BIO-SOCIOECONOMIC CONDITIONS INDEX FOR PACIFIC HALIBUT FISHERIES

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PURPOSE

The purpose of this document is to provide details on the construction of the IPHC's bio-socioeconomic conditions index for Pacific halibut fisheries.

This document supplements produced annually by the IPHC *Summary of the data, stock assessment, and harvest decision table for Pacific halibut (Hippoglossus stenolepis).*

INTRODUCTION

The IPHC's bio-socioeconomic conditions index monitors key factors directly related to the economic performance of the Pacific halibut fisheries operations in the Convention waters. It intends to capture trends in relative opportunities at the entire stock level (coastwide scale), as well as for major Pacific halibut-producing regions individually: Alaska, British Columbia, and the USA West Coast (WOC, covering Washington, Oregon, and California).

The index is based on trends in four indicators: fish prices (ex-vessel), fishing cost factors represented here by the average fuel price and wages in the fishing sector,[1] and stock condition represented by the weight per unit of effort (WPUE) of legal-size fish (i.e. O32) derived from the IPHC's Fishery-Independent Setline Survey (FISS). The aggregate index value weights region-specific indicators, specifically their variation from the average over the previous ten years, by Fishery Constant Exploitation Yield (FCEY), as adopted by the Commission at the time for each year and region (see section Index formula for details on index construction). FCEY was chosen as the weighting variable because the index intends to capture opportunities available to the stock users (i.e., fishers), and these are not necessarily equal to realized catch that represents outcome conditional on the behavior of stock users and the incentives they are presented with.

Figure 1 illustrates the evolution of the index over time, covering the period from 2000 to 2021 (black solid line), as well as the contribution of each of the four factors to the formation of the index (colored bars). Dotted bars represent preliminary estimates based on incomplete data (e.g., when the fishing season is still in progress or there is a data publication lag). Note that

[1] Fishing costs are determined by a number of factors besides fuel price and wages. These include vessel maintenance, provisions, government-mandated fees (license fees), and bait. However, the index captures the impact of the two most important cost components for the Pacific halibut fleet that are also subject to the most fluctuations across years. Thus, it should reflect cost-driven shifts in the economic performance of the Pacific halibut fisheries. Given the cost determinants are also adjusted for inflation (see Data sources section), this approach is equivalent to assuming that other factors have been increasing at the same rate as the GDP, that is they have remained constant over time in real terms.

increasing price and WPUE impact the index positively, while cost factors impact the index negatively.[2] The figure also depicts the index derived separately for each region, presenting region-specific trends with no weighting applied (dashed lines).

Because the index is depicted at a relative scale, it does not provide an absolute measure of the bio-socioeconomic conditions in the given fishing season but rather informs on the relative changes from year to year. For example, the index value for 2021 indicates the bio-socioeconomic conditions improved by 37 percentage points when compared with the 2020 fishing season and were 23% above the last 10-year average. This was mainly driven by higher fish prices, and to some degree also lower labor costs. The overall coastwide increase in biomass available (i.e., higher WPUE), because of minimal estimated change, had very little impact on index movement between 2020 and 2021.

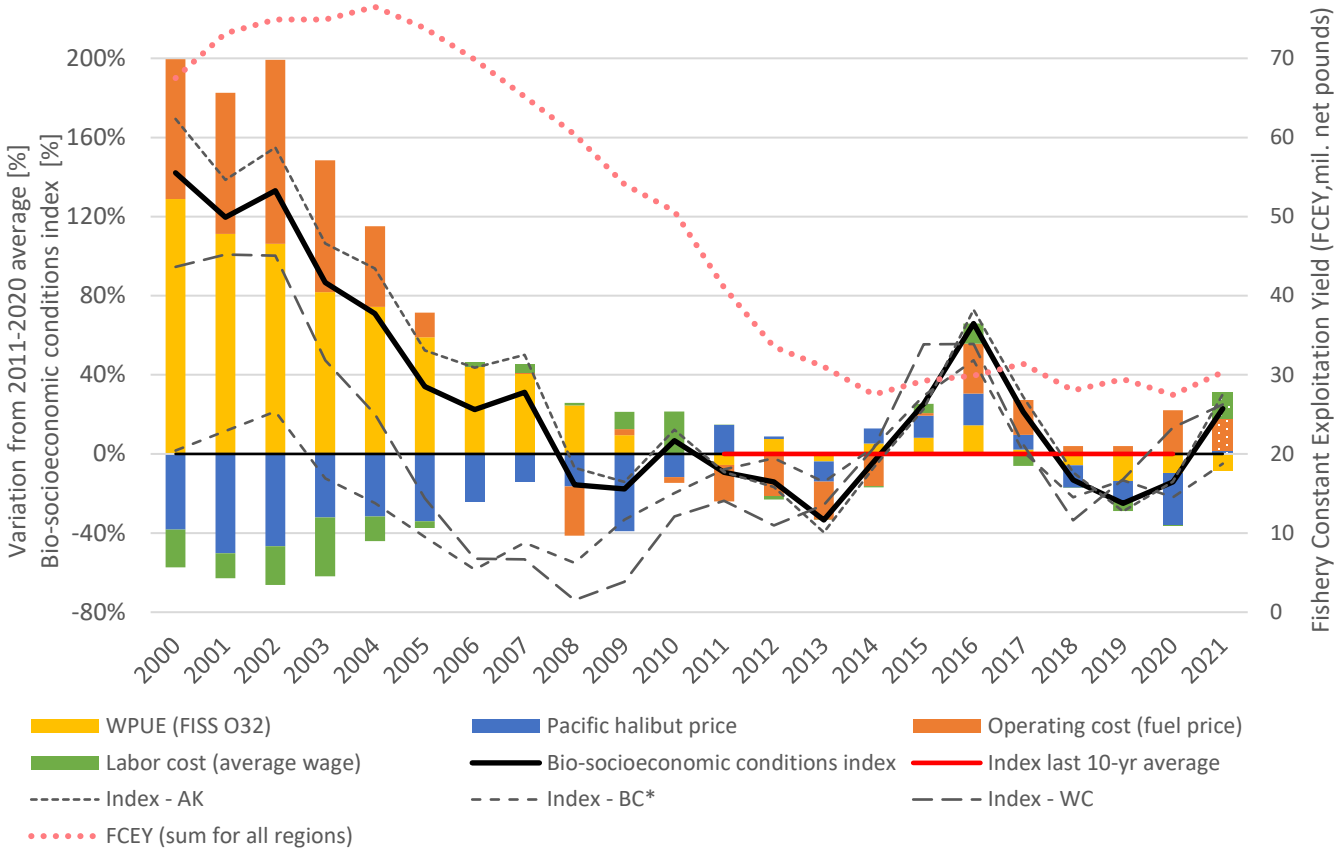
Region-specific index values, in general, follow the coastwide trend, although the change reported for the current (2021) year is mainly driven by the situation in Alaska. The increase for British Columbia is more modest, mainly because of slower price increase. While there are indications that the prices in BC experience a similar surge as these in Alaska and the US West Coast (see, e.g., Fry, 2021), the average price for BC was not available at the time of publication of this document and the index adopts price trend derived from the FISS sales. Thus the 2021 index value for BC should be interpreted cautiously.[3]

While the index intends to capture factors contributing to the economic performance of the Pacific halibut fisheries operations, the figure also depicts the evolution of absolute harvest opportunities represented in the figure by the sum of FCEY for all IPHC Regulatory Areas. The absolute level of opportunity (FCEY) will also affect overall profit, likely because of economies of scale. Economies of scale are cost advantages companies experience when fixed costs can be spread over a larger amount of output.

Note that data for 2021 is preliminary and the final index value is subject to change following the publication of final data for all index components (see details in the section Data sources).

[2] In practice, cost factors are incorporated in the calculation of the index as inverse values. This translates into the use of fuel volume per USD/CAD and labor input per USD/CAD. See details on the index calculation in section Index formula.

[3] The index price component for British Columbia for 2020 and 2021 is based on price trend derived from FISS sales. Pearson correlation coefficient for current prices in BC and AK for the period 2011-2019 (years in the baseline period with all prices available) was 0.26, and for current prices in BC and WOC for the same period, 0.02. Thus the use of trends in other areas was deemed inappropriate.



Stacked columns represent indicators contributing to the formation of the index. Columns above the 0% axis represent indicators being above the last 10-year average, while columns below the 0% axis represent indicators being below the last 10-year average. Index average over the previous ten years (2011-2020) is set to 0%. Dotted bars represent preliminary estimates, based on data reported up to October 2021. * Index value for 2020 and 2021 calculated based on incomplete fish price data for BC. Last two year's trend is approximated from FISS sales data. BC price data for 2020 are anticipated in November/December 2021, with the new release of the report *British Columbia Seafood Industry Year in Review*.

Figure 1: Bio-socioeconomic index for Pacific halibut fisheries (2000-2021).

DATA SOURCES

The bio-socioeconomic conditions index for Pacific halibut fisheries combines into a single value trends in the following four indicators:

(1) FISS WPUE:

a. stock conditions are based on the time series of modeled FISS WPUE of legal-size fish (i.e., O32) reported in net lb/skate by IPHC Regulatory Area (IPHC-2021-IM097-08);

(2) fish prices:

a. AK: Average fish prices for Alaska are available via the Alaska Fisheries Information Network (AKFIN, 2021). Last year's trend is approximated based on available to date (last updated on 19 October 2021) fish tickets data provided through the eLandings reporting system (ADFG, 2021).

b. BC: Average fish prices for British Columbia (2B) are sourced from series *British Columbia Seafood Industry Year in Review* (2014-18, e.g., AgriService BC, 2020) and direct reports to the IPHC (e.g., IPHC-2021-AM097-NR01 includes data for 2019). Prices for 2020 and 2021 are approximated from the trend from FISS sales, using average change in price between 2019 and 2020 or 2021. BC price data for 2020 are anticipated in November/December 2021, with the new release of the report *British Columbia Seafood Industry Year in Review*.
c. WOC: Fish prices for the US West Coast (2A) are based on the data reported by PacFIN (PacFIN, 2021). The current update is based on the data download on October 11, 2021.

(3) average fuel prices:

a. Marine fuel prices for Alaska, Washington, Oregon, and California are compiled by the PSMFC's Fisheries Economics Data Program (PSMFC, 2021). The latest update covers data up to September 2021 (last accessed on October 4, 2021).
b. The cost of fuel for British Columbia was approximated using average monthly retail prices of diesel in Vancouver and Victoria (Statistics Canada, 2021c). The current update covers data up to August 2021 (last accessed Oct 11, 2021).

(4) average wages in the fishing sector:[4]

a. AK: Alaska's labor cost is approximated by average wages in *Fishing, hunting and trapping* sector reported in *Nonresidents working in Alaska* series (2014-19, see Kreiger & Whitney (2021) for the latest report). Change from 2019 to 2020 is approximated using the trend in average wages derived for *Fishing, Hunting and Trapping* sector from the US Bureau of Economic Analysis (BEA), tables BSAEMP25N & SAINC6N (BEA, 2020). Change from 2020 to 2021 is based on the data reported in the Quarterly Census of Employment and Wages for the *Fishing, hunting and trapping* sector (BLS, 2021). The currently reported trend is based on the change in Q1 only (last accessed on October 7, 2021).
b. BC: British Columbia's labor cost is assessed as the average wage in *Fishing, hunting and trapping* sector reported by Statistics Canada (2021a) for 2000-2020. The change from 2020 to 2021 is approximated from the trend in the monthly-reported data for the BC's *Forestry, fishing, mining, quarrying, oil and gas* sector (Statistics Canada, 2021a).
c. WOC: and West Coast labor cost approximated by average wage in *Fishing, hunting and trapping* sector reported by BEA in tables SAINC6N and SAEMP25N (2014-19).
d. Labor cost for the US West Coast is approximated by average wages derived for *Fishing, Hunting and Trapping* sector from the US Bureau of Economic Analysis

[4] We do not need to use labor data specific to the Pacific halibut fishing sector. The more general sector data should reflect well the supply of qualified workers and the resultant wages.

(BEA), tables BSAEMP25N & SAINC6N (BEA, 2020).[5] Change from 2020 to 2021 is based on the data reported in the Quarterly Census of Employment and Wages for the *Fishing, hunting and trapping* sector (BLS, 2021). The currently reported trend is based on the change in Q1 only (last accessed Oct 7, 2021).

All monetary values are adjusted for inflation using the GDP deflator based on data published by the Organisation for Economic Co-operation and Development (OECD, 2021), and are expressed in 2020 USD/CAD.

FCEY by region, as adopted by the Commission at the time for each year and region, is sourced from the IPHC's data table IPHC-2020-TSD-013 (Time Series of Historical Management Information).

INDEX FORMULA

We denote indicators used in the construction of the bio-socioeconomic conditions index for Pacific halibut fisheries in region r ($r \in R$, where R represents the whole set of Pacific halibut-producing regions – AK, BC, and WOC) and year t as follows: b_t^r – modeled O32 WPUE (b for biomass), p_t^r – average Pacific halibut price, f_t^r – inverse of average fuel price, and l_t^r – inverse of average cost of labor in the fishing sector. The region-specific index values (I_t^r) are calculated as:

$$I_t^r = \frac{b_t^r - \bar{b}}{\bar{b}} + \frac{p_t^r - \bar{p}}{\bar{p}} + \frac{f_t^r - \bar{f}}{\bar{f}} + \frac{l_t^r - \bar{l}}{\bar{l}},$$

where variables with bar represent baseline period averages. Here, we have chosen to use the previous 10-year average for the calculation of the most current index update. For all years in the 2021 update, this implies a baseline covering 2011-2020. Note that the index uses a moving average, so future updates of the bio-socioeconomic conditions index for Pacific halibut fisheries will cover a shifting baseline period.

The weighting variable, FCEY, is represented by w_t^r. The aggregated index value for year t (I_t) is derived as follows:

$$I_t = \sum\nolimits_{r \in R} w_t^r \, I_t^r \Big/ \sum\nolimits_{r \in R} w_t^r.$$

[5] Note that this source was not suitable for Alaska because of data gaps for 2001-2002, 2006-2008 and 2018.

Note that the index assumes additivity of the factors contributing to the bio-socioeconomic conditions of the Pacific halibut fisheries and does not apply weighting between these factors. Thus, it would not be directly comparable with an indicator that would seek to trace profitability.[6]

Similar indicators have been used before in tuna fisheries (Ruaia, Gu'urau, & Reid, 2020).

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[6] Profitability in fisheries would be typically expressed as $p \times WPUE - \sum_{i \in I} c_i$, where p represents unit price (USD/CAD per weight unit), WPUE is weight per unit of effort, and c_i $(i \in I)$ represent cost items expressed in USD/CAD per unit of effort.

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