The IPHC mortality projection tool for 2022 mortality limits

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PURPOSE

This document provides a description of the IPHC's web-based mortality projection tool (https://www.iphc.int/data/projection-tool) for setting mortality limits in 2022.

BACKGROUND

To support the IPHC's process for setting the 2019 mortality limits, IPHC Secretariat staff developed an interactive tool for the evaluation of alternative Pacific halibut mortality levels based on the coastwide TCEY and the distribution of that mortality among IPHC Regulatory Areas. The tool was updated for use in developing mortality limits for 2020; however, agreements made during AM095 and IM095 led to additional complexity that rendered simple use of the tool challenging.

For the evaluation of 2021 mortality limits, the existing web-based tool was updated to again provide all participants in the process the ability to create alternative projection tables as is necessary for decision making, without having to rely directly on the IPHC Secretariat. Specifically, agreements in place for 2021-022 were included by default in the automatic calculations. No additional changes were made for 2022, beyond updating the data sources and assessment results underlying the tool.

THE MORTALITY PROJECTION TOOL

The tool relies on previously calculated stock assessment outputs representing a broad range of total mortality. These include projections of spawning stock size and fishing intensity, such that alternative harvest levels can be evaluated in the context of the harvest decision table as well as relative trends. The tool is divided into five components:

1) Inputs
2) Summary results
3) Biological distribution
4) Detailed sector mortality information
5) Graphics

A brief description of each of these is provided below.

Inputs

The first section of the tool provides the user with inputs primary information (Figure 1):

1) The total distributed mortality limit (TCEY) in millions of net[1] pounds.
2) The percent of the distributed mortality limit (TCEY) assigned to each IPHC Regulatory Area.

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[1] Net pounds refer to the weight with the head and entrails removed; this is approximately 75% of the round (wet) weight.

The default values loaded into the tool reflect the IPHC's interim management procedure, adjusted for current agreements for 2022 mortality limits and TCEY distribution, as well as an intersessional decision during 2020. The total TCEY is based on the value that produces a projected level of fishing intensity equal to $F_{43\%}$, or the fishing intensity that reduces the spawning output of the stock per recruit to 43% of its unfished level (SPR=43%) given recent recruitment, and current biology (weight at age, maturity, fecundity), allocation among fisheries and selectivity within fisheries. This level of fishing intensity reflects an adjustment made intersessionally (after AM096; IPHC 2020a) to the previous $F_{46\%}$ handrail adopted in 2016, in response to the results from the IPHC's ongoing Management Strategy Evaluation (MSE) process. The MSE results, presented at AM096 (IPHC-2020-AM096-12), found that a management procedure utilizing an $F_{43\%}$ target level of fishing intensity, and a control rule reducing that level of fishing intensity linearly if the relative spawning biomass drops below 30%, to a target value of $F_{100\%}$ (no fishing) if the spawning biomass reaches 20% successfully met the coastwide conservation and fishery objectives.
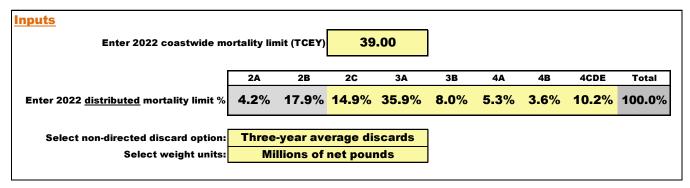
Inputs

Enter 2022 coastwide mortality limit (TCEY)			39.00						

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Enter 2022 <u>distributed</u> mortality limit %	4.2%	17.9%	14.9%	35.9%	8.0%	5.3%	3.6%	10.2%	100.0%

Select non-directed discard option: **Three-year average discards**
Select weight units: **Millions of net pounds**

Figure 1: Example of the "Inputs" section of the mortality projection tool. Cells in yellow are intended to be modified by the user. Note that specific values are for illustration only and do **NOT** correspond to default values for 2022.

The IPHC's interim management procedure also includes a method for distributing the coastwide TCEY among IPHC Regulatory Areas. The distribution method consists of the following steps:

1) Determine the current stock distribution of Pacific halibut greater than 32-inches (82.5 cm, O32) from the modeled survey WPUE and geographic extent of each IPHC Regulatory Area.
2) Assign relative harvest rates of 1.0 to IPHC Regulatory Areas 2A-3A and 0.75 to IPHC Regulatory Areas 3B-4CDE.
3) Generate a target TCEY distribution, as the normalized product (sums to 100%) of steps 1 and 2.

During AM095 (para. 69) two additional steps were adopted by the Commission, to apply to mortality limits for 2019-2022:

4) Set the IPHC Regulatory Area 2A TCEY to a value of 1.65.
5) Set the IPHC Regulatory Area 2B target TCEY percentage to a weighted average of 20% (weight = 0.7) and the result of step 3 (weight = 0.3).

6) In order to satisfy the coastwide TCEY as well as steps 4-5, reduce the target TCEY percentages for IPHC Regulatory Areas 2C-4CDE in proportion to the result of step 3.

At IM095 ([Req.03, para. 49](#)) an additional adjustment was added:

7) Remove all non-directed commercial discard ('bycatch') mortality of Pacific halibut less than 26 inches in length (66 cm; U26) occurring in Alaska from the projections.
8) Recalculate the TCEY (using the stock assessment ensemble) that corresponds to the reference fishing intensity (coastwide) and the distribution percentages from step 6.
9) Compare the recalculated TCEYs to those from step 6 to determine the 'yield gained' in IPHC Regulatory Area 2B.

This adjustment was further modified during AM096 ([para. 97](#)):

10) Add 50% the yield gained for IPHC Regulatory Area 2B (step 9) to that from step 6.
11) In order to satisfy the coastwide TCEY as well as steps 6 and 10, reduce the target TCEY percentages for IPHC Regulatory Areas 2C-4CDE in proportion to the result of step 6 (also equivalent to step 3).

The mortality projection tool satisfies these constraints by using the input coastwide TCEY to determine the distributed components. This relies on the inputs described above, as well as a range of pre-calculated yield gained values for 2B due to accounting for U26 non-directed discard mortality (the yield gained depends on the overall level of fishing intensity). Therefore, the distribution percentages for 2A and 2B are shaded grey[2] in the mortality projection tool, and will update to the appropriate percentages if the coastwide TCEY is adjusted. The distribution percentages for IPHC Regulatory Areas 2C-4CDE can be adjusted manually. Although the percentages describing the distribution of the mortality limit are intended to sum to 100%, if they do not the total will be highlighted in red, and 2C-4CDE are automatically rescaled so that the sum of the distributed mortality limits across all IPHC Regulatory Area will exactly match the coastwide total input.

There are two optional inputs, with drop-down menus, specifying:
1) The basis for projecting non-directed discard mortality. The default projection, consistent with the IPHC's Interim Management Procedure (specified during AM096 [para. 97](#)), is to use the three-year average non-directed discard mortality from the most recent year. Alternatives include the previous year's estimates and the values consistent with full regulatory attainment of domestic non-directed discard mortality limits.
2) The units of mortality measurement. This can either be millions of net pounds (default) or net metric pounds.

Summary results

The second section of the tool provides the projected coastwide SPR for comparison with the harvest decision table. In addition, this section reports the distributed mortality limit (TCEY) for each IPHC Regulatory Area; the total can be compared to the total input above to verify that

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[2] Note that the percentages for 2A and 2B can be adjusted manually for comparison of alternative distribution procedures, but the tool must be refreshed to return to automatic calculations that satisfy the Interim Management Procedure.

the calculations are working properly. The total mortality limit (all sizes and sources of mortality, including U26 non-directed discard mortality of Pacific halibut) is also summarized by IPHC Regulatory Area.

Biological and fishery distribution

The third section of the mortality projection tool provides the most current modelled estimates of stock distribution by Biological Region, compared to the distributed mortality limits (TCEY). These two values are then used to project a harvest rate by Region, standardized such that Region 3 (IPHC Regulatory Areas 3A and 3B) is always equal to a value of 1.0 and the other Regions (2, 4 and 4B) are relative to that value.

Detailed sector mortality information

This section provides a full distribution of mortality among IPHC Regulatory Areas and fishery sectors. Calculations are based on catch sharing agreements used by the domestic agencies for IPHC Regulatory Areas 2A, 2B, 2C, 3A, and 4CDE (4CDE allocating among sub-Areas). Static projections are used for non-directed discard mortality (see above), and subsistence mortality (based on the most recent estimates available). Discard mortality in directed fisheries scales with the landings based on the most recently observed rates for each fishery. The total of this section (matching the total in the summary results) provides the best projection of all sizes and sources of Pacific halibut mortality based on the specified mortality limits.

Graphics

The last section of the projection tool provides a series of five graphical results updated to reflect the inputs made by the user. These graphics are similar to those provided in the annual stock assessment and/or presentation material.

The first figure uses previously calculated three-year projections for a range of coastwide TCEY (and corresponding SPR) values to illustrate the coastwide spawning biomass trend associated with the specified inputs to the tool. Uncertainty is shown as a shaded region, with the projected period highlighted by the brighter color relative to the darker estimated time-series. Importantly, not all possible SPR values are available, so the closest value available is reported. The projected SPR is reported above the figure, and a warning will be returned if the user has specified a coastwide TCEY outside of the range of values available, or if the value lies between the pre-calculated grid.

The second figure provides a bar chart of the time-series of estimated relative fishing intensity with 95% confidence intervals. The inputs to the projection tool provide the basis for the projected fishing intensity, shown as the hatched bar at the end of the series. Values are relative to the IPHC's Interim Management procedure, currently based on an SPR of 43% (see description above), such that values above the target ('handrail' from 2016-2020) represent higher fishing intensity.

The third figure provides a graphical display of the relative harvest rates by Biological Region as reported in the ***Biological and fishery distribution*** section.

The fourth and fifth figures provided the detailed sector mortality information (allocations) in both absolute values (millions of net pounds) and relative values (percent of the projected mortality) by IPHC Regulatory Area.

DISCUSSION

There may be some alternatives (e.g., evaluations of alternative relative harvest rates by IPHC Regulatory Area) that will not be possible using this tool. Such alternatives will continue to be produced by the Secretariat staff as needed to support all meetings and decision-making.

UPDATE SCHEDULE

The existing mortality projection tool will be updated in early January 2022, in order to include the final end-of-year 2021 mortality estimates from various fisheries, for use during the 2022 Annual Meeting (AM098).

REFERENCES

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