

GROUND FISH MANAGEMENT TEAM REPORT ON METHODOLOGY REVIEW-FINAL

Over the course of the last several months, members of the Groundfish Management Team (GMT) have been working on developing mortality rates for additional species when descending devices are used. Additionally, the Council is tasked at this meeting with considering final selection of any impact projection methodologies to be reviewed in 2023. This report summarizes the GMT's discussions and recommendations on those two topics.

Mortality Rates for Additional Species When Descending Devices Are Used

Since June, members of the GMT, led by Dr. Chantel Wetzel from the National Marine Fisheries Service Northwest Fisheries Science Center, have been working to develop depth-dependent discard mortality rates for rockfish species when descending devices are used. Currently, based on a similar analysis conducted by the GMT in 2014, three species-specific cumulative discard mortality rates for canary rockfish, yelloweye rockfish, and cowcod are currently used to modify discard mortality based on the use of descending devices for recreational fisheries. This work updates and extends the 2014 approach to provide updated estimates for canary rockfish, yelloweye rockfish, and cowcod along with estimates for other rockfish species within the groundfish Fishery Management Plan. Dr. Wetzel provided a draft report with a proposed methodology and model estimates to the Scientific and Statistical Committee (SSC) in September 2022 for review. [Agenda Item G.4.a, Supplemental GMT Report 1, November 2022](#) is the updated analysis with the issues identified by the SSC addressed (details in [Agenda Item G.4.a, Supplemental GMT Report 2, November 2022](#)).

The GMT as a whole reviewed and discussed the methodology and estimates presented in the report. The expanded dataset used in this new analysis includes observations from 22 rockfish species. However, there were not sufficient observations for all 22 species to support the development of species-specific discard mortality rates across a range of depth bins. Given this, the analysis outlines two possible applications for the estimated discard mortality rates: 1) apply guild-based discard mortality estimates for demersal, pelagic, and dwarf rockfishes (Tables 6, 7, and 9 in [Agenda Item G.4.a, Supplemental GMT Report 1, November 2022](#)) and/or 2) apply species-specific estimates for select species identified to have sample sizes sufficient to inform discard mortality rates by depth bin.

The analysis provided summarizes the estimated discard mortality distribution based on five pre-specified percentiles for consideration: the 50th, 60th, 70th, 80th, and 90th, combined with the following guidance on how these percentiles should be interpreted ([Agenda Item G.4.a, Supplemental GMT Report 1, November 2022](#)):

“The general interpretation of selected percentile is the percentage of values that would be expected to be less than the given value, for example, 80 percent of outcomes (or observations) would be expected to be less than the 80th percentile value. In the context of this analysis, the discard mortality estimate associated with the 80th percentile for the posterior prediction would be that 80 percent of discard mortality values would fall below this given value based on available data.”

The selection of a percentile is considered a management decision. In 2014, the Council selected the 90th percentiles for canary rockfish, cowcod, and yelloweye rockfish for all depth bins. However, the 2014 analysis incorrectly referred to the percentiles as upper confidence intervals. The GMT would like to note that the upper confidence intervals and percentiles represent different levels of uncertainty. For example, an upper confidence interval of 90 percent would align with the 80th percentile, rather than the 90th percentile.

The selected percentile from the estimated discard mortality is then used to determine the final cumulative mortality rate which will be the value applied to determine discard mortality with the use of descending devices for the recreational fishery¹. The updated analysis provides a simplified approach relative to the methodology applied in the 2014 analysis which was driven by the additional data available to inform discard mortality estimates. The updated analysis, given the additional data, suggests that the specification of the cumulative mortality could be either set equal to a selected percentile alone or combined with an additional mortality component if the selection of a percentile is considered not sufficiently precautionary for a guild or species (see Figure 1b, [Agenda Item G.4.a, Supplemental GMT Report 1, November 2022](#)).

After considering all of this, **the GMT recommends:**

- **Adopting updated species-specific rates for canary rockfish, cowcod, and yelloweye rockfish, and new species-specific rates for black rockfish.**
- **For all other species, the GMT recommends adopting guild-based rates for demersal, pelagic, and dwarf rockfishes.**
- **Finally, the GMT recommends setting the cumulative mortality rate equal to the 80th percentile.**

The current estimates are based on a larger dataset that included a wider range of species compared to the data available in 2014, and therefore are likely more representative of discard mortality across a larger suite of rockfish species compared to the previous estimates. Given this, the GMT thinks the 80th percentile represents a reasonable level of precaution. Additionally, selecting the 90th percentile resulted in some instances where the discard mortality estimates using descending devices were higher than surface mortality rates, which seems implausible. This behavior was often the result of a distribution with a long upper tail that resulted in estimates of the 90th percentiles that were considerably higher than the other estimated percentiles. The GMT notes that the selection of any percentile greater than the 50th percentile provides an additional buffer to account for uncertainty around discard mortality rates, and therefore the 80th percentile provides a reasonable level of precaution (see Figure 1a, [Agenda Item G.4.a, Supplemental GMT Report 1, November 2022](#)).

Based on the above, **the GMT recommends the following species-specific depth-based cumulative mortality rates when descending devices are used (Table 1). For all rockfish species not listed in Table 1, the guild rates (Table 2) should be used.** The species that would be subject to the guild-based estimates are listed in Table 3.

¹ Descending device depth-dependent mortality rates are not used in the commercial fishery as insufficient data is collected on descending device use. Depth-dependent surface release mortality rates are incorporated into Nearshore fishery discards for the portion of the fishery that uses “sport-like” gear ([Agenda Item I.2.a, GMT Report 2, April 2017](#)).

The values in Table 1 within the 0-10 fathom depth bin were set equal to the surface release discard mortality rate if it was less than the cumulative discard mortality in the 10-30 fathom depth bin (i.e., black rockfish in Table 1). However, if the cumulative discard mortality with the use of descending devices from the 10-30 fathom depth bin was less than the estimated surface release mortality rate for the 0-10 fathom bin, the rate was based on the estimated descending device rate from the 10-30 fathom depth bin (e.g., canary rockfish, yelloweye rockfish, and cowcod). Additionally, if a species-specific discard mortality rate when using descending devices was not available for a specific depth bin or the species-specific rate was identified to have a minimal effect size relative to the corresponding guild-based estimate (i.e., power less than 0.80) the value was based on the corresponding guild-based estimate (e.g., cowcod 10-30 and 50-100 fathom depth bin). Finally, the cumulative discard mortality rate for the 100+ fathom depth bin was set equal to 100 percent based on surface release mortality rates (Appendix A) since the updated analysis did not include this depth bin given the lack of data.

Special consideration was given when determining the rate to use for black rockfish in the 50-100 fathom depth bin. Black rockfish is a pelagic species and was only observed between 10-50 fathoms in the new analysis. In lieu of a species-specific rate, the pelagic guild-based estimate of 92 percent mortality from the 50-100 fathom depth bin was considered. However, this value exceeded the black rockfish surface release mortality rate for this depth range. Based on the same logic applied to the 0-10 fathom depth bin, the cumulative discard mortality rate for the 50-100 fathom depth bin was set at the surface release mortality rate of 63 percent.

Table 1. GMT recommended species-specific depth-dependent cumulative mortality rates (in percent) with the use of descending devices based on the 80th percentile.

Depth Bin (in fms)	Canary rockfish	Yelloweye rockfish	Cowcod	Black rockfish
0-10	3% ^{a/}	9% ^{a/}	9% ^{a/}	11% ^{b/}
10-30	3%	9% ^a	9% ^{c/}	16%
30-50	18%	11%	25%	24% ^{c/}
50-100	92% ^{c/}	38% ^{c/}	38% ^{c/}	63% ^{b/}
100+	100% ^{b/}			

^{a/} Depth-dependent discard mortality based on guild-based estimate from the next deeper-depth bin with the use of a descending device.

^{b/} Depth-dependent discard mortality based on the surface mortality rate.

^{c/} Depth-dependent discard mortality rate with the use of a descending device based on the guild-based estimate.

Table 2. GMT recommended guild-specific depth-dependent cumulative mortality rates (in percent) with the use of descending devices based on the 80th percentile.

Depth Bin (in fm)	Pelagic Guild	Demersal Guild	Dwarf Guild
0-10	34% ^{c/}	9% ^{a/}	21% ^{b/}
10-30	34%	9%	67% ^{a/}
30-50	53%	30%	67%
50-100	92%	38%	100% ^{b/}
100+	100% ^{b/}		

^{a/} Depth-dependent discard mortality based on guild-based estimate from the next deeper-depth bin with the use of a descending device.

^{b/} Depth-dependent discard mortality based on the surface mortality rate.

^{c/} Depth-dependent discard mortality based on the surface mortality rate for olive rockfish that had the highest pelagic surface mortality rate at this depth.

Table 3. List of the rockfish species or species complex within each rockfish guild that do not have species-specific cumulative mortality rates where the guild-based estimate from Table 2 would be used to estimate recreational discard mortality with the use of descending devices.

Guild	Rockfish Species or Species Complex
Demersal	Aurora, Bank, Black and Yellow, Blackgill, Blackspotted, Bronzespotted, Brown, Calico, Chameleon, China, Copper, Darkblotched, Dusky, Flag, Gopher, Grass, Greenblotched, Greenspotted, Greenstriped, Kelp, Mexican, Pacific ocean perch, Pink, Pinkrose, Puget Sound, Quillback, Redbanded, Redstripe, Rosethorn, Rosy, Rougheye, Sharpchin, Shortbelly, Shortraker, Silvergray, Speckled, Splitnose, Starry, Stripetail, Sunset/Vermilion, Swordspine, Tiger, Treefish, Yellowmouth
Pelagic	Blue/Deacon, Bocaccio, Chilipepper, Olive, Widow, Yellowtail
Dwarf	Dwarf-red, Freckled, Halfbanded, Harlequin, Honeycomb, Pygmy, Semaphore, Squarespot

For reference, the adopted surface release mortality rates are provided in Appendix A to highlight potential differences between the new estimated rates with the use of descending devices.

Updating the Sablefish Trip Limit Model

In September 2022, the Council preliminarily chose to conduct a methodology review of the Sablefish Trip Limit (STL) model in 2023 due to unrealistic output projections identified by the GMT, the suspected cause of which is described in [Agenda Item G.4.a, Supplemental GMT Report 1, September 2022](#). For reference, issues with the model and associated adjustments made in September are described in more detail in Appendix B, along with other model revisions to potentially investigate during the methodology review. **The GMT recommends making a final selection of the STL model for full methodology review in 2023.**

Appendix A. Table of Council Adopted Mortality Rates for Rockfish Released at the Surface

Species	Surface release rates			
	0-10 fm	11-20 fm	21-30 fm	>30 fm
Black	11%	20%	29%	63%
Black and Yellow	13%	24%	37%	100%
Blue	18%	30%	43%	100%
Bocaccio	19%	32%	46%	100%
Brown	12%	22%	33%	100%
Calico	24%	43%	60%	100%
Canary	21%	37%	53%	100%
China	13%	24%	37%	100%
Copper	19%	33%	48%	100%
Gopher	19%	34%	49%	100%
Grass	23%	45%	63%	100%
Kelp	11%	19%	29%	100%
Olive	34%	45%	57%	100%
Quillback	21%	35%	52%	100%
Tiger	20%	35%	51%	100%
Treefish	14%	25%	39%	100%
Vermillion	20%	34%	50%	100%
Widow	21%	36%	52%	100%
Yelloweye	22%	39%	56%	100%
Yellowtail	10%	17%	25%	50%

Appendix B. Recent and Potential Future Revisions to the Sablefish Trip Limit Model

The GMT made minor adjustments to the predictor variables used in the model in September 2022 so that the Council could make inseason adjustments, and the SSC approved those adjustments for inseason use. The adjustments made in September for the respective sectors' models are shown in Table 1 and described below.

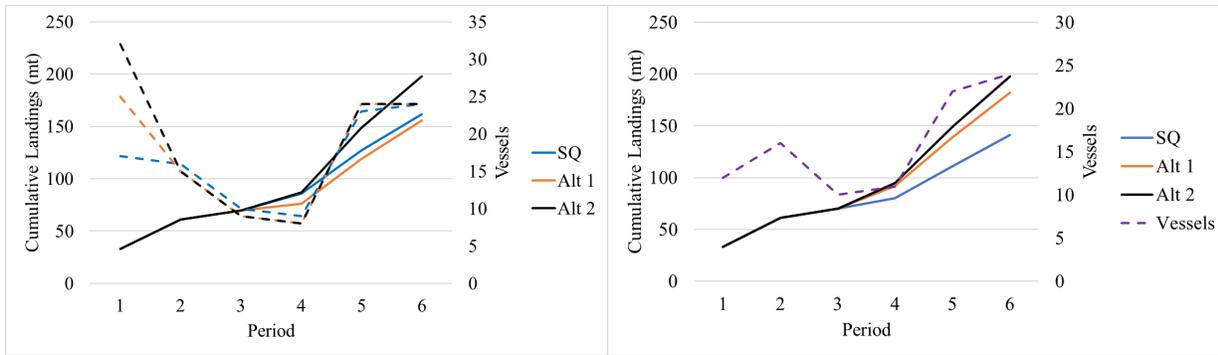
Table 1. Regression inputs of the STL model by sector and projection, prior to and after September 2022. For sectors in which landings per vessel and number of vessels are projected, the two are multiplied to project total fleetwide landings. Shaded cells highlight changes made in September 2022.

Sector Model	Projection	Previous Regression Inputs	Regression Inputs as Revised September 2022
LEN	Landings per vessel	weekly limit + bimonthly limit	weekly limit + bimonthly limit
	Number of vessels	weekly limit + sablefish price (inflation adjusted)	sablefish price (inflation adjusted)
OAN	Landings per vessel	weekly limit	weekly limit
	Number of vessels	P4 peak adjuster* + weekly limit	P4 peak adjuster* + sablefish price (inflation adjusted)
LES a/	Total fleet-wide landings	weekly limit + sablefish price (inflation adjusted)	weekly limit + sablefish price (inflation adjusted)
OAS a/	Landings per vessel	bimonthly limit + weekly limit	bimonthly limit + weekly limit
	Number of vessels	bimonthly limit + weekly limit	bimonthly limit + weekly limit

* The P4 peak adjuster is a standardized numerical value developed by Dr. Sean Matson (National Marine Fisheries Service) to account for higher effort in period 4 and lower effort in other periods of the year.

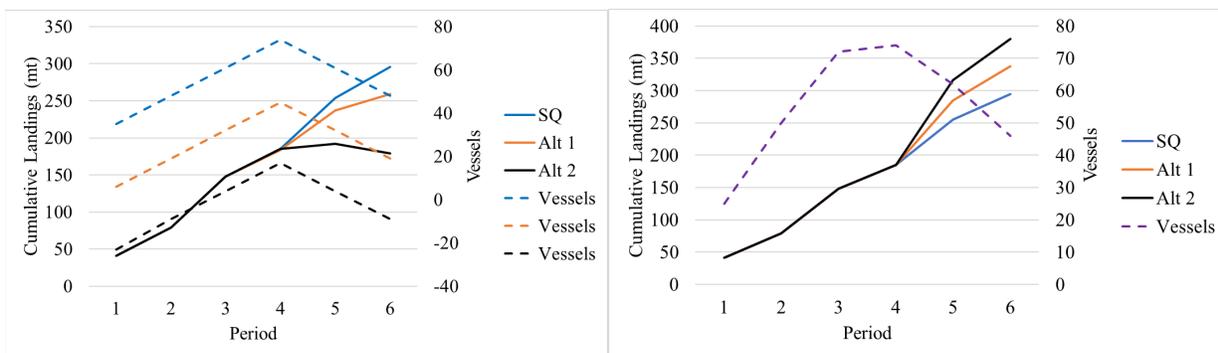
a/ No changes were made to the Limited Entry Fixed Gear sector south of 36° N. lat. (LES) and the Open Access sector south of 36° N. lat. (OAS), because there were no inseason adjustments to their trip limits in September 2022, and attainments are so low in recent years that a model-based projection may not be appropriate.

For the Limited Entry Fixed Gear sector north of 36° N. lat. (LEN), the weekly limit was removed from the linear regression predicting vessel participation. This was chosen because the model was projecting unrealistically high vessel participation in Period 1 (Jan-Feb) under higher alternative trip limits but fewer vessels under higher trip limits in other periods (Figure 1). When the weekly limit was removed, the adjusted R-squared decreased by 0.0084 but gave much more realistic landings projections under different alternatives (Figure 2). With the model revision, the same number of vessels was predicted under all alternatives, because trip limits are the only differentiation between alternatives. However, the GMT considered that vessel participation for both the LEN and OAN sectors does not appear to be heavily influenced by trip limits in recent years, but rather largely influenced by prices and activity in other fisheries.



Figures 1 & 2. Figure 1 (left) shows projections of cumulative landings (solid line) and vessel number (dashed line) in the LEN sector when weekly limit was included in the participation regression. Figure 2 (right) shows the same projection outputs after removing weekly limit from the participation regression.

For the Open Access sector north of 36° N. lat. (OAN), the weekly limit was replaced with inflation-adjusted sablefish prices as a predictor of vessel participation. This was chosen for reasons similar to the LEN sector. Figures 3 and 4 below show the projections under the previous and revised participation regressions.



Figures 3 & 4. Figure 3 (left) shows cumulative landings (solid line) and vessel number projections (dashed line) in the OAN sector when weekly limit was included in the participation regression. Figure 4 (right) shows the same projection outputs after removing weekly limit from the participation regression.

The GMT has begun thinking of possible further adjustments to the STL model to improve projections and better capture fishery dynamics. The following is a non-exhaustive list of potential changes that may warrant investigation during the 2023 methodology review:

- Consider whether Fisheries Observation Science (FOS) codes are a better alternative to the currently used GMT_SABLEFISH_CODE.
- All four sectors currently use a linear regression, but the GMT is considering whether a generalized linear model or generalized linear mixed model may better capture unique relationships between predictors and outputs for certain sectors.
- Consider adding Dungeness crab prices as a predictor variable given the cross-over between it and the fixed gear sablefish fishery.
- Consider adding fuel prices as a predictor variable given the significant economic influences on profitability and participation in recent years.

- Consider adding allocations from other fisheries as a predictor variable, to the extent practicable, because industry has commented that when other fisheries (e.g., Dungeness crab, salmon) have high allocations, vessels may prioritize those fisheries over the fixed gear sablefish fishery, and vice versa.
- For the LES and/or OAS sectors, consider developing a non-model projection methodology given the extremely low attainments in recent years. With so little data, the models are fairly weak and have difficulty making reasonable predictions.

PFMC
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