methods used by crew to handle halibut. As a result, vessel operation and gear type are the broad data groupings that will likely minimize DMR variance (minimizes within group variability). Vessel categories are currently proposed to be designated as Catcher Vessel (CV), Catcher Processor/Mothership (CP/M), and gear categories are proposed to be separated into pelagic trawl, non-pelagic trawl, hook and line, and pot. Additionally, trips in the BSAI Pollock (AFA) pelagic trawl category and CV trips in the Rockfish Program are grouped separately. Handling of catch and the likely impacts to discarded halibut for each operation type are described in general terms below with the descriptions being drawn from Observer Program experience. Figures 4 and 5 illustrate these groupings for each FMP area and within each operation type.

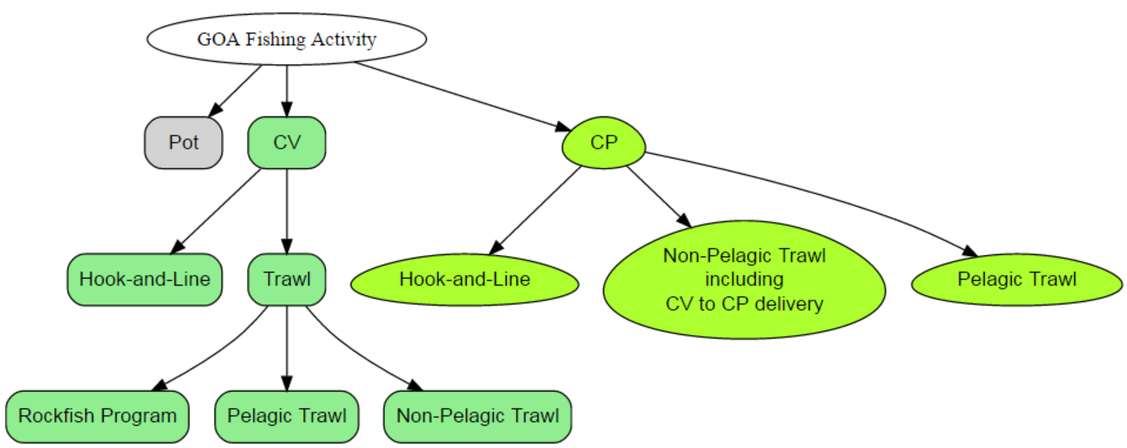

Figure 4. Proposed fishery-level aggregation scheme(operational groupings) for the calculation of DMRs in the Gulf of Alaska.

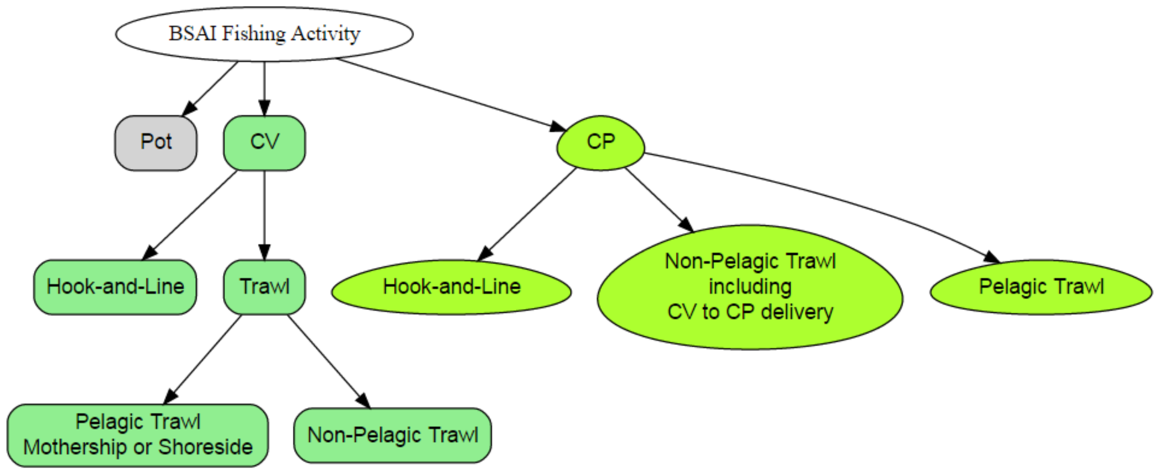

Figure 5. Proposed fishery-level aggregation scheme (operational grouping) for the calculation of DMRs in the Bering Sea.

4.1 Catcher Processors – Trawl Gears

4.1.1 Non-pelagic Trawl Gear

The logistics and handling of catch is different on vessels fishing non-pelagic trawl gear (NPT) than on vessels fishing pelagic trawl gear (PTR). Catches associated with vessels fishing NPT gear are generally smaller, have higher species diversity, and have operationalized at-sea sorting and discarding of catch (e.g. Amendment 80 flatfish fisheries). Sorting of catch on CPs is prohibited by regulation from occurring on deck and hence all sorting occurs in the factory. Operationally, this means halibut remain on the vessel until sorting can occur, which is different from CVs where halibut are sorted on deck shortly after being brought onboard. An important exception to this regulation is the current Experimental Fishing Permit in the BSAI (deck-sorting of Pacific halibut), however, vessels participating in that program are exempt from the normal DMR assignment done by CAS.

The amount of handling and injury experienced by halibut on CPs fishing NPT gear is associated more with vessel operational characteristics than species targeted; crew sorting and handling behaviors are often consistent between hauls while dominant species in the retained catch (trip target) is unknown until the catch is processed. Observers sampling NPT hauls collect halibut viability data in the factory as close to the point of discard as possible, minimizing changes in the condition of halibut between the time of observation and the discarding event. Depending on the factory layout, an observer may not have access to halibut near enough to the point of discard to enable the collection of viability data. These sampling exceptions vary depending on the vessel, weather and fishing conditions, or a suite of other factors such as an abnormal volume of fish. Of note is that observers do not collect viability data from halibut that do not represent "true crew handling" or in situations where a factory has obstacles between the observer and the point of discard that affect the viability (i.e., incline belts).

Although the dominant species of a haul may vary, the size and general handling of the catches is similar regardless of the predominant species caught. As a result, the viability of the halibut does not vary greatly between target species on CPs fishing NPT gear. Thus, target does not appear to be an important DMR estimation factor and, under certain target groupings, may result in small sample sizes. For these reasons, **the WG and Plan Teams recommend DMRs be calculated separately for CPs using NPT gear.**

4.1.2 Pelagic Trawl Gear

Vessels fishing pelagic trawl gear tend to have large, relatively low diversity catches. For vessels in the BSAI pollock fishery (AFA), fish are unsorted and transferred directly from the trawl net into the live tanks where they are 'aged' for several hours before being processed in the factory. Hence, the survivability of any halibut in the catch is impacted by being pressurized in the net (especially for larger catches) and aged[2] for several hours before it is sorted from the catch and discarded. When observers encounter halibut and are able to collect viability data, the halibut are rarely alive. Based on these operational characteristics, **the WG and Plan Teams recommend all halibut caught on CPs fishing PTR gear in the BSAI be assumed dead (i.e., DMR of 100%).**

Similarly, in other pelagic gear fisheries such as the Rockfish Program, most catches are unsorted prior to processing and bycatch is transferred directly to the live tanks. Although rockfish are not aged prior to processing, they tend to remain in holds for long periods due to large tows and the constant need for crew to facilitate the movement of rockfish towards the exit points in the hold. In addition, rockfish spines are a source of injury to halibut that can be substantial in rockfish-dominant tows (e.g.., Pacific Ocean Perch). While most hauls on these trips may be dominated by rockfish species and not sorted on deck, often the last haul(s) may be dominated by P. cod or other species and will be sorted on deck. On these hauls where catch is sorted and halibut are discarded, observers are more able to collect condition data. This differential sorting of catches for different hauls is another reason for the estimation process to follow the sampling hierarchy. **The WG and Plan Teams recommend CPs using PTR gear in the GOA be assessed separately from other GOA CP activity (Figure 4).**

4.2 CPs acting as Motherships

There are special situations in the Bering Sea and Aleutian Islands (BSAI) and in the Gulf of Alaska (GOA) where CVs deliver unsorted catch to CPs. This activity is often referred to as "bags over the side", in reference to fish being retained in the codend and being transferred from one vessel to another (unsorted codends are defined in federal regulation). This activity mainly occurs in the BSAI when trawl vessels are targeting Pacific cod, yellowfin sole, Pacific ocean perch, or Atka mackerel. This activity may also occur in the GOA for vessels using trawl gear, but is not used as much as in the BSAI. Since the unsorted catch is transferred directly to the processing vessel and is sampled by the observer in vessel factory, halibut in these situations are handled consistent with other CP vessels. **The WG and Plan Teams recommend combining mothership and CPs by gear type and FMP.**

4.3 Catcher Processors - Hook-and Line Gear

Sorting of bycatch on hook and line vessels (both CPs and CVs) occurs on deck, generally at the hauling station as the line comes over the rail. Hence, bycaught halibut are rarely transferred to the factory or hold. Observers collect data on injuries to halibut on deck of both CPs and CVs. Injuries are often a result of release from the hook, entanglement in the groundline, or sand flea infestations. Of note is that on either CPs or CVs, large halibut have a higher tendency to drop off the line and are more difficult to bring onboard and release in a typical fashion. If the halibut is not released using typical handling methods, the observer is instructed not to assess injuries of the halibut.

Although catches are generally handled on CPs and CVs in a similar fashion, CPs tend to set longer groundlines with retrieval times that can be in excess of 10 hours. As a result, halibut remain on the hook for long periods and are susceptible to sand flea infestation. In addition, larger vessels (most CPs) are more likely than smaller vessels (e.g., many CVs) to straighten hooks in order to release bycaught halibut. Hook straightening is a release method where the hook is straightened against the roller and the halibut

[2] Aging refers to the practice of letting the fish reach rigor mortis prior to processing.

can easily slide off the straightened hook. This release method causes fewer and less severe injuries to the discarded halibut. Unfortunately, since the hook is straightened by the action of the gangion coming over the rail against the roller, this release method is very difficult to replicate inboard of the rail so that the halibut is available to the observer. Injury assessments are often not recorded on vessels that use this release method. The hook straightening release method is used primarily on CPs.

These important operational differences between hook-and-line CPs versus CVs should be captured in the DMR calculation. **The WG and Plan Teams recommend that hook-and-line DMRs for CPs be estimated separately from CV operations, resulting in separate DMRs for hook-and-line CPs versus CVs for each FMP area.**

4.4 Catcher Vessels – Trawl Gears

Trawl catcher vessels (CVs) deliver their catch either to a CP or mothership (at-sea) or to a shoreside / stationary floating processor. In either scenario, catches are sorted immediately from the trawl deck or, in cases where the catch is less diverse, the vessel may not sort at-sea but rather deliver unsorted catch to the shoreside processing facility. The type of gear used, fishery, and vessel operational differences often dictate onboard sorting behavior and the ability of the observer to sample halibut for viabilities.

4.4.1 Non-pelagic Trawl Gear

CVs fishing with non-pelagic trawl gear have different crew sorting and processing behaviors than those using pelagic gear. These vessels fish smaller tows than pelagic trawl CVs and sort their catches prior to delivery to the shoreside or stationary floating processor. Halibut on these vessels are actively sorted and viability data can generally be collected by an observer. Recorded viabilities for halibut sorted from the catch at-sea will vary based on a number of factors including handling and crew sorting behaviors, access to the closest point of discard, weather conditions, and the amount of time the halibut is out of the water. These factors are similar across a range of dominant target species (e.g., for various flatfish species). **The WG and Plan Teams recommend calculating a DMR specific to an FMP for CVs fishing NPT gear.**

4.4.2 Pelagic Trawl Gear

CVs fishing pelagic trawl gears tend to have large tows with low species diversity and these tows are not sorted at-sea. In the pollock fishery, catch is transferred directly from the trawl to a recirculating seawater (RSW) tank where it remains until it is delivered to the shoreside or at-sea processor. Pollock catches delivered to at-sea processors (i.e., CPs and motherships) are ‘aged’ prior to being processed, hence any halibut in the catches will rarely be alive. Halibut caught by CVs making either a shoreside or mothership delivery are likely dead prior to discard as well. **The WG and Plan Teams recommend 100% mortality (DMR=1) be assumed for all halibut caught by CVs using pelagic trawl gear and not in the Rockfish Program.**

4.4.3 Rockfish Program

Operational characteristics in the rockfish fishery both increase the DMR and complicate sample collection by an observer. When crew is actively sorting halibut, such as when fishing non-pelagic gear, an observer is able to collect viability data. However, when the catch is dumped directly into the RSW tanks and the crew is not actively sorting for halibut, such as when fishing pelagic gear (Pacific Ocean Perch), viability data cannot be collected. In these latter situations, all halibut are delivered to a shoreside processing facility. Halibut delivered to the shoreside processing facility are dead. Even in situations where the crew is sorting halibut and observers obtain viabilities, the presence of rockfish spines may decrease the overall condition of the halibut. For these reasons, **the WG and Plan Teams recommend calculating DMRs specific to the Rockfish Program and separately for pelagic and non-pelagic gears, reflecting different handling processes (i.e. at-sea sorting). When fishing with pelagic trawl**

gear, a DMR of 100% will be used since catch is not sorted at sea and any bycaught halibut are delivered shoreside.

Due to difficulties in matching viability data to CV trips using non-pelagic gear (within Rockfish Program), a proxy DMR based on trips with rockfish as the primary target is recommended. This is consistent with status quo, but based on updated years and the proposed estimation methods. As methods for obtaining viability data from the Rockfish Program operational grouping become available, the DMR computations would be derived directly from Rockfish Program sampling.

4.5 Community Development Quotas

All CDQ hauls are required to be observed (full coverage). CDQ status can be assigned after the haul is processed (regulations allow this assignment up to two hours after processing). Hauls with less bycatch (halibut or salmon) will tend to have a higher probability of being designated as CDQ hauls while those with higher amounts of bycatch will tend to be designated as non-CDQ. Although the amount of bycatch may vary with CDQ status, the size of the haul, fishing operations, and catch handling process does not tend to differ. For this reason, **the WG and Plan Teams do not recommend CDQ as an aggregation factor for estimating DMR.**

4.6 Catcher Vessels - Hook-and Line Gear

Similar to CPs, sorting of bycatch on hook and line vessels occurs on deck at the hauling station as the line comes over the rail. Bycaught halibut are discarded at the rail and observers collect data on injuries to halibut prior to discard. Injuries are often a result of release from the hook, entanglement in the groundline, or sand flea infestations. Again similar to CP vessels, large halibut have a higher tendency to drop off the line and are more difficult to bring onboard and release in a typical fashion. If halibut are not released using typical handling methods, the observer is instructed not to assess injuries of halibut. **As described in 4.3, the WG and Plan Teams recommend that hook-and-line DMRs for CPs be estimated separately from CV operations, resulting in separate DMRs for hook-and-line CPs versus CVs for each FMP area.**

4.7 Catcher Processors and Catcher Vessels - Pot Gear Vessels

Observers on pot vessels (CP or CV) rarely have difficulty accessing halibut and collecting viability data. Catches are sorted on-deck before being transferred either to the factory to be processed or the RSW tanks where they are stored until delivered to the shoreside processor. Due to on-deck sorting of discards from the catch of individual pots as they are brought onboard, bycatch species are not transferred to the factory or delivered to the shoreside processor. Since halibut are accessible on deck regardless of whether the vessel is a CP or CV, and the halibut are handled similarly between the vessel types, **the WG and Plan Teams recommend combining CVs and CPs into a single DMR calculation for pot gear (by FMP area). Note that there is not a halibut PSC limit for pot gear, but halibut mortality is estimated and provided to the IPHC.**

4.8 Synthesis of Factors Affecting DMR Differences among Operations

The proposed aggregation of data according to fishing operations takes into account important factors that affect Pacific halibut survival (after being returned to the water post-capture). These factors are explored directly in a number of historical studies (e.g., Hoag 1972, Richards et al. 1994 and 1995, Pikitch et al. 1996, Kaimmer and Trumble 1998, among others) which generally approach factors affecting halibut survival as they are associated with particular gear types. The IPHC's comprehensive review of studies that support assumptions in current DMR estimation, is expected to address this subject in detail and also help identify areas where new research is needed.

For the purposes of the proposed operational groupings, which rely largely on observer knowledge of fishery behavior, operational characteristics are identified that are linked to differential halibut survival. In Figures 6-8, below, three major influences on halibut survival (time out of water, time on/in gear, occurrence of physical injury) are described.

4.8.1 Time out of Water

Operational differences in halibut sorting and handling affect the amount of time before a captured halibut is returned to the water. Figure 6, provides several examples of when halibut are returned to the water. Discards on hook and line vessels occur mainly occurring at the rail as the gear is retrieved and in pot fisheries, halibut are discarded shortly after the pot comes on deck during the sorting of the catch. In trawl fishery operations, catch sorting occurs either on the deck of catcher vessels before retained catch are transferred to the hold, or in the vessel's processing plant at sea sorting occurs on CVs, mostly those that are fishing with non-pelagic gears. Since catch is sorted before being stored in RSW, discarded halibut are returned to the water in a relatively short time. CVs fishing pelagic gear, however, do not generally sort their catch and any bycatch species are returned to port. On CPs, the catch are transferred below deck into the hold (live tank) where they are stored until processed in the factory where any bycatch to be discarded is sorted from the catch. On some vessels, fish are transferred from the live tank, sorted, and fish to be discarded are moved on conveyor belts, including tined incline belts to the point of discard. On some CPs fishing for AFA pollock, the catch is 'aged' prior to being transferred to the vessel's factory for processing. This aging process conditions the fish for easier processing; fish may be aged for several hours. Clearly and additional holding, such as the aging process for pollock CPs, or the time involved in processing unsorted catch shoreside lengthens the time out of water; in these cases it is reasonable to assume no halibut survival.

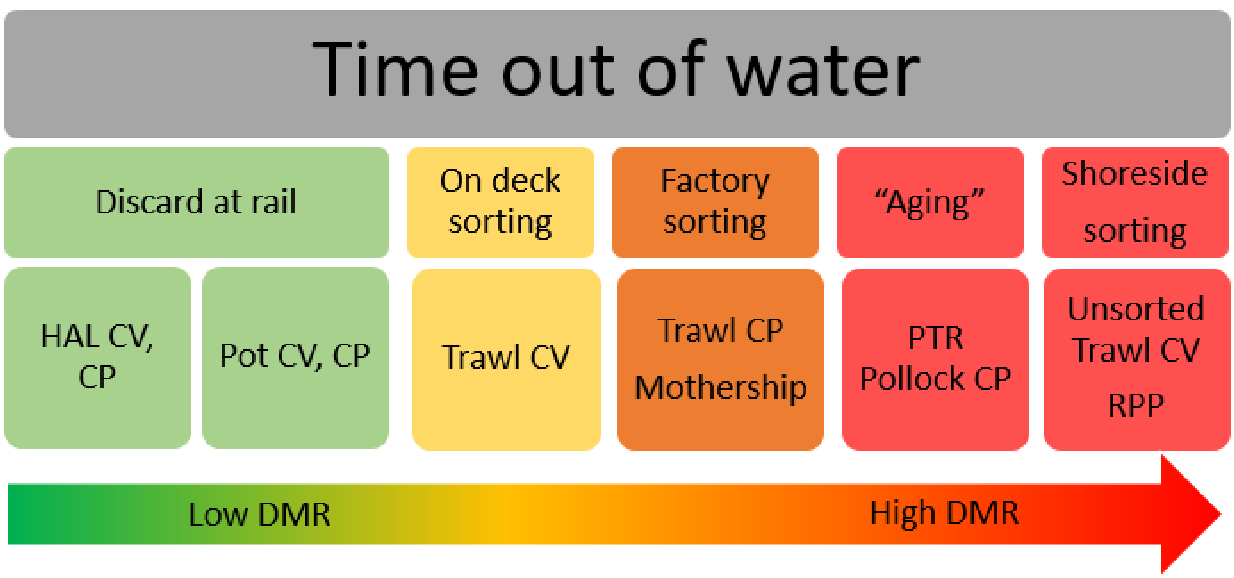

Figure 6. Illustration of the expected increase in DMR as time out of water for halibut increase and its relationship to operational aspects of different component of the groundfish fisheries.

4.8.2 Time in/on Gear

The working group is recommending separate application of DMRs for CV and CP operations, with some exceptions (e.g., pot, PTR gears), in part because these operations differ in the amount of time halibut spend interacting with the gear before the gear is retrieved. Because of their larger size, CPs generally deploy more gear and take longer to retrieve their gear. Additionally, CPs are associated with longer set times for fixed gear and longer tows for mobile gear. It follows, then, that any negative effects associated with capture by gear occur for a longer amount of time as sets and tows become longer. Thus, the negative impacts to halibut condition tend to be greater on CPs than on CVs. This is simplistically illustrated in Figure 7.

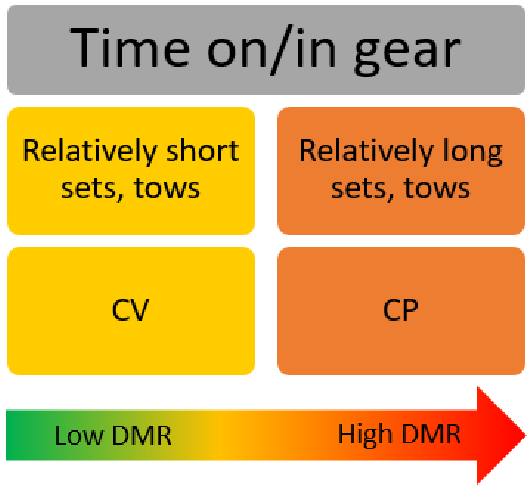

Figure 7. Illustration of the expected increase in DMR as time on/in gear for halibut increase and its relationship to groundfish fishery CVs and CPs.

4.8.3 Occurrence of Injury

Aside from the two categories discussed above, a range of other contributing factors to mortality may be experienced by halibut as a result of capture by non-target fisheries. Rather than illustrate a gradient of lesser to greater DMRs, these other factors are arranged under the single heading of "occurrence of injury" (Figure 8). The types of injuries tend to be gear specific, such as hooking and de-hooking injuries, or trawl compression and abrasion injuries. For a given type of injury, the magnitude of trauma is considered to be highly variable both within and across gear types. The differential DMR estimates that have been provided to the Council in the past, as well as the historic literature, suggest that survival is generally lower for trawl gear than for hook and line gear. However, a halibut caught in a trawl just before haul back may have a lower degree of physical injury than a longline caught halibut that sustained substantial trauma during dehooking. Nevertheless, discard at the rail that occurs on vessels fishing hook and line gear generally precludes additional on-vessel injuries that happen on trawl vessels where on-deck sorting or a trip through the factory precedes the eventual discard event.

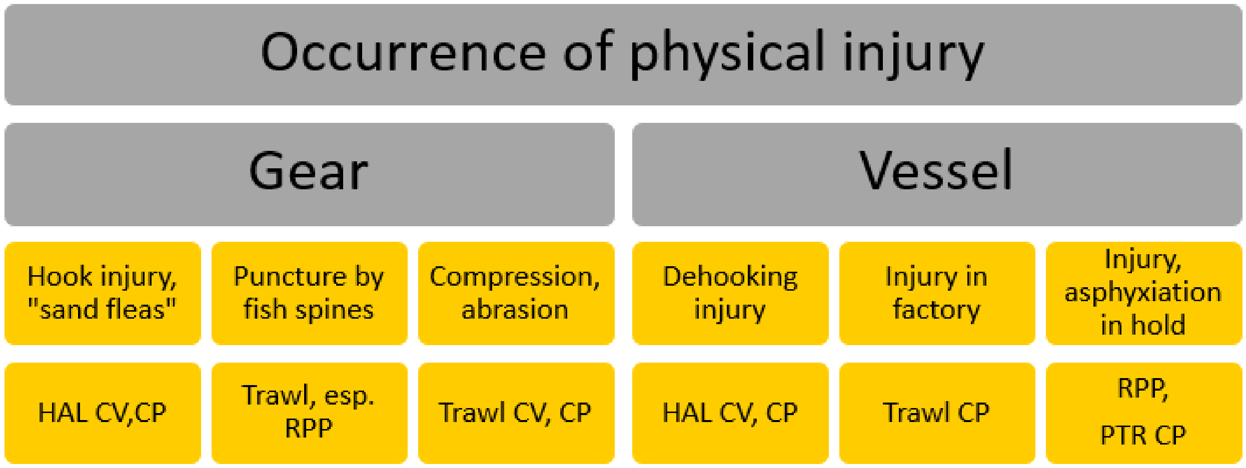

Figure 8. Illustration of the expected association of injury types with operational components of the groundfish fisheries.

4.8.4 Interactions of DMR Factors

The time out of water, time in/on gear, and occurrence of other specific injuries from either gear or vessel all contribute to the survival probability of incidentally caught halibut. While injury severity for halibut captured by trawl gear may vary, halibut caught in trawl gear spend more time out of water than those caught on hook and line gear. The additional compression and potential asphyxiation within very large trawl catches (and/or long duration tows) can be more damaging than capture and release by vessels using hook or pot gear. Within the trawl fleet, time out of water, time in/on gear, and occurrence of injury combined have smaller impact of halibut condition in the CV fleet than on the CP vessels. Exceptions to these groupings are likely to occur, and for those exceptions, it may be desirable to devote resources to developing better estimation methods for DMRs. The working group, however, considers the proposed partitioning of the groundfish fleet to well represent the majority of the operational contributions to halibut DMR and thus, expects their application to improve the accuracy of DMR estimation.

5 Results (DMR estimates)

5.1 Constraints on Estimation

Table 2 contains the proposed breakout of operational groupings as well as an indication of the number of individual halibut for which data were collected from 2009 to 2015. For much of the groundfish fleet, the average annual number of viabilities ranged from just under 500 (GOA CV HAL) to over 11 thousand (BSAI CV HAL). While a minimum number of halibut conditions on which a DMR estimate can be based has not been identified, in all cases, except PTR, the working group suggests using an observer-based estimate. On vessels fishing PTR outside of pollock fisheries, however, observers were unable to collect viability data. **The quantity of halibut PSC in non-pollock PTR fisheries is small, and so we propose that these trips be grouped with pollock PTR (100% mortality) based on their operational similarities.**

Rockfish Program CVs fishing NPT in the GOA are difficult to unambiguously identify in the viability datasets. As stated in 4.4.3, **we recommend basing RPP DMR for NPT CVs in the GOA on the *rockfish target* DMR for GOA NPT CVs until direct estimates are possible**.

Most CVs in the BSAI fishing hook and line gear have only recently been required to carry observers (2013 restructuring), and hence limited viability data are available from this fleet prior to 2013.

5.2 Reference Timeframe

At the September PT meeting, the Plan Teams agreed with the Working Group that DMR estimates be based on 3-year averages of annual estimates as opposed to long term (2009-2015) averages. Because the proposed operational groupings are based, in part, on current operational management structure, they may not be appropriate under previous management programs (e.g. prior to implementation of AM80, RPP, etc.) . In addition, applying this estimation method to data collected under different landings accounting (e-landings pre-2009) systems presents computational difficulties. Changes have been implemented in observer data collection methods over time that result in several distinct sampling design periods. As stated in the introduction, prior to 2013, observer deployment into the fishing fleet was not randomized. Prior to 2016, viability sampling was not subject to the same randomization methods used in other aspects of observer sampling. Hence, pooling years subject to less potential bias (2013 forward) with years subject to different assumptions (pre-2013) would not be advisable and would obscure key improvements made in recent annual estimates.

We recommend using years 2013 forward as the reference period unless sample availability is constraining.

Table 2. Halibut DMR operational groups, sample sizes, and working group decision on whether to estimate DMRs or assign 100% DMRs.

Operational Group						
Sector	Region	Gear	Target	Sample Size (Mean Annual $N_{Viabilities}$)	Estimate DMR?	DMR
CP	BSAI	PTR	pollock	6,051	N	100%
			non-pollock	1	N	100%
		NPT	all	4,306	Y	85%
		HAL	all	11,210	Y	8%
		POT	all	686[b]	Y	6%
	GOA	PTR	pollock	0	N	100%
			non-pollock	0	N	100%
		NPT[a]	all	493	N	85%
		HAL	all	1,295	Y	11%
		POT	all	523[c]	Y	10%
CV	BSAI	PTR	pollock	569	N	100%
			non-pollock	14	N	100%
		NPT	all	2,174	Y	52%
		HAL	all	62[d]	Y	14%
		POT	all	686[b]	Y	6%
	GOA	PTR	pollock	2	N	100%
			non-pollock	4	N	100%
		NPT	RPP[e]	103	Y	67%
			non-RPP	1,265	Y	65%
		HAL	all	490	Y	12%
		POT	all	523[c]	Y	10%

[a] GOA CP NPT RPP and non-RPP pooled
[b] CV, CP pots in same group by design
[c] CV, CP in same group by design
[d] Most vessels not required to have observer coverage prior to 2013
[e] GOA CV NPT RPP based on GOA CV NPT rockfish target

Tables 3-5, below, provide counts of vessels, hauls, and viability samples, as well as estimated DMRs for each operational grouping. Shaded red cells indicate where sampling was considered to be too constraining for DMR estimation. Long term and recent (2013 fwd) average DMRs are also provided.

Table 3. Time series of numbers of vessels and hauls where viability data were collected, and the number of viabilities or injury assessments collected, as well as annual DMR estimates for **trawl** operational groupings in the BSAI and GOA. Long term and short term (2013 fwd) average DMRs are also provided (bottom panel). Red highlighting indicates limited sample size that prevented DMR estimation and yellow highlighting indicates assignment of 100% DMRs rather than estimation.

	VESSELS							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CP	**45**	**39**	**44**	**34**	**39**	**36**	**24**	**31**
BSAI	**35**	**35**	**36**	**29**	**33**	**34**	**23**	**28**
NPT	21	21	22	16	19	20	10	15
PTR	14	14	14	13	14	14	13	13
GOA	**10**	**4**	**8**	**5**	**6**	**2**	**1**	**3**
NPT	9	4	8	5	6	2	1	3
PTR	1							
CV	**109**	**91**	**84**	**93**	**77**	**64**	**74**	**92**
BSAI	**74**	**54**	**53**	**57**	**43**	**39**	**50**	**52**
NPT	27	28	25	35	24	22	34	41
PTR	47	26	28	22	19	17	16	11
GOA								
NPT	30	31	29	35	26	21	19	35
ROCK_TGT	8	12	12	14	10	11	9	15
PTR	3	5	1		2			
Grand Total	**154**	**130**	**128**	**127**	**116**	**100**	**98**	**123**

	HAULS							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CP	**3964**	**3344**	**2960**	**1853**	**2549**	**1896**	**1162**	**2058**
BSAI	**3747**	**3174**	**2759**	**1775**	**2382**	**1823**	**1161**	**2023**
NPT	1680	1717	801	600	892	535	186	1362
PTR	2067	1457	1958	1175	1490	1288	975	661
GOA	**217**	**170**	**201**	**78**	**167**	**73**	**1**	**35**
NPT	216	170	201	78	167	73	1	35
PTR	1							
CV	**1129**	**1040**	**1202**	**1098**	**772**	**849**	**628**	**866**
BSAI	**752**	**566**	**921**	**592**	**609**	**727**	**532**	**597**
NPT	200	411	514	430	459	581	446	562
PTR	552	155	407	162	150	146	86	35
GOA								
NPT	277	404	242	422	106	98	58	206
ROCK_TGT	23	35	28	54	32	21	26	72
PTR	3	10	1		2			
Grand Total	**5093**	**4384**	**4162**	**2951**	**3321**	**2745**	**1790**	**2924**

Table 3 (continued). Time series of numbers of vessels and hauls where viability data were collected, and the number of viabilities or injury assessments collected, as well as annual DMR estimates for **trawl** operational groupings in the BSAI and GOA. Long term and short term (2013 fwd) average DMRs are also provided (bottom panel). Red highlighting indicates limited sample size that prevented DMR estimation and yellow highlighting indicates assignment of 100% DMRs rather than estimation.

	VIABILITIES							
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CP	**22236**	**13797**	**12189**	**8614**	**9310**	**6139**	**2853**	**11659**
BSAI	**21065**	**13228**	**11286**	**8023**	**8886**	**5975**	**2852**	**11537**
NPT	8967	7375	2363	1410	2868	1928	463	9074
PTR	12098	5853	8923	6613	6018	4047	2389	2463
GOA	**1171**	**569**	**903**	**591**	**424**	**164**	**1**	**122**
NPT	1170	569	903	591	424	164	1	122
PTR	1	0	0	0	0	0	0	0
CV	**3724**	**4825**	**5899**	**5803**	**3067**	**3547**	**2552**	**3884**
BSAI	**1937**	**2428**	**4234**	**2921**	**2406**	**3002**	**2112**	**2503**
NPT	765	2151	2972	2228	2090	2780	1977	2431
PTR	1172	277	1262	693	316	222	135	72
GOA								
NPT	1291	2197	1521	2582	511	477	319	1218
ROCK_TGT	53	79	99	130	81	39	69	275
PTR	4	28	1		4	0	0	0
Grand Total	**25960**	**18622**	**18088**	**14417**	**12377**	**9686**	**5405**	**15543**

	DMRs							long term average	2013-2015 average
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**		
CP									
BSAI									
NPT	87.76%	85.87%	83.17%	81.60%	86.83%	87.14%	81.59%	85%	85%
PTR	90.0%	90.0%	89.9%	89.9%	90.0%	90.0%	90.0%	90%	90%
GOA									
NPT	79.54%	84.00%	73.00%	84.29%	82.34%	81.34%	90.00%	81%	82%
PTR	20.0%							20%	NA
CV									
BSAI									
NPT	42.09%	67.41%	62.31%	68.33%	43.85%	51.73%	59.61%	56%	52%
PTR	90.0%	85.8%	87.0%	89.9%	88.0%	81.4%	81.2%	86%	84%
GOA									
NPT	52.51%	62.41%	52.74%	58.12%	66.05%	65.62%	64.38%	60%	65%
ROCK_TGT	77.05%	53.60%	52.34%	56.22%	59.29%	65.24%	76.96%	63%	67%
PTR		20.0%			20.0%			20%	20%

Table 4. Time series of numbers of vessels, hauls, and viabilities, as well as annual DMRs for HAL operational grouping in the BSAI and GOA. Red highlighting indicates limited sample size that prevented DMR estimation. Long term and short term (2013 fwd) average DMRs are also provided.

	VESSELS							
	2009	2010	2011	2012	2013	2014	2015	2016
CP	**53**	**48**	**38**	**35**	**38**	**38**	**37**	**33**
BSAI	36	33	29	30	30	29	29	27
GOA	17	15	9	5	8	9	8	6
CV	**3**	**2**	**1**	**2**	**31**	**81**	**72**	**44**
BSAI					2	11	11	2
GOA	3	2	1	2	29	70	61	42
Grand Tot	**56**	**50**	**39**	**37**	**69**	**119**	**109**	**77**

	HAULS							
	2009	2010	2011	2012	2013	2014	2015	2016
CP	**2597**	**2376**	**2766**	**2747**	**3569**	**3306**	**3325**	**1314**
BSAI	2380	2101	2412	2667	3449	2986	2894	1202
GOA	217	275	354	80	120	320	431	112
CV	**22**	**27**	**9**	**42**	**205**	**332**	**253**	**128**
BSAI					2	26	21	2
GOA	22	27	9	42	203	306	232	126
Grand Tot	**2619**	**2403**	**2775**	**2789**	**3774**	**3638**	**3578**	**1442**

	VIABILITIES							
	2009	2010	2011	2012	2013	2014	2015	2016
CP	**11551**	**10704**	**13373**	**13156**	**15994**	**11781**	**10977**	**4465**
BSAI	10323	9015	11261	12837	15348	10332	9356	3658
GOA	1228	1689	2112	319	646	1449	1621	807
CV	**90**	**163**	**18**	**127**	**933**	**1236**	**1048**	**519**
BSAI					11	82	94	5
GOA	90	163	18	127	922	1154	954	514
Grand Tot	**11641**	**10867**	**13391**	**13283**	**16927**	**13017**	**12025**	**4984**

	DMRs									
	2009	2010	2011	2012	2013	2014	2015	2016	long term average	2013-2015 average
CP										
BSAI	9.71%	8.42%	9.58%	8.97%	8.97%	8.47%	7.85%		8.85%	8.43%
GOA	10.0%	8.9%	9.1%	12.3%	12.2%	9.5%	10.5%		10.34%	10.73%
CV										
BSAI	NA	NA	NA	NA	NA	23.74%	3.50%		13.62%	13.62%
GOA	6.93%	9.52%	5.32%	39.00%	13.44%	8.62%	13.93%		13.82%	11.99%

Table 5. Time series of numbers of vessels, hauls, and viabilities, as well as annual DMRs for **POT** operational grouping in the BSAI and GOA. Long term and short term (2013 fwd) average DMRs are also provided.

	VESSELS						
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
BSAI	16	25	32	26	21	20	24
GOA	9	11	16	15	26	17	32
Grand	**25**	**36**	**48**	**41**	**47**	**37**	**56**

	HAULS						
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
BSAI	129	236	348	428	259	264	310
GOA	42	40	200	228	163	68	208
Grand	**171**	**276**	**548**	**656**	**422**	**332**	**518**

	VIABILITIES						
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
BSAI	231	616	1259	1502	491	498	723
GOA	78	179	1067	1070	363	179	891
Grand	**309**	**795**	**2326**	**2572**	**854**	**677**	**1614**

	DMRs								
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**long term average**	**2013-2015 average**
BSAI	8.80%	23.68%	15.28%	12.72%	7.25%	5.30%	6.02%	11.29%	6.19%
GOA	0.00%	7.53%	4.31%	15.56%	16.86%	10.27%	1.61%	8.02%	9.58%

Tables 6 and 7 below, taken from NPFMC (2016) present the current DMRs as specified for GOA and BSAI groundfish fisheries. The recommended methods replace target fisheries with operational groupings and separate by CV, CP rather than CDQ, non-CDQ. As such, it is difficult to present a 1:1 comparison to status quo DMR values in a similar table.

Tables 8-11 incorporate the new estimates, and assign them to the recommended operational groupings. Target species and the current DMR associated with harvest for those grouping are included in the table to provide for comparison. As stated above, there is not a halibut PSC limit for pot gear, but halibut mortality is estimated and provided to the IPHC.

Table 12 compares total halibut mortalities to specified PSC limits using either current or proposed DMRs.

Table 6. 2016 and 2017 Pacific Halibut Discard Mortality Rates for the **BSAI**, as established in the annual harvest specifications

Non-CDQ			CDQ		
Gear	**Fishery**	**DMR (%)**	**Gear**	**Fishery**	**DMR (%)**
Trawl	Alaska plaice	66	Trawl		
	Arrowtooth flounder	84			
	Atka mackerel	82		Atka mackerel	82
	Flathead sole	72		Flathead sole	79
	Greenland turbot	82		Greenland turbot	89
	Non-pelagic pollock	84		Non-pelagic pollock	86
	Pelagic pollock	81		Pelagic pollock	90
	Other flatfish	88			
	Other species	63			
	Pacific cod	66		Pacific cod	87
	Rockfish	66		Rockfish	70
	Rock sole	86		Rock sole	86
	Sablefish	66			
	Yellowfin sole	84		Yellowfin sole	85
Hook and line	Greenland turbot	11	Hook and line	Greenland turbot	10
	Other species	9			
	Pacific cod	9		Pacific cod	10
	Rockfish	9			
Pot	Other species	9	Pot		
	Pacific cod	9		Pacific cod	1
				Sablefish	41

Table 7. 2016 and 2017 Pacific Halibut Discard Mortality Rates for the **GOA**, as established in the annual harvest specifications

Gear	Fishery	DMR (%)	Gear	Fishery	DMR (%)
Trawl	Arrowtooth flounder	76	Hook and line	Other fisheries[1]	10
	Deepwater flatfish	62		Pacific cod	10
	Flathead sole	67		Rockfish	10
	Non-pelagic pollock	58			
	Other fisheries[1]	62	Pot	Other fisheries[1]	15
	Pacific cod	62		Pacific cod	15
	Pelagic pollock	65			
	Rex sole	72			
	Rockfish	65			
	Sablefish	59			
	Shallow-water flatfish	66			

[1]"Other fisheries" includes all gear types for skates, sculpins, squids, octopuses, and hook-and-line sablefish.

Table 8. Estimated Pacific halibut mortalities for the **GOA** in **2015**, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

2015 Gulf of Alaska Halibut Mortality using proposed DMRs (as of August 30, 2016)										
				Current			New		Difference	
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target	DMR	Halibut mortality	Current minus New	PSC limit
HAL	CV	OA	1,262	0.11	139	Pacific cod	0.12	151	(13)	145
PTR	CV	RPP	0	0.60	0	Bottom pollock	1.00	0	(0)	
PTR	CV	RPP	5	0.66	3	Rockfish	1.00	5	(2)	
NPT	CV	RPP	0	0.60	0	Bottom pollock	0.67	0	(0)	
NPT	CV	RPP	22	0.62	14	Pacific cod	0.67	15	(1)	
NPT	CV	RPP	30	0.66	20	Rockfish	0.67	20	(0)	
NPT	CV	RPP	3	0.71	2	Shallow water flatfish	0.67	2	0	
								-	-	
PTR	CV	OA	6	0.60	4	Bottom pollock	1.00	6		
PTR	CV	OA	1	0.62	1	Pacific cod	1.00	1	(0)	
PTR	CV	OA	7	0.71	5	Pelagic pollock	1.00	7	(2)	
								-	-	
NPT	CV	OA	150	0.60	90	Bottom pollock	0.65	98	(8)	
NPT	CV	OA	757	0.62	469	Pacific cod	0.65	492	(23)	
NPT	CV	OA	99	0.67	66	Shallow water flatfish	0.65	64	2	
NPT	CV	OA	0	0.66	0	Rockfish	0.65	0	0	
NPT	CV	OA	3	0.71	2	Pelagic pollock	0.65	2	0	
NPT	CV	OA	-	0.71	-	Shallow water flatfish	0.65	-		
NPT	CV	OA	488	0.73	356	Arrowtooth flounder	0.65	317	39	
NPT	CV	OA	8	0.69	5	Rex sole	0.65	5	0	
HAL	CP	OA	628	0.11	69	Pacific cod	0.11	69	-	
HAL	CP	OA	0	0.11	0	Other species	0.11	0	-	116
									-	
NPT	CP	OA	0	0.60	0	Bottom pollock	0.85	0	(0)	
NPT	CP	OA	1	0.62	1	Pacific cod	0.85	1	(0)	
NPT	CP	OA	-	0.43	-	Deep water flatfish	0.85	-	-	
NPT	CP	OA	62	0.67	41	Shallow water flatfish	0.85	53	(11)	
NPT	CP	OA	46	0.66	30	Rockfish	0.85	39		
NPT	CP	OA	4	0.65	2	Flathead sole	0.85	3	(1)	
NPT	CP	OA	0	0.71	0	Sablefish	0.85	0	(0)	
NPT	CP	OA	306	0.73	223	Arrowtooth flounder	0.85	260	(37)	
NPT	CP	OA	35	0.69	24	Rex sole	0.85	30	(6)	
NPT	CP	RPP	77	0.66	51	Rockfish	0.85	65	(15)	
NPT	CP	RPP	3	0.73	2	Arrowtooth flounder	0.85	3	(0)	
PTR	CP	OA	-	0.66	-	Rockfish	1.00	-	-	
Total			4,002		1,620			1,708	(87)	2,021
Summary										
Hook-and-line CV			1,262		139			151	(13)	145
Hook-and-line CP			628		69			69	-	116
Trawl			2,112		1,413			1,487	(75)	1,759
Total			4,002		1,620			1,708	(87)	2,020

Table 9. Estimated Pacific halibut mortalities for the **GOA** in **2016**, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

2016 Gulf of Alaska Halibut Mortality using proposed DMRs (as of August 30, 2016)										
				Current			New		Difference	
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target	DMR	Halibut mortality	Current minus New	PSC limit
HAL	CV	OA	1,509	0.10	151	Pacific cod	0.12	181	(30)	129
NPT	CV	RPP	35	0.65	23	Rockfish	0.67	23	(1)	
NPT	CV	RPP	6	0.59	4	Sablefish	0.67	4	(1)	
PTR	CV	RPP	1	0.65	0	Rockfish	1.00	1	(0)	
PTR	CV	OA	2	0.58	1	Bollom pollock	1.00	2	(1)	
PTR	CV	OA	1	0.66	0	Shallow water flatfish	1.00	1	(0)	
PTR	CV	OA	1	0.65	0	Pelagic pollock	1.00	1	(0)	
NPT	CV	OA	56	0.58	33	Bollom pollock	0.65	37	(4)	
NPT	CV	OA	537	0.62	333	Pacific cod	0.65	349	(16)	
NPT	CV	OA	51	0.66	34	Shallow water flatfish	0.65	33	1	
NPT	CV	OA	10	0.67	6	Flathead sole	0.65	6	0	
NPT	CV	OA	-	0.62	-	Other species	0.65	-	-	
NPT	CV	OA	0	0.65	0	Pelagic pollock	0.65	0	-	
NPT	CV	OA	550	0.76	418	Arrowtooth flounder	0.65	358	61	
NPT	CV	OA	18	0.72	13	Rex sole	0.65	12	1	
HAL	CP	OA	459	0.10	46	Pacific cod	0.11	50	(5)	128
NPT	CP	OA	3	0.62	2	Pacific cod	0.85	3	(1)	
NPT	CP	OA	26	0.66	17	Shallow water flatfish	0.85	22	(5)	
NPT	CP	OA	24	0.65	15	Rockfish	0.85	20	(5)	
NPT	CP	OA	2	0.67	1	Flathead sole	0.85	1	(0)	
NPT	CP	OA	139	0.76	105	Arrowtooth flounder	0.85	118	(12)	
NPT	CP	OA	2	0.72	1	Rex sole	0.85	1	(0)	
NPT	CP	RPP	56	0.65	37	Rockfish	0.85	48	(11)	
NPT	CP	RPP	2	0.76	2	Arrowtooth flounder	0.85	2	(0)	
PTR	CP	OA	-	0.65	-	Rockfish	1.00	-	-	
Total			3,490		1,243			1,273	(30)	1,706
Summary										
Hook-and-line CV			1,509		151			181	(30)	129
Hook-and-line CP			459		46			50	(5)	128
Trawl			1,521		1,047			1,042	5	1,706
Total			3,490		1,243			1,273	(30)	1,963

Table 10. Estimated Pacific halibut mortalities for the **BSAI** in **2015**, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

HAL	S	OA	17	0.09	2	Pacific cod	0.14	2	(1)
									-
PTR	M	AFA	2	0.88	2	Pelagic pollock	1.00	2	(0)
PTR	S	AFA	4	0.77	3	Bottom pollock	1.00	4	(1)
PTR	S	AFA	29	0.88	25	Pelagic pollock	1.00	29	(3)
PTR	S	OA	1	0.71	1	Pacific cod	1.00	1	(0)
									-
NPT	M	CDQ	0	0.80	0	Rockfish	0.85	0	(0)
NPT	M	CDQ	0	0.86	0	Atka mackerel	0.85	0	0
NPT	M	CDQ	15	0.86	13	Yellowfin sole	0.85	12	0
NPT	M	CDQ	1	0.88	1	Rock sole	0.85	1	0
NPT	M	OA	23	0.71	16	Pacific cod	0.85	20	(3)
NPT	M	OA	6	0.77	4	Atka mackerel	0.85	5	(0)
NPT	M	OA	0	0.77	0	Bottom pollock	0.85	0	(0)
NPT	M	OA	1	0.79	1	Rockfish	0.85	1	(0)
NPT	M	OA	84	0.83	69	Yellowfin sole	0.85	71	(2)
NPT	M	OA	8	0.85	7	Rock sole	0.85	7	-
									-
NPT	S	OA	297	0.71	211	Pacific cod	0.52	154	56
									-
HAL	CP	CDQ	221	0.10	22	Pacific cod	0.08	18	4
HAL	CP	IFQ	-	0.04	-	Rockfish	0.08	-	-
HAL	CP	OA	0	0.09	0	Bottom pollock	0.08	0	0
HAL	CP	OA	3,207	0.09	289	Pacific cod	0.08	257	32
HAL	CP	OA	2	0.09	0	Other species	0.08	0	0
HAL	CP	OA	24	0.13	3	Greenland turbot	0.08	2	1
									-

Table 10 (continued). Estimated Pacific halibut mortalities for the **BSAI** in **2015**, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

				Current			New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target	DMR	Halibut mortality	Current minus New
NPT	CP	A80	51	0.71	36	Pacific cod	0.85	44	(7)
NPT	CP	A80	3	0.71	2	Alaska Plaice	0.85	2	(0)
NPT	CP	A80	-	0.71	-	Other flatfish	0.85	-	-
NPT	CP	A80	61	0.73	44	Flathead sole	0.85	51	(7)
NPT	CP	A80	58	0.76	44	Kamchatka flounder	0.85	49	(5)
NPT	CP	A80	82	0.76	62	Arrowtooth flounder	0.85	70	(7)
NPT	CP	A80	111	0.77	85	Atka mackerel	0.85	94	(9)
NPT	CP	A80	23	0.77	18	Bottom pollock	0.85	20	(2)
NPT	CP	A80	75	0.79	60	Rockfish	0.85	64	(5)
NPT	CP	A80	696	0.83	578	Yellowfin sole	0.85	592	(14)
NPT	CP	A80	559	0.85	475	Rock sole	0.85	475	-
NPT	CP	CDQ	3	0.76	3	Arrowtooth flounder	0.85	3	(0)
NPT	CP	CDQ	0	0.79	0	Flathead sole	0.85	0	(0)
NPT	CP	CDQ	0	0.80	0	Rockfish	0.85	0	(0)
NPT	CP	CDQ	1	0.83	1	Bottom pollock	0.85	1	(0)
NPT	CP	CDQ	8	0.86	7	Atka mackerel	0.85	7	0
NPT	CP	CDQ	48	0.86	42	Yellowfin sole	0.85	41	0
NPT	CP	CDQ	27	0.88	24	Rock sole	0.85	23	1
NPT	CP	CDQ	12	0.90	11	Pacific cod	0.85	10	1
NPT	CP	OA	18	0.71	13	Pacific cod	0.85	15	(2)
NPT	CP	OA	3	0.73	2	Flathead sole	0.85	3	(0)
NPT	CP	OA	1	0.77	1	Atka mackerel	0.85	1	(0)
NPT	CP	OA	0	0.77	0	Bottom pollock	0.85	0	(0)
NPT	CP	OA	66	0.83	55	Yellowfin sole	0.85	56	(1)
NPT	CP	OA	1	0.85	1	Rock sole	0.85	1	-
									-
PTR	CP	AFA	7	0.77	5	Bottom pollock	1.00	7	(2)
PTR	CP	AFA	78	0.88	69	Pelagic pollock	1.00	78	(9)
PTR	CP	AIP	-	0.77	-	Bottom pollock	1.00	-	-
PTR	CP	AIP	-	0.79	-	Rockfish		-	-
PTR	CP	AIP	-	0.88	-	Pelagic pollock	1.00	-	-
PTR	CP	CDQ	0	0.83	0	Bottom pollock	1.00	0	(0)
PTR	CP	CDQ	8	0.90	8	Pelagic pollock	1.00	8	(1)
Total			5,942		2,312			2,300	12

Table 11. Estimated Pacific halibut mortalities for the BSAI in 2016, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

2016 BSAI Halibut Mortality using proposed DMRs (as of 8/30/2016, does not include decksorting EFP)

				Current			New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target	DMR	Halibut mortality	Current minus New
HAL	S	OA	0	0.09	0	Pacific cod	0.14	0	(0)
PTR	M	AFA	-	0.81	-	Bottom pollock	1.00	-	-
PTR	M	AFA	1	0.88	1	Pelagic pollock	1.00	1	(0)
PTR	S	AFA	-	0.81	-	Bottom pollock	1.00	-	-
PTR	S	AFA	19	0.88	17	Pelagic pollock	1.00	19	(2)
PTR	S	OA	2	0.66	1	Pacific cod	1.00	2	(1)
NPT	M	CDQ	-	0.70	-	Rockfish	0.85	-	-
NPT	M	CDQ	-	0.82	-	Atka mackerel	0.85	-	-
NPT	M	CDQ	14	0.85	12	Yellowfin sole	0.85	12	-
NPT	M	CDQ	10	0.86	8	Rock sole	0.85	8	0
NPT	M	CDQ	-	0.87	-	Pacific cod	0.85	-	-
NPT	M	OA	33	0.66	22	Pacific cod	0.85	28	(6)
NPT	M	OA	0	0.81	0	Bottom pollock	0.85	0	(0)
NPT	M	OA	1	0.82	0	Atka mackerel	0.85	0	(0)
NPT	M	OA	-	0.83	-	Rockfish	0.85	-	-
NPT	M	OA	93	0.84	78	Yellowfin sole	0.85	79	(1)
NPT	M	OA	33	0.86	29	Rock sole	0.85	28	0
NPT	S	OA	391	0.66	258	Pacific cod	0.52	203	55
HAL	CP	CDQ	209	0.10	21	Pacific cod	0.08	17	4
HAL	CP	IFQ	0	0.09	0	Pacific cod	0.08	0	0
HAL	CP	IFQ	0	0.09	0	Rockfish	0.08	0	0
HAL	CP	IFQ	1	0.09	0	Arrowtooth flounder	0.08	0	0
HAL	CP	OA	1,486	0.09	134	Pacific cod	0.08	119	15
HAL	CP	OA	14	0.11	2	Greenland turbot	0.08	1	0

Table 11 (continued). Estimated Pacific halibut mortalities for the **BSAI** in **2016**, under the DMRs calculated using current methods (current) as well as the proposed alternative methods (new).

				Current				New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target		DMR	Halibut mortality	Current minus New
NPT	CP	A80	15	0.63	10	Other flatfish		0.85	13	(3)
NPT	CP	A80	30	0.66	20	Pacific cod		0.85	25	(6)
NPT	CP	A80	4	0.66	2	Alaska plaice		0.85	3	(1)
NPT	CP	A80	39	0.72	28	Flathead sole		0.85	33	(5)
NPT	CP	A80	10	0.81	8	Bottom pollock		0.85	8	(0)
NPT	CP	A80	51	0.82	42	Atka mackerel		0.85	43	(2)
NPT	CP	A80	1	0.82	1	Greenland turbot		0.85	1	(0)
NPT	CP	A80	15	0.83	13	Rockfish		0.85	13	(0)
NPT	CP	A80	19	0.84	16	Kamchatka flounder		0.85	16	(0)
NPT	CP	A80	55	0.84	46	Arrowtooth flounder		0.85	47	(1)
NPT	CP	A80	329	0.84	276	Yellowfin sole		0.85	280	(3)
NPT	CP	A80	532	0.86	457	Rock sole		0.85	452	5
NPT	CP	CDQ	0	0.70	0	Rockfish		0.85	0	(0)
NPT	CP	CDQ	7	0.82	6	Atka mackerel		0.85	6	(0)
NPT	CP	CDQ	28	0.85	24	Yellowfin sole		0.85	24	-
NPT	CP	CDQ	-	0.86	-	Bottom pollock		0.85	-	-
NPT	CP	CDQ	24	0.86	20	Rock sole		0.85	20.08	0
NPT	CP	CDQ	13	0.87	11	Pacific cod		0.85	11	0
NPT	CP	CDQ	0	0.89	0	Greenland turbot		0.85	0	0
NPT	CP	OA	6	0.66	4	Pacific cod		0.85	5	(1)
NPT	CP	OA	0	0.81	0	Bottom pollock		0.85	0	(0)
NPT	CP	OA	-	0.82	-	Atka mackerel		0.85	-	-
NPT	CP	OA	57	0.84	48	Yellowfin sole		0.85	48	(1)
NPT	CP	OA	22	0.86	19	Rock sole		0.85	19	0
PTR	CP	AFA	6	0.81	5	Bottom pollock		1.00	6	(1)
PTR	CP	AFA	-	0.83	-	Rockfish		1.00	-	-
PTR	CP	AFA	62	0.88	55	Pelagic pollock		1.00	62	(7)
PTR	CP	CDQ	0	0.86	0	Bottom pollock		1.00	0	(0)
PTR	CP	CDQ	9	0.90	8	Pelagic pollock		1.00	9	(1)
Total			3,641		1,701				1,663	38

Table 12. Estimated Pacific halibut mortalities for the GOA and BSAI in 2015 and 2016, under the current and proposed DMRs compared to specified PSC limits (Data as of 08/30/2016).

BSAI

BSAI Sector		2016 Halibut mortality			**2016 Halibut PSC Limit**	2015 Halibut mortality			**2015 Halibut PSC Limit**
		With current DMR	With proposed DMR	Current minus Proposed		With current DMR	With proposed DMR	Current minus Proposed	
Hook-and-line Pacific cod	CV	0	0	(0)	13	2	2	(1)	15
Hook-and-line Pacific cod	CP	134	119	15	648	289	257	32	760
Non-trawl	CV/CP	2	1	0	49	3	2	1	58
BSAI trawl limited access	CV/CP	537	502	35	745	484	453	31	875
Amendment 80	CP	918	934	(16)	1,745	1,404	1,461	(57)	2,325
CDQ	CV/CP	110	107	4	315	130	124	5	393
Total		1,701	1,663	38	3,515	2,312	2,300	12	4,426
Does not include the 2016 trawl deck sorting Experimental Fishing Permit (EFP) halibut mortality.									
Does not include the 2015 Amendment 80 deck sorting EFP halibut mortality of 232 mt.									

GOA

GOA Sector		2016 Halibut mortality			**2016 Halibut PSC Limit**	2015 Halibut mortality			**2015 Halibut PSC Limit**
		With current DMR	With proposed DMR	Current minus Proposed		With current DMR	With proposed DMR	Current minus Proposed	
Hook-and-line Pacific cod	CV	151	181	(30)	129	139	151	(13)	145
Hook-and-line Pacific cod	CP	46	50	(5)	128	69	69	(0)	116
Trawl	CV/CP	1,047	1,042	5	1,706	1,413	1,487	(75)	1,759
Total		1,243	1,273	(30)	1,963	1,620	1,708	(87)	2,020

6 Review by the Plan Team

In keeping with direction provided by the Council, the proposed DMRs for application in 2017 is going through the Plan Team-SSC-AP-Council specifications review. In addition to this document, a presentation has been provided to the Plan Team at its September meeting. The DMR working group posed the following questions to the Plan Teams, soliciting feedback and input to be incorporated, as necessary, into any additional analyses. *Responses from the WG below are in italics.*

1. Does the Plan Team support the general approach of using operational groupings for DMRs as opposed to target fishery specific DMRs?

The Teams recommend moving forward with operational groupings for estimation and application of DMRs, since the operational differences associated with these groupings represent an improvement over target fishery aggregation. These operational groupings would avoid some of the issues associated with pooling different gear types by target when the viabilities of halibut associated with those targets are not consistent across gear types. Also, the sample sizes are increased by aggregating in this manner. Aligning estimation procedures with sampling design is also an improvement and can be used to better inform the observer program where additional sampling is needed. Additional data can then inform future evaluations of potential modifications.

No response necessary.

2. Are the specific operational groupings described by the Working Group appropriate?

In general the teams agree with these operational groupings with additional considerations to encourage the working group to elaborate on the rationale for these groupings.

The current document reflects this recommendation.

The Teams recommend some additional fine tuning of these groupings (working with the industry as appropriate) for best characterizations of operational groupings.

The current document reflects this recommendation.

3. Are the methods for expanding viability samples into strata appropriate?

The Teams agree that these methods are appropriate.

No response necessary.

4. The Working Group is recommending using annual DMR estimates from 2013 forward unless this results in inadequate sample size. Is this the appropriate reference period appropriate for calculating DMRs at this time?

The Teams agree with the recommendation to begin the reference period in 2013 in conjunction with the restructured observer program. In the future, with more data to inform these estimates, a different rolling time frame may be used. The WG does not have a firm recommendation at this time, and any future recommendations will be dependent on both the availability of data as well as the management aspect of how much change over time in DMRs is desirable. It was noted that improvements to Pacific halibut mortality estimates by fleets, and incentivizing improvements, would not be picked up by a longer term average. Team members noted that slow moving averages may not be appropriate as they are unresponsive to changes in behavior. Cross-validation was suggested as a possible method of testing alternative estimators.

The Teams recommend that, for the short-term, this choice of averaging years and the reference period appears appropriate.

Absent cross-validation, the current document reflects these recommendations

5. Are operational groupings for which sample size is an issue appropriately addressed for management purposes?

The assumptions involved in treatment of low sample size should be listed. It was noted that inadequate *sample size* should not be confused with inadequate *sampling*. Some strata with limited viabilities may be a result of either no halibut bycatch or the halibut bycatch being inaccessible for viability estimation, and neither of these should be presumed to imply a lack of observer coverage issue. In general, the Teams agree that the treatment of these groupings appears appropriate.

No response necessary.

6. Can the proposed methods be used for management in 2017?

The Teams recommend that these methods be used for 2017 harvest specifications.

The proposed DMRs will be recommended to the Council for implementation in 2017.

7 References

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