**TSC WReport – IPHC 2023**

Contents

[**I.** **Overview** 1](#_Toc130470096)

[**II.** **Fishery-Independent Setline Survey (FISS)** 2](#_Toc130470097)

[**III.** **Reserves** – N/A 3](#_Toc130470098)

[**IV.** **Review of Groundfish Research, Assessment, and Management** 3](#_Toc130470099)

[**A.** **Pacific halibut and IPHC activities** 3](#_Toc130470100)

[**1.** **Research** 3](#_Toc130470101)

[**2.** **Assessment** 9](#_Toc130470102)

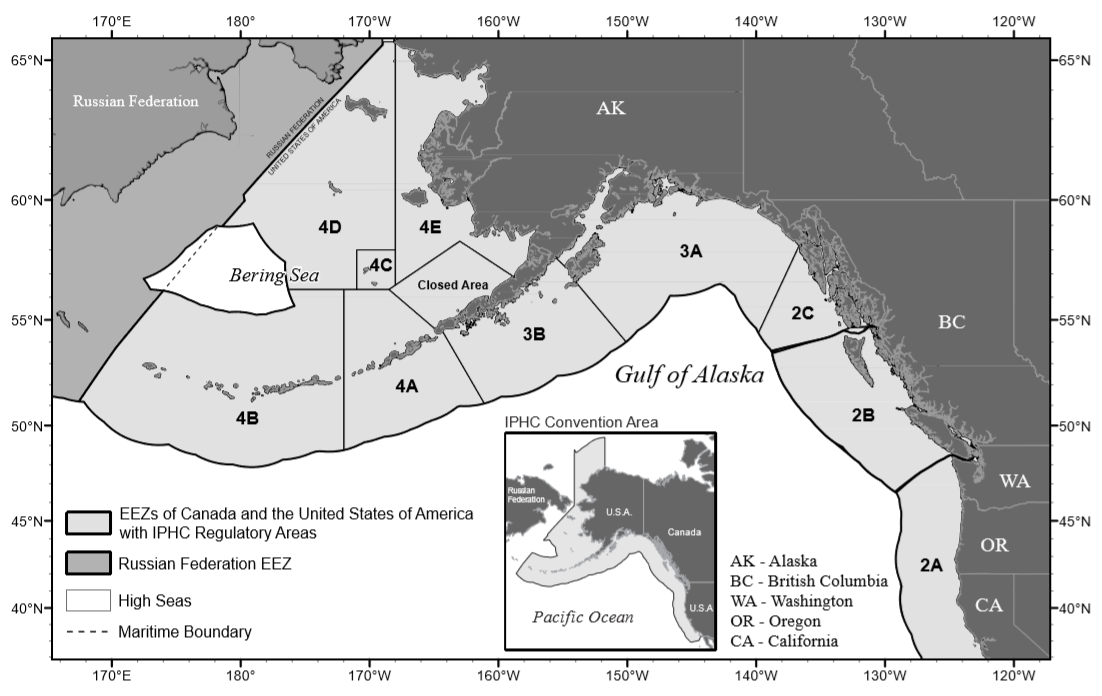
[**3.** **Management** 10](#_Toc130470103)

[**V.** **Ecosystem Studies** 12](#_Toc130470104)

[**VI.** **Publications in 2022** 12](#_Toc130470105)

# **Overview**

Management of the Pacific halibut resource and fishery has been the responsibility of the International Pacific Halibut Commission (IPHC) since its creation in 1923, see [Figure 1](#Fig1) for a map of the IPHC Convention Area. Assessing, forecasting, and managing the resource and fishery requires accurate assessments, continuous monitoring, and research responsive to the needs of managers and stakeholders. The fishery for Pacific halibut (*Hippoglossus stenolepis*) is one of the most valuable and geographically largest in the northeast Pacific Ocean. Industry participants from Canada and the United States of America have prosecuted the modern fishery and have depended upon the resource since the 1880s. Annual removals have been as high as 100 million pounds, and the long-term average of removals is 64 million pounds.



**Figure 1.** Map of the IPHC Convention Area and IPHC Regulatory Areas.

Staffing Updates: see <https://www.iphc.int/locations/map>.

# **Fishery-Independent Setline Survey (FISS)**

The IPHC’s Fishery-Independent Setline Survey (FISS) provides catch information and biological data on Pacific halibut (*Hippoglossus stenolepis)* that are collected independently of the commercial fishery. These data, which are collected using standardized methods, bait and gear during the summer of each calendar year, provide an important comparison with data collected from the commercial fishery. The directed commercial fishery is variable in its gear composition and distribution of fishing effort over time, and presents a broad spatial and temporal sampling of the stock. Pacific halibut biological data collected on the FISS (e.g. the size, age, and sex composition) are used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the Pacific halibut population. In addition, records of non-target species caught during FISS operations provide insight into bait competition, rate of bait attacks, and serve as an index of abundance over time, making them valuable to the assessment, management, and avoidance of non-target species. In addition, oceanographic data is collected at each station (please see section in [Other Ongoing Data Collection Programs](#Ongoing)).

For details on FISS work conducted in 2022, please refer to the following paper [*IPHC Fishery-Independent Setline Survey (FISS) design and implementation in 2022*](https://www.iphc.int/uploads/pdf/am/am099/iphc-2023-am099-08.pdf).

# **Reserves** – N/A

# **Review of Groundfish Research, Assessment, and Management**

## **Pacific halibut and IPHC activities**

### **Research**

The primary biological research activities at IPHC that follow Commission objectives are identified and described in the [IPHC Five-Year Program of Integrated Research and Monitoring (2022-2026)](https://www.iphc.int/uploads/pdf/5yrirm/iphc-2022-5yrirm.pdf).

Overview of research activities in 2022 and planned for 2023

1. Migration and Population Dynamics.

The IPHC Secretariat is currently conducting studies on Pacific halibut juvenile habitat and movement through conventional wire tagging, as well as studies that incorporate genomics approaches in order to produce useful information on population structure, distribution and connectivity of Pacific halibut.

* 1. Estimation of Pacific halibut juvenile habitat. Although it is known that following the pelagic larval phase Pacific halibut begin their demersal stage as approximately 6-month-old juveniles, settling in shallow nursery (settlement) areas, near or outside the mouths of bays (reviewed in Carpi et al., 2021: <https://doi.org/10.1007/s11160-021-09672-w>), very little information is available on the geographic location and physical characteristics of these areas. In order to fill this knowledge gap and set the stage for future studies to further investigate the connectivity between spawning and nursery grounds, the IPHC Secretariat has initiated studies to identify potential settlement areas for juvenile Pacific halibut throughout IPHC Convention Waters. A first objective of this study is to create a map of suitable settlement habitat by combining available bathymetry information (e.g. benthic sediment composition and shoreline morphological data) and information on recorded presence of age-0, age-1 and age-2 Pacific halibut juveniles as well as absence of young Pacific halibut noted by various nursery habitat projects focused on other flatfish species. Data sources are currently being collected.
  2. Wire tagging of sub-legal Pacific halibut. The patterns of movement of Pacific halibut among IPHC Regulatory Areas have important implications for management of the Pacific halibut fishery. The IPHC Secretariat has undertaken a long-term study of the migratory behavior of Pacific halibut through the use of externally visible tags (wire tags) on captured and released fish that must be retrieved and returned by workers in the fishing industry. In 2015, with the goal of gaining additional insight into movement and growth of young Pacific halibut (less than 32 inches [82 cm]; sub-legal), the IPHC began wire-tagging small Pacific halibut encountered on the NOAA Fisheries groundfish trawl survey and, beginning in 2016, on the IPHC fishery-independent setline survey (FISS). In 2022, 1,499 Pacific halibut were tagged and released on the IPHC FISS but no tagging was conducted in the NMFS groundfish trawl surveys. Therefore, a total of 7,610 U32 Pacific halibut have been wire tagged and released on the IPHC FISS to date. Of these, a total of 149 tags have been recovered to date. In the NMFS groundfish trawl surveys through 2019, a total of 6,421 tags have been released and, to date, 78 tags have been recovered.
  3. Population genomics. The primary objective of these studies is to investigate the genetic structure of the Pacific halibut population and to conduct genetic analyses to inform on Pacific halibut movement and distribution within the Convention Area.
     1. Revised assembly of the Pacific halibut genome and characterization of its sex determining region. The IPHC Secretariat has updated the Pacific halibut genome assembly, with an estimated size of 602 Mb, 24 chromosome-length scaffolds that contain 99.8% of the assembly and a N50 scaffold length of 27.3 Mb (Jasonowicz et al., 2022: <https://doi.org/10.1111/1755-0998.13641>). The Pacific halibut whole genome sequencing data are openly available in NCBI at <https://www.ncbi.nlm.nih.gov/bioproject/622249>, under BioProject PRJNA622249, and the updated assembly is openly available in NCBI at <https://www.ncbi.nlm.nih.gov/assembly/GCA_022539355.2/> with GenBank assembly accession number GCA\_022539355.2. This improved genome assembly will increase our ability to resolve Pacific halibut population structure at a fine scale using the proposed approach (Section 1.3.2).

Using the updated genome assembly, genome-wide analyses of sex-specific genetic variation was conducted by mapping reads from male and female pools to the Pacific halibut genome assembly. A potential sex-determining region of approximately 12 Mb was identified in chromosome 9, containing a high density of female-specific SNPs. Within this sex-determining region, we identified among the annotated genes a potential candidate for the master sex-determining gene in Pacific halibut. Mapping of previously identified Pacific halibut RAD-tags associated with sex (Drinan et al., 2018) to the updated Pacific halibut genome assembly resulted in the alignment of 55 of the 56 RAD-tags, all of which mapped to the putative SD region, including the two tags containing the sex-linked markers currently used for genetic sex identification (Section 2.2) (Jasonowicz et al., 2022: <https://doi.org/10.1111/1755-0998.13641>).

* + 1. Studies to resolve the genetic structure of the Pacific halibut population in the Convention Area. With funding from the North Pacific Research Board (NPRB Project No. 2110), the IPHC Secretariat has generated genomic sequences from 610 individual Pacific halibut collected from five spawning groups in different geographic areas (Figure 1) using low-coverage whole-genome resequencing (lcWGR). The lcWGR approach offers a cost-effective way to develop a large number (~millions) of single nucleotide polymorphisms (SNPs) that can be used as genetic markers to evaluate population structure with very high resolution. Using this method, the IPHC Secretariat is working to establish a baseline of genetic diversity using sample collections made during the spawning season and will use this data set to develop genomic tools (i.e. genetic marker panels) that can be applied to conduct mixed stock analysis and identify the population of origin for samples collected outside of the spawning season.

Map

Description automatically generated

**Figure 1**. Map of sample collections made during the spawning season used for genomic analysis of population structure in Pacific halibut in the Northeast Pacific Ocean.

1. Reproduction.

Research activities aim at providing information on key biological processes related to reproduction in Pacific halibut (maturity and fecundity) and to provide sex ratio information of Pacific halibut commercial landings.

* 1. Female maturity and fecundity assessment. Recent sensitivity analyses have shown the importance of changes in maturity schedules and/or due to skip spawning changes in spawning output for stock assessment (Stewart and Hicks, 2018). Information on these key reproductive parameters provides direct input to stock assessment. In order to fill existing knowledge gaps related to the reproductive biology of female Pacific halibut, research efforts are devoted to characterize female maturity and fecundity in this species. Specific objectives of current studies include: 1) histological assessment of the temporal progression of female developmental stages and reproductive phases throughout an entire reproductive cycle; 2) update of maturity schedules based on histological-based data; and, 3) fecundity determinations.
     1. Histological assessment of the temporal progression of female developmental stages and reproductive phases throughout an entire reproductive cycle. The IPHC Secretariat completed in 2022 the first detailed examination of temporal changes in female ovarian developmental stages, reproductive phases, and biological indicators of Pacific halibut reproductive development. The results obtained by ovarian histological examination indicate that female Pacific halibut follow an annual reproductive cycle involving a clear progression of female developmental stages towards spawning within a single year (Fish et al., 2020: <https://doi.org/10.1111/jfb.14551>); Fish et al., 2022: <https://doi.org/10.3389/fmars.2022.801759>).
     2. Update of maturity schedules based on histological-based data. The IPHC Secretariat is undertaking studies to revise maturity schedules in Pacific halibut females through histological (i.e. microscopic) characterization of maturity based on studies described in 2.1.1. The maturity schedule that is currently used in stock assessment was based on past visual (i.e. macroscopic) maturity classifications in the field (FISS). The IPHC Secretariat collected ovarian samples for histology in the 2022 FISS coastwide (June to August). Ovarian samples have been processed for histology and are currently being analyzed. A comparison between macroscopic and histological maturity classification criteria will be established.
     3. Fecundity estimations. An important existing knowledge gap regarding the reproductive biology of Pacific halibut is the current lack of understanding of fecundity-at-age and fecundity-at-size. Information on these two parameters could be used to replace spawning biomass with egg output as the metric of reproductive capability in the stock assessment and management reference points. For this purpose, the IPHC Secretariat is planning gonadal sample collections during the 2023 FISS for fecundity estimations using the auto-diametric method (Witthames et al., 2009).
  2. Sex ratio of the commercial landings. The IPHC Secretariat has completed five consecutive years of sex ratio data of aged commercial landings (2017-2021) by genotyping and is currently processing samples from 2022.

1. Mortality and Survival Assessment. Information on all Pacific halibut removals is integrated by the IPHC Secretariat, providing annual estimates of total mortality from all sources for its stock assessment. Bycatch and wastage of Pacific halibut, as defined by the incidental catch of fish in non-target fisheries and by the mortality that occurs in the directed fishery (i.e. fish discarded for sublegal size or for regulatory reasons), respectively, represent sources of mortality that can result in significant reductions in exploitable yield in the directed fishery. Given that the incidental mortality from the commercial Pacific halibut fisheries and bycatch fisheries is included as part of the total removals that are accounted for in stock assessment, changes in the estimates of incidental mortality will influence the output of the stock assessment and, consequently, the catch levels of the directed fishery. For this reason, the IPHC Secretariat is conducting investigations on the effects of capture and release on survival and on providing experimentally-derived estimates of discard mortality rates (DMRs) in the directed longline and guided recreational Pacific halibut fisheries.
   1. Evaluation of the effects of hook release techniques on injury levels and association with the physiological condition and survival of longline-caught Pacific halibut. The IPHC Secretariat, with funding by a grant from the Saltonstall-Kennedy Grant Program NOAA (NA17NMF4270240; 2017-2020), has conducted studies to evaluate the effects of hook release techniques on injury levels, their association with the physiological condition of captured Pacific halibut and, importantly, has generated experimentally-derived estimates of DMR in the directed longline fishery. Results on individual survival outcomes for Pacific halibut released in excellent viability condition indicate a minimum DMR of 4.2%, that is consistent with the currently-applied DMR value of 3.5% (Loher et al., 2022a: [https://doi.org/10.1002/nafm.10711](https://afspubs.onlinelibrary.wiley.com/doi/abs/10.1002/nafm.10711)).
   2. Discard mortality rates of Pacific halibut in the charter recreational fishery. The IPHC Secretariat is conducting a research project to better characterize the nature of charter recreational fisheries with the ultimate goal of providing direct estimates of DMRs in this fishery and to better understand discard practices relative to that which is employed in the directed longline fishery. This project has received funding from the National Fish and Wildlife Foundation (NFWF Project No. 61484) and the North Pacific Research Board (NPRB Project No. 2009). Based on the use of sPAT tags, experimentally-derived estimates of discard mortality from the charter recreational fishery point towards a 1.35% (95% CI 0.00-3.95%) discard mortality rate for Pacific halibut released in excellent viability category captured and released from circle hooks. The levels in the blood of stress parameters (cortisol, glucose and lactate) did not vary by release viability but appeared to increase with fight time, suggestive of a positive relationship between stress levels and fight time in recreationally captured Pacific halibut. Analysis of diurnal activity patterns, focusing on the periods shortly after capture and release, is being conducted to identify typical patterns in activity as fish recover from the capture and release event.
2. Fishing Technology. The IPHC Secretariat is conducting studies on the development and application of methods and tools to reduce Pacific halibut bycatch and mortality.
   1. Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries. Removal of captured fish from fishing gear (known as depredation) is a growing problem among many hook-and-line fisheries worldwide. In the north Pacific Ocean, both Killer (*Orcinus orca*) and Sperm (*Physeter macrocephalus*) whales are involved in depredation behavior in Pacific halibut, sablefish, and Greenland turbot longline fisheries. The IPHC Secretariat, with funding from NOAA’s Bycatch Research and Engineering Program (BREP), is investigating gear-based approaches to protect longline catches from whale depredation. Current efforts are devoted to testing the functionality and catch characteristics of two different catch protection designs: A) an underwater shuttle design consisting in an aluminum frame that is set with the gear that secures the fish inside during hauling, and B) a branch gear with a sliding shroud system. Field testing of the two designs to investigate the logistics and efficacy of setting, fishing and hauling is planned for early summer 2023.

Other ongoing data collection projects

In addition to specific research projects, the IPHC collects data each year through ongoing data collection projects that are funded separately, either as part of the FISS or as part of the directed commercial fishery data collection program. Ongoing data collections projects include the following:

*IPHC Secretariat aboard NOAA Fisheries groundfish trawl surveys in the Gulf of Alaska, Bering Sea and Aleutian Islands*

The National Oceanic and Atmospheric Administration (NOAA) Fisheries has conducted annual bottom trawl surveys on the eastern Bering Sea continental shelf since 1979 and the IPHC has participated in the survey on an annual basis since 1998 by directly sampling Pacific halibut from trawl survey catches. The IPHC has participated in the NOAA Fisheries Aleutian Islands trawl survey, which takes place every two years, since 2012. Alternating year by year with the Aleutian Islands trawl survey is the NOAA Fisheries Gulf of Alaska trawl survey, which IPHC has participated in since 1996. The IPHC uses the NOAA Fisheries trawl surveys to collect information on Pacific halibut that are not yet vulnerable to the gear used for the IPHC FISS or directed commercial fishery, and as an additional data source and verification tool for stock analysis. In addition, trawl survey information is useful as a forecasting tool for cohorts approaching recruitment into the FISS or directed commercial fishery.

*Sampling of directed commercial landings*

The IPHC positions Secretariat to sample the directed commercial landings for Pacific halibut in Alaska, British Columbia, Washington, and Oregon. Sampling of commercial landings involves collecting Pacific halibut otoliths, tissue samples (fin clips) for genetic sexing, fork lengths, weights, logbook information, and final landing weights.

The collected data are used in the stock assessment and other research. The collected otoliths provide age composition data and the tissue samples provide sex composition. Lengths and weight data, in combination with age data and sex data, provide size-at-age analyses by sex. Mean weights are combined with final landing weights to estimate catch in numbers. Logbook information provides weight per unit effort data, fishing location for the landed weight, and data for research projects. Finally, tags are collected to provide information on migration, exploitation rates, and natural mortality.

In addition to sampling the catch, other objectives include collecting recovered tags, and copying information from fishing logs along with the respective landed weights, for as many Pacific halibut trips as possible throughout the entire season.

*Environmental data collection in the IPHC FISS*

Since 2009, the IPHC has been collecting environmental data as water column profiles in each station sampled as part of the IPHC FISS. The data collected includes surface to depth profiles of pressure (depth), temperature, conductivity (salinity), dissolved oxygen, pH, and chlorophyl a concentration. From from 2009 until 2022, collected environmental data, related metadata and maps of profiled FISS stations are publicly available on the IPHC website (<https://www.iphc.int/datatest/data/water-column-profiler-data>).

### **Assessment**

The 2022 stock assessment produced the following scientific advice regarding the Pacific halibut stock:

***Sources of mortality****: In 2022, total Pacific halibut mortality due to fishing increased to 39.69 million pounds (18,003 t), above the 5-year average of 38.10 million pounds (17,284 t). Of that total, 85% comprised the retained catch, down from 87% in 2021.*

***Fishing intensity****: The 2022 fishing mortality corresponded to a point estimate of Spawning Potential Ratio (SPR) = 51%; there is a 27% chance that fishing intensity exceeded the IPHC’s current reference level of F43%. The Commission does not currently have a coastwide fishing intensity limit reference point.*

***Stock status*** *(spawning biomass): Current (beginning of 2023) female spawning biomass is estimated to be 192 million pounds (87,058 t), which corresponds to an 25% chance of being below the IPHC trigger reference point of SB30%, and less than a 1% chance of being below the IPHC limit reference point of SB20%. The stock is estimated to have declined by 16% since 2016 but is currently at 42% of the unfished state. Therefore, the stock is considered to be ‘not overfished’. Projections indicate that mortality consistent with the interim management procedure reference fishing intensity (F43%) is very likely to result in further declining biomass levels in the near future.*

***Stock distribution****: After increases in 2020-2021, the proportion of the coastwide stock represented by Biological Region 3 has decreased sharply in 2022,. This trend occurs in tandem with increases in Biological Regions 2, 4 and 4B; however, all regions remain within the historical range observed from 1993-2021.*

***Outlook****: The projections for this assessment are much more optimistic than those from recent assessments due to the increase in the estimated productivity of the stock resulting from 3/4 rather than 2/4 models estimating natural mortality at much higher values than the historical fixed assumption of 0.15. Further, the trend in spawning biomass is estimated to have stabilized as the 2012 year-class continues to mature. This translates to a lower probability of stock decline at higher yields for 2023 than in recent assessments as well as a decrease in this probability through 2024-26. There is greater than a 50% probability of stock decline in 2024 (53-86/100) for all yields greater than the status quo, including the entire range of SPR values from 40-46%. The 2023 “3-year surplus” alternative, corresponds to a Total Constant Exploitation Yield (TCEY) of 43.0 million pounds 19,504 t), and a projected SPR of 48% (credible interval 28-62%). At the reference level (a projected SPR of 43%), the probability of spawning biomass decline from 2023 to 2024 is 75%, decreasing to 71% in three years. The one-year risk of the stock dropping below SB30% is 25% across all alternatives.*

For more information on the 2022 stock assessment and the fishery status, please refer to paper [IPHC-2023-AM099-11](https://www.iphc.int/uploads/pdf/am/am099/iphc-2023-am099-11.pdf) at the IPHC website.

### **Management**

The IPHC completed the 99th Session of the IPHC Annual Meeting (AM099) on 27 January 2023 with decisions on total mortality limits, fishery limits, fishing period dates, and other fishery regulation changes. A total of 134 members of the public attended the Session.

Meeting documents, presentations, recordings of the sessions, and the report of the meeting are available on the AM099 meeting page at the IPHC website: [99th Session of the IPHC Annual Meeting (AM099)](https://www.iphc.int/venues/details/99th-session-of-the-iphc-annual-meeting-am099). Decisions arising from this meeting, including management decisions, are documented in the following report: [Report of the 99th Session of the IPHC Annual Meeting (AM099)](https://www.iphc.int/uploads/pdf/am/am099/iphc-2023-am099-r.pdf).

*Mortality limits*

Mortality limits adopted for 2023 added up to a 10.3% decrease in comparison with the last year ([Table 1](#tab1)). The adopted mortality limits for 2023 correspond to a 38% probability of stock decline through 2024, and a 36% probability of stock decline through 2026

Table 1. Mortality limits for 2022 and 2023.

|  |  |  |  |
| --- | --- | --- | --- |
| **IPHC Regulatory Area** | **2022 TCEY (Mlbs)** | **2023 TCEY (Mlbs)** | **Change** |
| USA: 2A | 1.65 | 1.65 | - |
| Canada: 2B | 7.56 | 6.78 | -10.3% |
| USA: 2C | 5.91 | 5.85 | -1.0% |
| USA: 3A | 14.55 | 12.08 | -17.0% |
| USA: 3B | 3.90 | 3.67 | -5.9% |
| USA: 4A | 2.10 | 1.73 | -17.6% |
| USA: 4B | 1.45 | 1.36 | -6.2% |
| USA: 4CDE | 4.10 | 3.85 | -6.1% |
| **IPHC Convention Area** | **41.22** | **39.97** | **-10.3%** |

Other Actions

*Management Strategy Evaluation:* <https://www.iphc.int/the-commission/harvest-strategy-policy>

The IPHC continued to improve the Management Strategy Evaluation (MSE) framework throughout the 2022. The development of the MSE framework supports the evaluation of the trade-offs between fisheries management scenarios.

The MSE framework was updated to accommodate any size limit and produce meaningful outputs of directed commercial discard mortality. The removal of a size limit resulted in a 3.7% increase, on average, in the short-term median coastwide TCEY and a 2.7% increase, on average, in the long-term median coastwide TCEY. A majority of that increase occurs when reducing the size limit for directed commercial fisheries to 26 inches. Even though a gain in overall yield is likely, reducing the size limit for the directed commercial fishery would likely result in a decline in directed commercial landings of O32 Pacific halibut while U32 landings would likely increase, which is dependent on population characteristics such as incoming recruitment and size-at-age. Without a size limit for the directed commercial fishery, short-term directed commercial fishery discard mortality would decline by, on average, 80% coastwide and between 67% to 89% across IPHC Regulatory Areas.

An important concept to bring into the evaluation of size limits is market considerations. The MSE framework applied the concept of the Equal Value Price Ratio (EVPR). The EVPR indicates the percentage the price for U32 fish compared to the price of O32 fish must be for the Pacific halibut fishery to have the same value as with a 32-inch size limit. The short-term Equal Value Price Ratio (EVPR) shows a median near 0.5 for both comparisons of no size limit to the current size limit and a 26-inch size limit compared to the current size limit. It is unknown what prices will be for U32 Pacific halibut if a size limit was removed, but the FISS has recently begun selling U32 fish, which may be an indicator for the potential price of small fish. This empirical price ratio was near 88% in 2022.

The MSE framework was also expanded to accommodate multi-year stock assessments. The mortality limits in a year with the stock assessment can be determined as in previously defined management procedures, but in years without a stock assessment, the mortality limits would need an alternative approach. The IPHC Secretariat investigated three empirical rules for determining IPHC Regulatory Area-specific TCEYs in non-assessment years, which either use no observations or FISS observations:

1. The same TCEY from the previous year for each IPHC Regulatory Area.
2. Updating the coastwide TCEY proportionally to the change in the coastwide FISS O32 WPUE and updating the distribution of the TCEY using FISS results and the applied distribution procedure.
3. Maiintaining the same coastwide TCEY as the previous year but updating the distribution of the TCEY using FISS results and the applied distribution procedure.

# **Ecosystem Studies**

[See details in the Research section on ongoing IPHC data collection projects above.]

# **Publications in 2022**

Adams GD, Holsman KK, Barbeaux SJ, Dorn MW, Ianelli JN, Spies I, Stewart IJ, and Punt AE. 2022. An ensemble approach to understand predation mortality for groundfish in the Gulf of Alaska. *Fisheries Research* 251: 106303, <https://doi.org/10.1016/j.fishres.2022.106303>.

Fish, T., Wolf, N., Smeltz, T.S., Harris, B.P., Planas, J.V. 2022. Reproductive biology of female Pacific halibut (Hippoglossus stenolepis) in the Gulf of Alaska. *Frontiers in Marine Science*. 9: 801759, [https://doi.org/10.3389/fmars.2022.801759](https://www.frontiersin.org/articles/10.3389/fmars.2022.801759/abstract).

Good TP, Jannot JE, Somers KA, Ward EJ. 2022 Using Bayesian time series models to estimate bycatch of an endangered albatross. *Fisheries Research* 256: 106492, <https://doi.org/10.1016/j.fishres.2022.106492>.

Hutniczak B. 2022. Assessing cross-regional flows of economic benefits: A case study of Pacific halibut commercial fishing in Alaska, *Fisheries Research* 255: 106449, <https://doi.org/10.1016/j.fishres.2022.106449>.

Hutniczak B. 2022 Efficient updating of regional supply and use tables with the national-level statistics, *Journal of Economic Structures* 11: 16, <https://doi.org/10.1186/s40008-022-00274-8>.

Jasonowicz, A.J., Simeon, A:, Zahm, M., Cabau, C., Klopp, C., Roques, C., Iampietro, C., Lluch, J., Donnadieu, C., Drinan, D., Hauser, L., Guiguen, Y., Planas, J. V. 2022. Generation of a chromosome-level genome assembly for Pacific halibut (Hippoglossus stenolepis) and characterization of its sex determining region. *Molecular Ecology Resources*. 22: 2685-2700. DOI: <https://doi.org/10.1111/1755-0998.13641>.

Loher, T., Dykstra, C.L., Hicks, A.C., Stewart, I.J., Wolf, N., Harris, B.P. and Planas, J.V. 2022a. Estimation of Postrelease Longline Mortality in Pacific Halibut Using Acceleration-Logging Tags. *North American Journal of Fisheries Management*. 42: 37-49. [https://doi.org/10.1002/nafm.10711](https://doi.org/10.1002/nafm.10711%20)

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Executive Director Date