TSC Agency Reports – IPHC 2019

Contents

I. Agency 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. 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.

Staffing Updates: In addition to some standard turnover seen in the field (port and sea sampling) seasonal positions, the following transitions occurred in 2018 and early 2019:

Name	Position	Start Date	End Date
Jamie Goen	Fisheries Statistics and Services Branch Manager		April 2018
Lara Erikson	Fisheries Statistics and Services Branch Manager	August 2018	
Caroline Robinson	Fisheries Data Specialist (2A, Recreational, Subsistence, & Data Entry)	June 2018	
Ed Henry	Fisheries Data Specialist (Bycatch)	July 2018	
Huyen Tran	Fisheries Data Manager		November 2018
Colin Jones	Setline Survey Specialist (Gear and Bait)	January 2019	

II. Surveys

BACKGROUND

The International Pacific Halibut Commission's (IPHC's) fishery-independent setline survey (FISS or setline survey) 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 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.

The IPHC has conducted the FISS in selected areas during most years since 1963 (with a break from 1987 to 1992). Historical information regarding previous FISS operations has been presented in IPHC Annual Reports and FISS Manuals; IPHC Report of Assessment and Research Activities documents 1993-2017; and IPHC Technical Reports 18 and 58. The majority of the current FISS station design and sampling protocols have been standardized since 1998.

FISHERY-INDEPENDENT SETLINE SURVEY (FISS) DESIGN AND PROCEDURES

In summary, the 2018 FISS chartered 13 commercial longline vessels (four (4) Canadian and nine (9) USA) during a combined 88 trips and 806 charter days. Fishing vessels are chosen through a competitive bid process each year where up to 3 regions per vessel are awarded and 10-15 vessels are chosen. All 1,496 stations planned for the 2018 FISS season were either scouted or completed. Of these stations, 1,458 (97%) were effectively completed. A total of 13,290 otoliths were collected coastwide. Approximately 818,246 pounds (371 t) of Pacific halibut, 85,716 pounds (39 t) of Pacific cod, and 51,337 pounds (23 t) of rockfish were landed from the FISS stations.

Design

The IPHC's FISS design encompasses nearshore and offshore waters of the IPHC Convention Area (Figure 1a). The current FISS station layout has been in place since 1998 (with some additions in 2006 (Bering Sea), and in 2011 (IPHC Regulatory Area 2A)).

The IPHC Regulatory Areas are divided into 32 regions, each requiring between 10 and 46 charter days to survey. FISS stations were located at the intersections of a 10 nmi by 10 nmi square grid within the depth range occupied by Pacific halibut during summer months (20-275 fm [37-503 m] in most IPHC Regulatory Areas). Figure 1b depicts the FISS station positions, charter region divisions, and IPHC Regulatory Areas surveyed.

The current standard grid (SG) station layout has been in place since 1998, with the addition of stations around the Pribilof Islands and St. Matthew Island beginning in 2006 and twelve stations in the Washington/Oregon charter regions beginning in 2011. Thirteen extra stations (ES) in southeast Alaska and eight rockfish (*Sebastes spp*.) index (RI) stations in the Washington charter

region are fished on a different layout than the FISS and are not included in the IPHC stock assessment dataset.

Eight (8) skates were set in IPHC Regulatory Area 2A and in IPHC Regulatory Area 4CDE. IPHC Regulatory Areas 2B, 2C, 4A and 4B had seven (7) skates of baited gear set at each FISS station in all charter regions. FISS specifications for gear, setting schedule, and soak time have been consistent since 1998. FISS gear consists of fixed-hook, 1,800-foot (549 m) skates with 100 16/0 circle hooks baited with 0.25 to 0.33 pounds (0.11 to 0.15 kg) of chum salmon (*Oncorhynchus keta*) and spaced 18 feet (5.5 m) apart. Gangion length ranges from 24 to 48 inches (61 cm to 122 cm). Each vessel sets one to four stations daily beginning at or after 0500 AM, and soaks the gear at least five hours before hauling. Vessels avoided soaking the gear at night, when possible. Data from gear soaked longer than 24 hours were not used for stock assessment purposes.

Sets were considered ineffective for stock assessment if predetermined limits for lost gear, snarls, depredation, or displacement from station coordinates were exceeded. The fork lengths of all Pacific halibut captured at FISS stations were recorded to the nearest centimeter and all lengths stated hereafter will be fork lengths. Each length was converted to an estimated weight using a standard formula, and these weights were then used to generate the weight per unit effort (WPUE) data. Average WPUE, expressed as net pounds per skate, was calculated by dividing the estimated catch in pounds (net weight) of Pacific halibut equal to or over 32 inches (81.3 cm; O32 Pacific halibut) in length by the number of skates hauled for each station, and averaging these values by area (statistical, charter, or IPHC Regulatory Area).

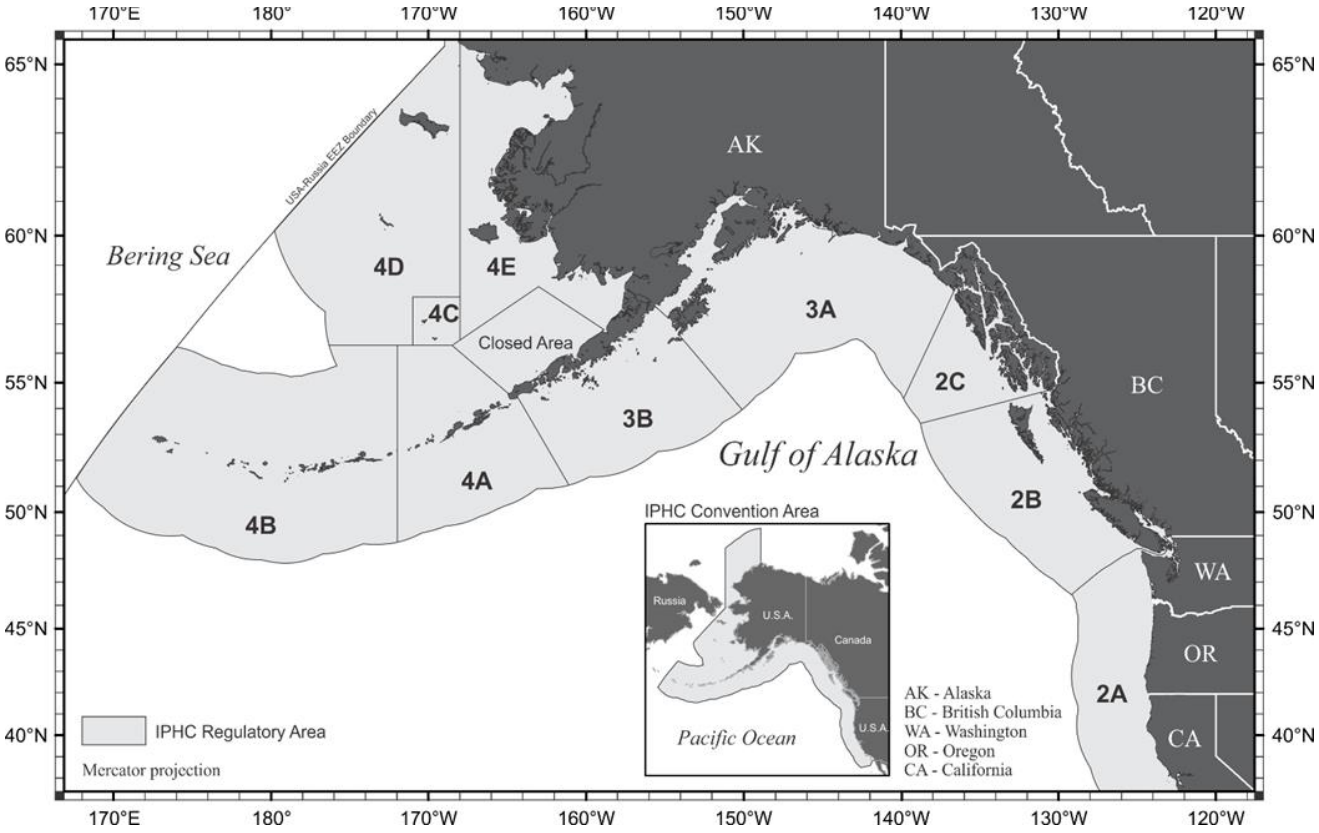

Figure 1a. Map of the IPHC Convention Area and IPHC Regulatory Areas.

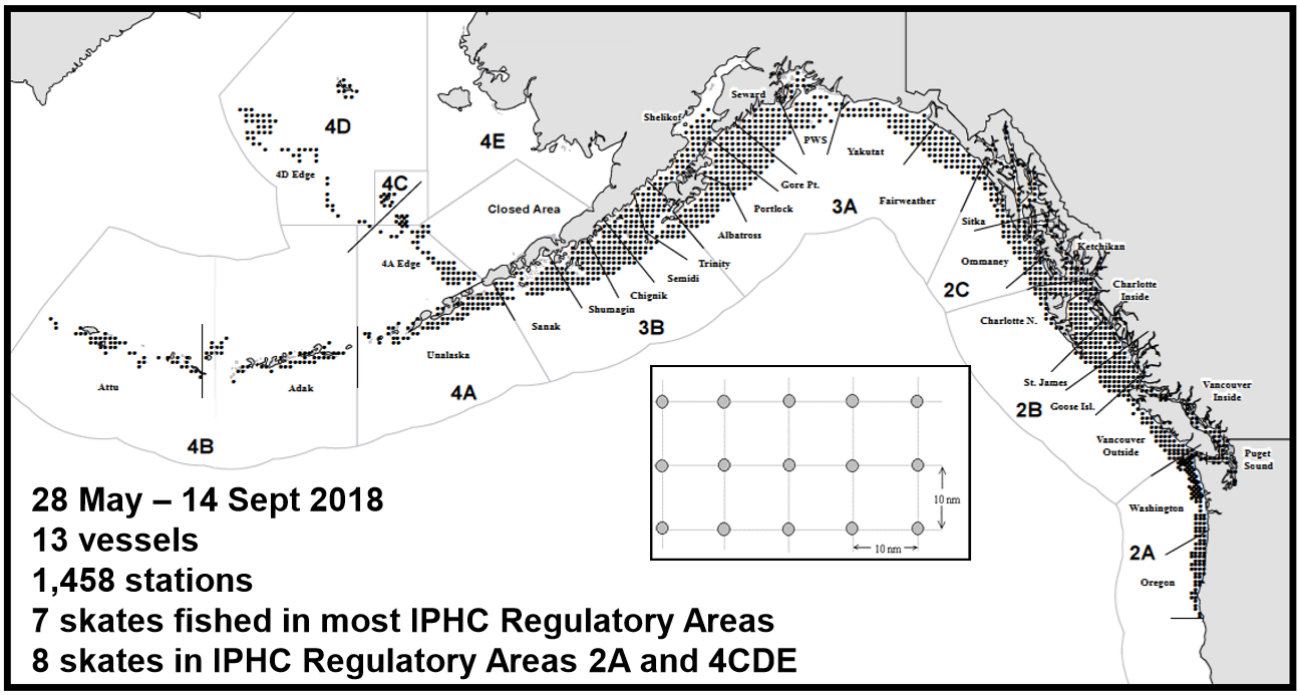

Figure 1b. 2018 IPHC fishery-independent setline survey station positions, charter region divisions, and IPHC Regulatory Areas.

FISHERY-INDEPENDENT SETLINE SURVEY (FISS) EXPANSION STATIONS

Since 2014, the IPHC has been sampling expansion FISS stations in one or two IPHC Regulatory Areas each year (Figure 2). Commercial fishery data and other sources have shown the presence of Pacific halibut down to depths of 732 m (400 fm) and in waters shallower than 37 m (20 fm). Further, most IPHC Regulatory Areas have substantial gaps in station coverage within the standard 37-503 m depth range. The incomplete coverage of Pacific halibut habitat by the FISS could potentially lead to biased estimates of the weight per unit effort (WPUE) and numbers per unit effort (NPUE) when used in the density indices for stock assessment modelling and for stock distribution estimation. For this reason, the IPHC has been undertaking a sequence of expansions since 2014 (following a 2011 pilot), with FISS stations added to the standard grid to cover habitat not previously sampled.

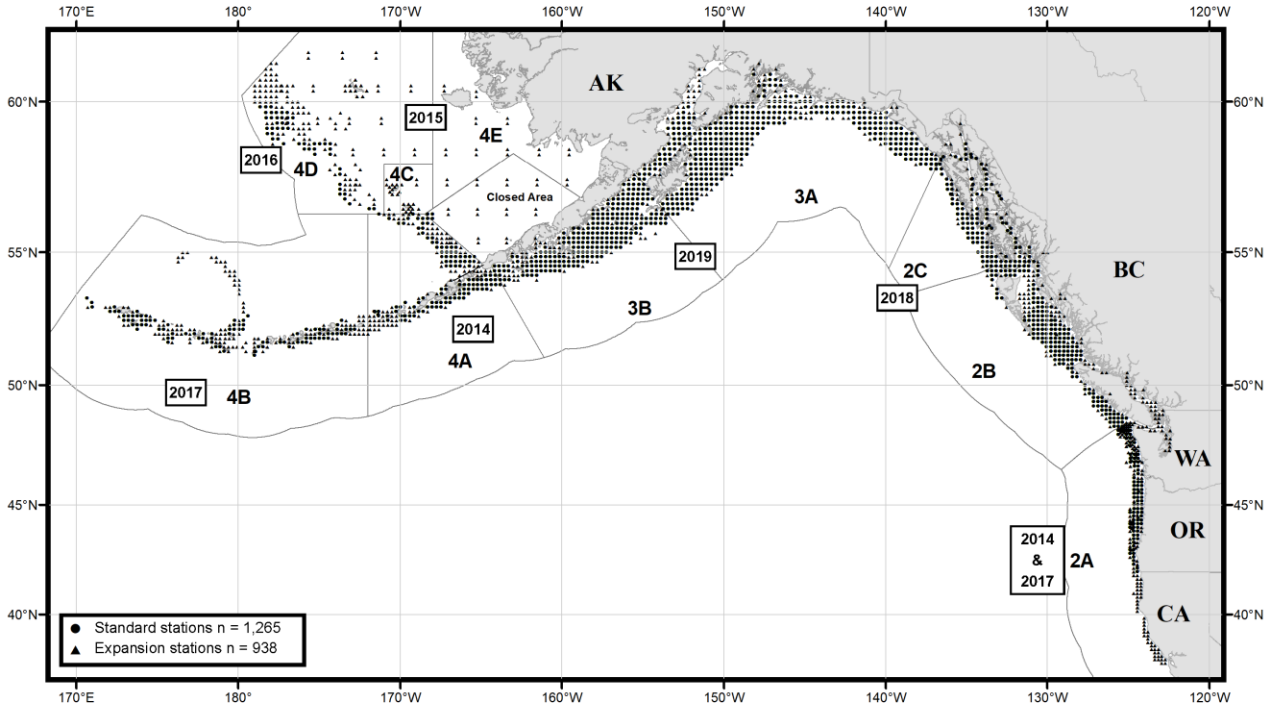

Figure 2. IPHC fishery-independent setline survey (FISS) and expansion stations planned (2014-19).

2018 FISS Expansion in IPHC Regulatory Area 2A

The expansion stations in the Puget Sound charter region were fished to allow for a contiguous survey in the Salish Sea in conjunction with expansion work in IPHC Regulatory Area 2B. In addition, an ad-hoc densified grid off the north Washington coast was fished for the second time. A total of 144 stations were surveyed, of which 14 were expansion stations and 26 were the ad-hoc densified grid stations off the north Washington coast (Figure 3).

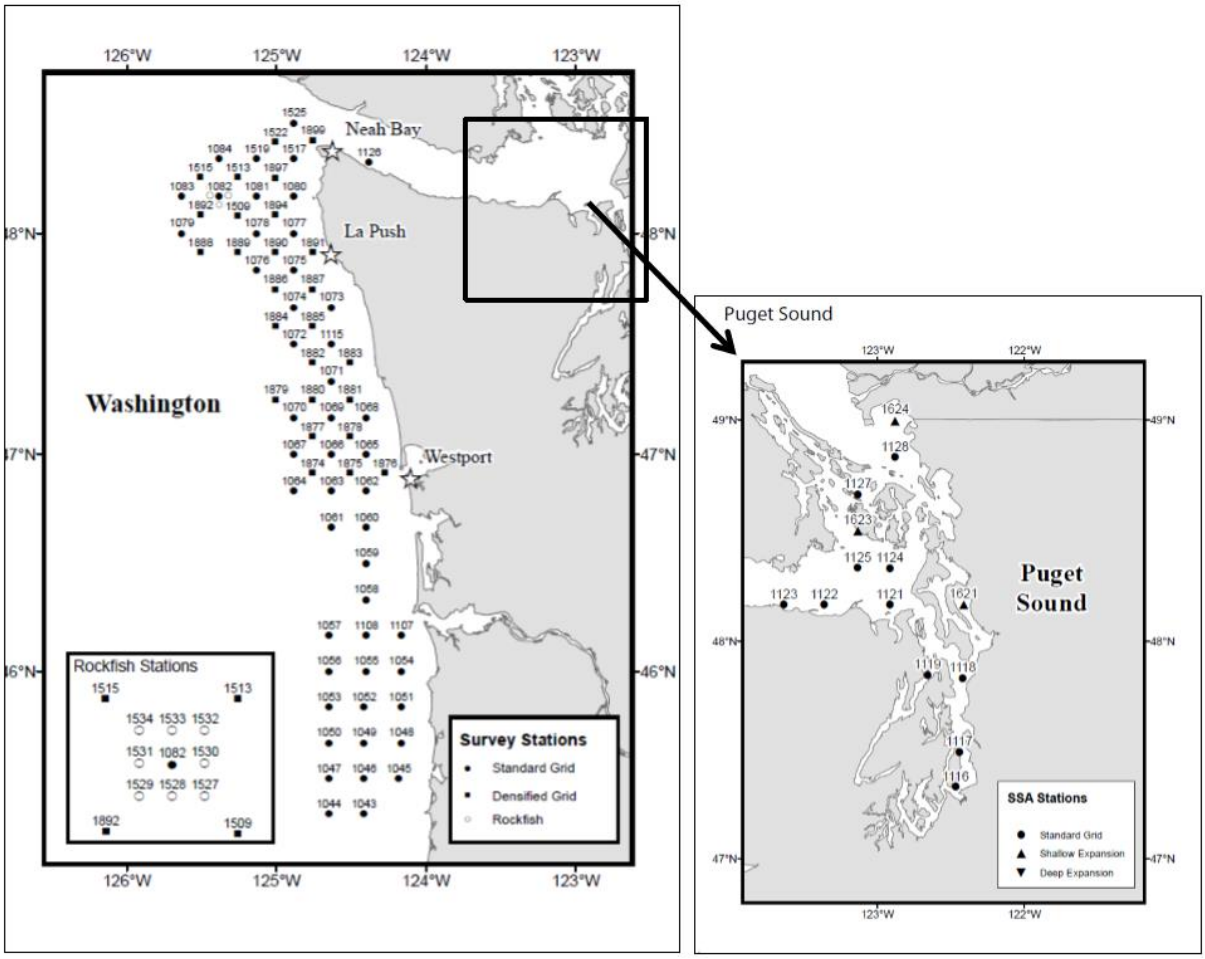

Figure 3. 2018 IPHC fishery-independent setline survey stations in IPHC Regulatory Area 2A with charter regions.

2018 FISS Expansion in IPHC Regulatory Area 2B

The expansion in IPHC Regulatory Area 2B included an additional 136 new stations (129 expansion and seven extra) that were added to the existing 166 FISS stations (standard) in IPHC Regulatory Area 2B. These included stations as shallow as 17 m (9 fm) and as deep as 732 m (399 fathoms (732 m) (Figure 4). To help manage this expansion, the historical Charlotte and Vancouver charter regions were divided into four new regions identified as Charlotte Inside, Charlotte North, Vancouver Inside and Vancouver Outside (Table 1).

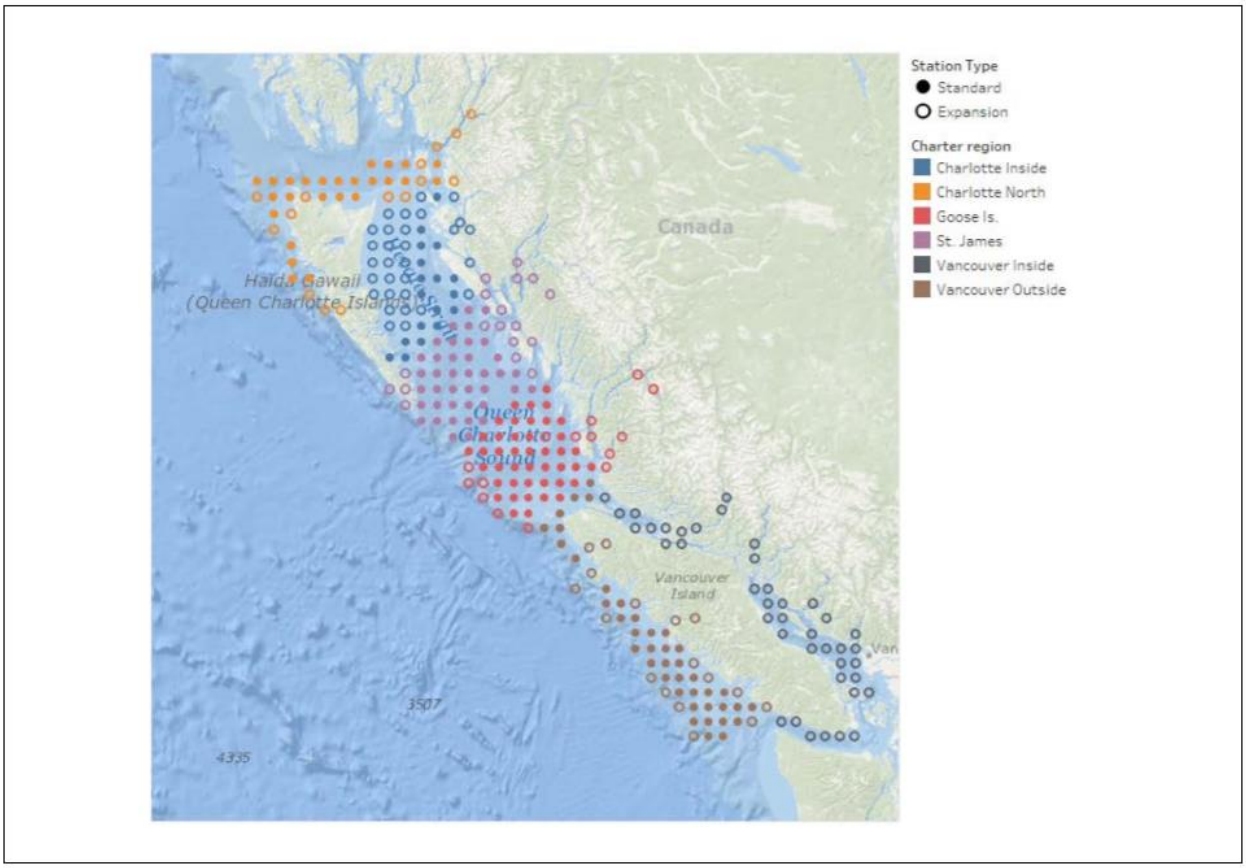

Figure 4. 2018 IPHC FISS stations in IPHC Regulatory Area 2B with charter regions.

Table 1. IPHC Regulatory Area 2B FISS charter regions and count by station type.

Charter Region	Total Stations	Expansion	Extra[2]	Standard
Charlotte Inside	48	29	1	18
Charlotte North	40	14	1	25
Goose Islands	58	14	1	43
St. James	57	18	0	39
Vancouver Inside	41	39	2	0
Vancouver Outside	58	15	2	41
Total	302[1]	129	7	166

[1] six stations were not permitted because of habitat closures.
[2] extra stations are added between grid stations that are far apart from each other, typically up fjords and channels.

2018 FISS Expansion in IPHC Regulatory Area 2C

The expansion in IPHC Regulatory Area 2C included 121 of the existing FISS stations (standard) with an additional 44 new stations (40 expansion and four extra), including stations as shallow as 17 m (9 fm) and as deep as 797 m (436 fm) (Figure 5). The expansion stations were divided into the existing FISS charter regions (Table 2).

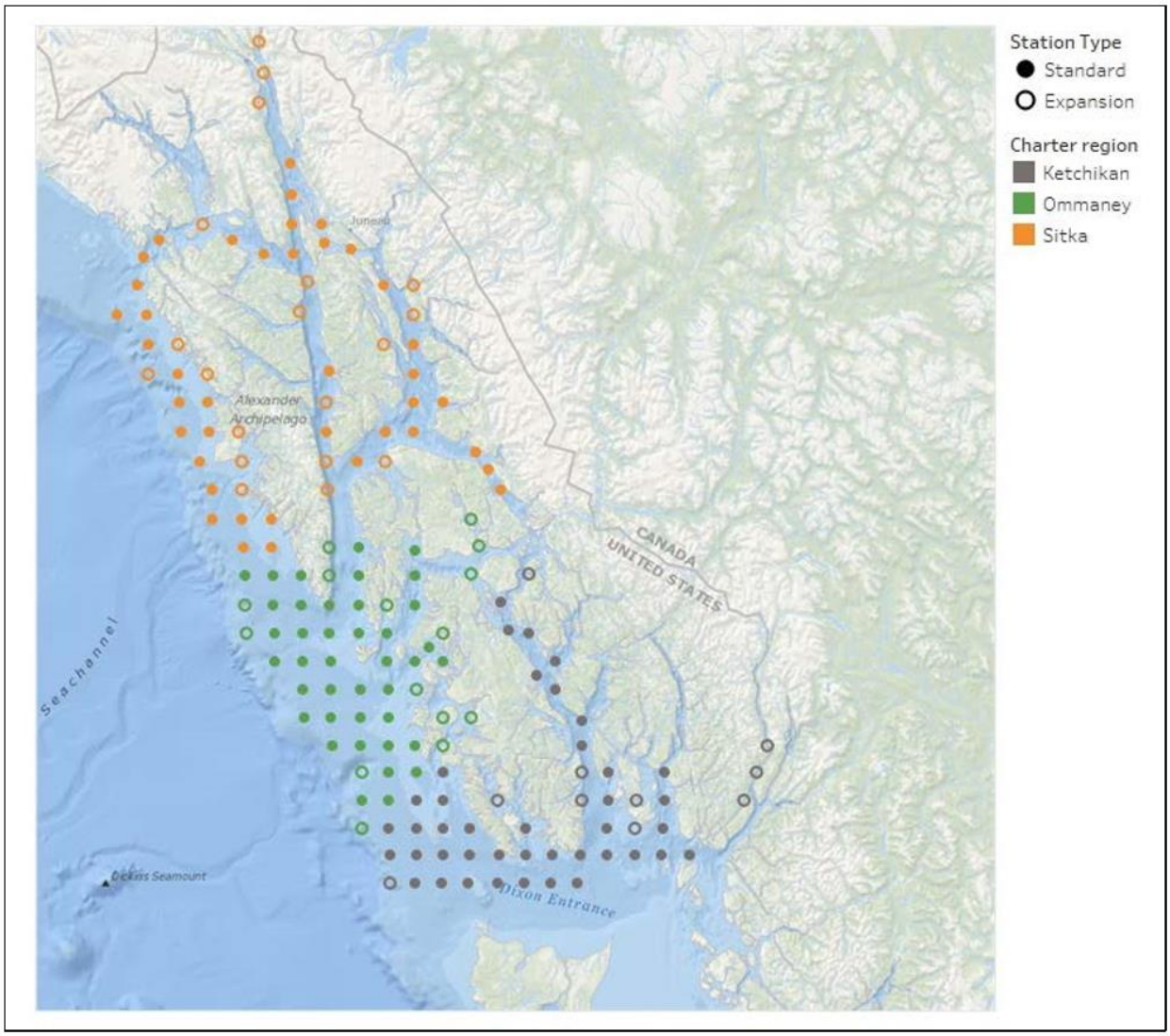

Figure 5. 2018 FISS stations in IPHC Regulatory Area 2C by charter region.

Table 2. IPHC Regulatory Area 2C FISS charter regions and count by station type.

Charter Region	Total station count	Expansion	New extra stations [2]	Standard
Ketchikan	51	9	1	41
Ommaney	55	14	1	40
Sitka	59	17	2	40
Total	165[1]	40	4	121

[1] three stations in Glacier Bay were not fished because of permitting
[2] extra stations are added between grid stations that are far apart from each other, typically up fjords and channels.

Pacific halibut catch-per unit effort in weight (WPUE) and numbers (NPUE)

The FISS covers commercial as well as non-commercial fishing grounds, so the average WPUE and NPUE for all IPHC Regulatory Areas surveyed was below that of the commercial fleet. Detailed information such as catch by station within the IPHC Regulatory Area(s) as well as over a time series is available here:

https://iphc.int/data/setline-survey-catch-per-unit-effort

A record of hook status, either as a 20% subsample or a full census, is collected for each set. Hook status, which is either the organism captured, a bait returned, an empty hook, or a missing hook, is used to calculate the hook competition adjustment factor. The impact of the hook competition adjustment can also be observed through the above link.

Pacific halibut biological data

FISS Sea Samplers record fork lengths of all Pacific halibut caught, with the corresponding location details. All O32 Pacific halibut, as well as sublegal-sized (U32) Pacific halibut randomly selected for otolith collection are assessed for sex, maturity, prior-hooking injury severity, and evidence of depredation. Otoliths, used to determine age, are collected from a randomized subsample. Male Pacific halibut are assessed as either mature or immature, and females as immature, mature, spawning or resting. All U32 Pacific halibut not selected for otolith collection were measured and released alive, a subsample of which were tagged prior to release. Details of the biological data collected on the FISS are available here:

https://iphc.int/data/fiss-biologicals-maps-and-plots

Prior hooking injury results

A prior hooking injury (PHI) is defined an injury that appears to have occurred when the fish was being released during a previous capture by hook-and-line gear. A PHI code was assigned using predefined criteria for every Pacific halibut captured (e.g. no injury, minor injury, moderate injury, severe injury, or unknown). The PHI results are also available at the above link.

Biological data for other species

Over 100 other species of fish or other organisms are consistently observed on the IPHC FISS. To explore the bycatch species observed by IPHC Regulatory Area since 1998 check out the interactive web pages here:

https://iphc.int/static/56/fiss-bycatch

FUTURE WORK

2019 expansions

As shown in Figure 6, one more year remains to complete the FISS expansions for each IPHC Regulatory Area. The IPHC will be continuing with the FISS expansion into IPHC Regulatory Areas 3A and 3B, as approved by the Commission in 2014. The IPHC has begun vetting the proposed FISS stations with the respective State and Federal agencies. In some cases, this also involves special permitting requirements. There are 89 expansion stations planned for IPHC Regulatory Area 3A and 67 for IPHC Regulatory Area 3B.

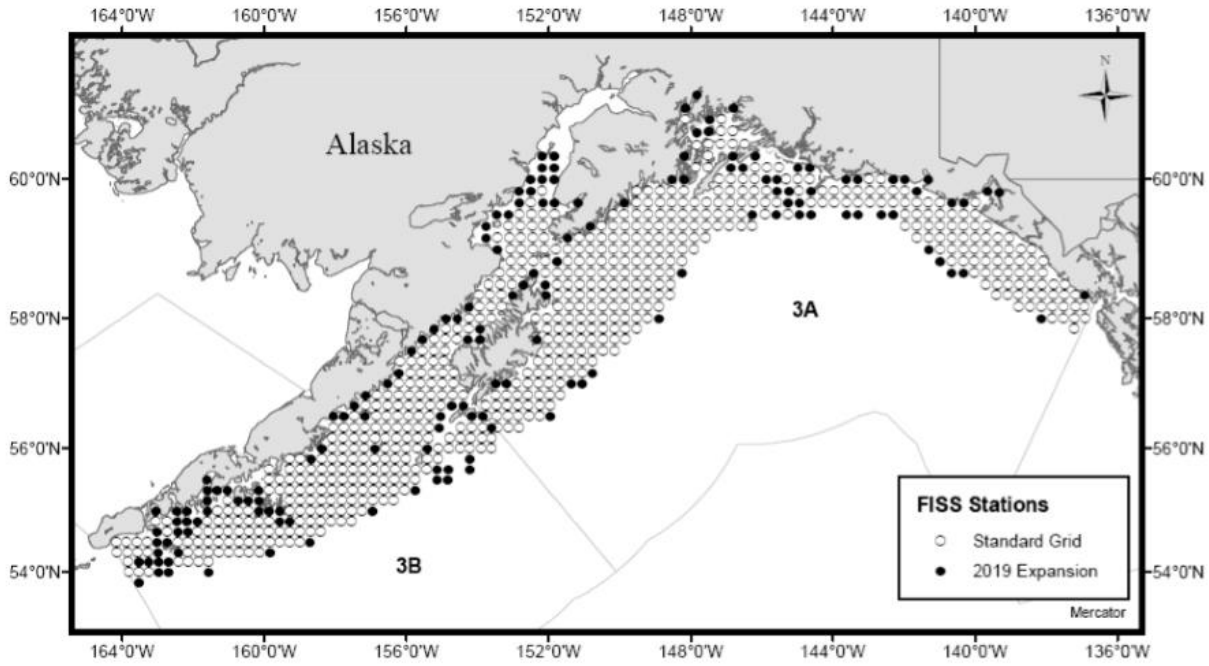

Figure 6. 2019 IPHC Regulatory Areas 3A and 3B FISS stations.

Gear comparison

The IPHC is conducting a gear comparison during the 2019 FISS to compare fixed-hook and snap gear. The comparison will evaluate whether data from both gear types can be used in the IPHC stock assessment process and how FISS work compares to the gear and results of the commercial fishery. All stations in IPHC Regulatory Area 2C will be fished twice, once by the FISS standard of fixed-hook gear and once by snap gear. To accomplish this work, IPHC Regulatory Area 2C has been divided into early and late charter regions instead of by the traditional three charter regions of Ketchikan, Sitka and Ommaney. Vessels using snap or fixed-

hook gear interested in bidding on IPHC Regulatory Area 2C should refer to the 2019 FISS Bid Specifications for the bidding options (https://iphc.int/the-commission/opportunities). Vessels using any single gear type will not be able to fish more than half the stations in IPHC Regulatory Area 2C in 2019 i.e. 65 stations. The stations for each charter region by gear type are shown in Figures 7 and 8.

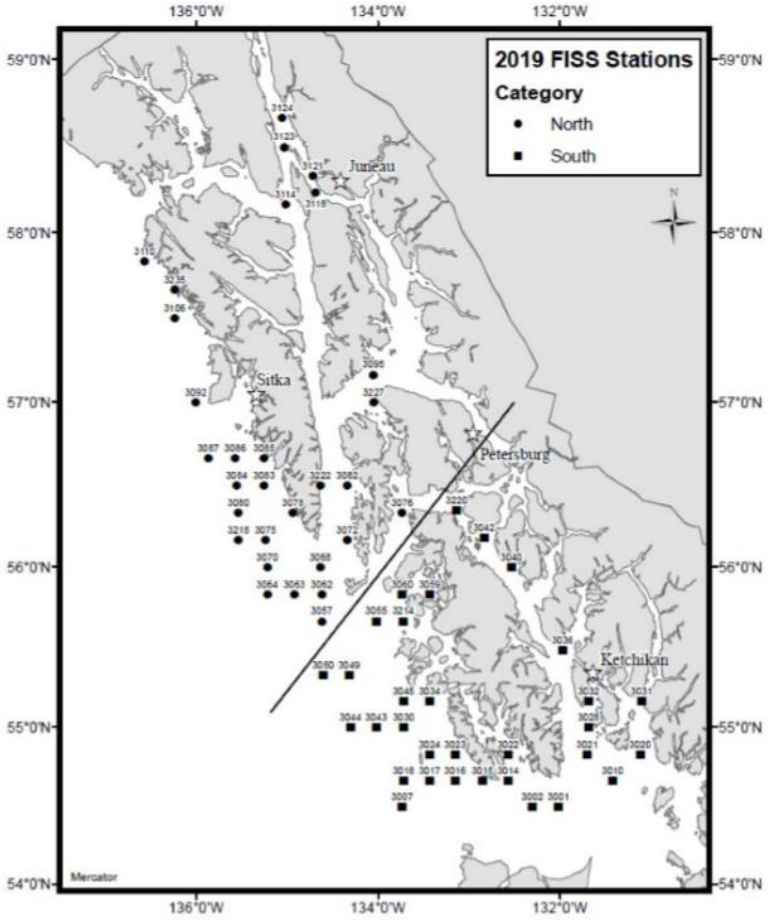

Figure 7. IPHC Regulatory Area 2C fixed-hook gear early (26 May to 15 July) charter region or snap gear late (16 July to 31 August) charter region.

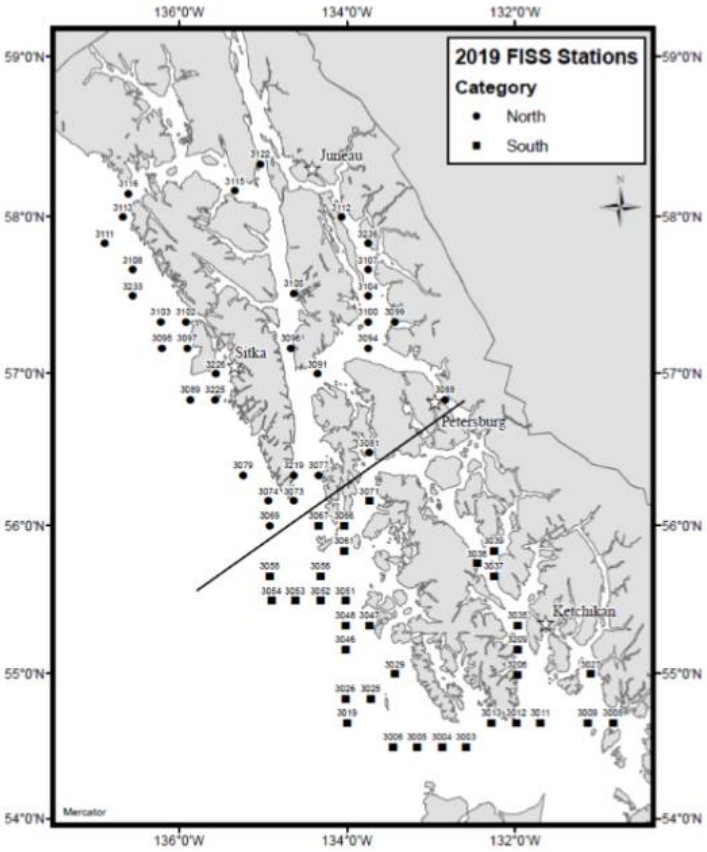

Figure 8. IPHC Regulatory Area 2C fixed-hook gear late (16 July to 31 August) charter region or snap gear early (26 May to 15 July) charter region.

Pacific halibut weights

Beginning in 2019, weights of all Pacific halibut are to be collected on the FISS.

III. Reserves – N/A

IV. Review of Agency Groundfish Research, Assessment, and Management

A. Pacific halibut and IPHC activities

1. Research

Abstract

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of the Pacific halibut (*Hippoglossus stenolepis*). At the present time, the main objectives of the Research Program put forward by the Biological and Ecosystem Science Branch at IPHC are to:

1) identify and assess critical knowledge gaps in the biology of the Pacific halibut;
2) understand the influence of environmental conditions; and
3) apply the resulting knowledge to reduce uncertainty in current stock assessment models.

Traditionally, IPHC Secretariat staff propose new projects annually that are designed to address key biological issues as well as the continuation of certain projects initiated in previous years. Proposals are based on their own input as well as input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC such as the Research Advisory Board (RAB) and the Scientific Review Board (SRB). Proposed research projects are presented to the Commissioners for feed-back and subsequent approval. Importantly, biological research activities at IPHC are guided by a Five-Year Research Plan that is put forward by the Branch Manager identifying key research areas that follow Commission objectives. According to the Five-Year Research Plan for the period 2018-2023, the primary biological research activities at IPHC can be summarized in five main areas:

1) Migration
2) Reproduction
3) Growth and Physiological Condition
4) Discard Mortality Rates (DMRs) and Survival
5) Genetics and Genomics

These research areas have been selected for their important management implications. The studies conducted on Migration are aimed at further understanding reproductive migration and identification of spawning times and locations as well as larval and juvenile dispersal, The studies conducted on Reproduction are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity. The studies conducted on Growth are aimed at describing the role of some of the factors responsible for the observed changes in size-at-age and to provide tools for measuring growth and physiological condition in Pacific halibut. The proposed work on Discard Mortality and Survival is aimed at providing updated estimates of discard mortality rates in both the longline and the trawl fisheries. The studies conducted on Genetics and Genomics are aimed at describing the genetic structure of the Pacific halibut population and at providing the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences. An overarching objective of the Five-Year Research Plan is to promote integration and synergies among the various research activities led by IPHC in order to significantly improve our knowledge of key biological inputs that are introduced into the stock assessment.

Overview of research projects for 2019

In 2019, the IPHC will be continuing research activities related to twelve continuing projects. These include the following:

- projects aimed at the development of tools for sex identification (621.16) and at producing accurate reproductive maturity estimations (674.11),
- project monitoring the Pacific halibut population for heavy metal and persistent organic pollutants (642.00),
- projects conducting migration-related research involving the use of satellite and wire tagging, estimating larval abundance and distribution over time and in relation to oceanographic and environmental conditions, and tail imaging recognition (650.21, 650.22, 670.11, 675.11),
- projects dealing with the identification of markers for growth-related studies (673.14) and on the relationship between temperature history and growth (673.15).
- projects investigating condition factor indices in wire-tagged fish (672.12) and characterizing the discard mortality rates in the longline fishery (672.13) and,
- project conducting work related to the sequencing of the Pacific halibut genome (673.13).

Project 621.16 ("*Development of genetic sexing techniques*") has as its main objective the identification of molecular markers for sex in order to provide a genetic method for sex identification in settings in which direct observations of sex cannot be obtained (i.e. fish at commercial offloads). In addition, this project was designed to provide genetic validation of the physical marking of sex at sea (Project 621.15, IPHC-2017-WM2017-10). Three single nucleotide polymorphisms (SNPs) were identified to be associated with sex and molecular assays were developed for two of the identified SNPs. These assays were estimated to have an accuracy of 97.5% in a comparison between assayed sex and visually-determined sex in a sample of 199 fish, based on an assumption that no process or recording errors existed within the visually-determined data (Drinan et al., 2018). The assay was subsequently used to evaluate the accuracy of commercial sex-marking at sea and is now being applied to provide sex information from biological samples (i.e. fin clips) collected from sampled fish from the 2017 commercial catch.

Project 642.00 ("*Assessment of mercury and other contaminants*") is the continuation of a project monitoring the prevalence of heavy metal and persistent organic pollutant contamination in the Pacific halibut population. Tissue samples for monitoring have been collected in IPHC's FISS since 2002.

A total of four projects are continuing migration-related studies, two of which involve tagging. First, **Project 650.21**: ("*Investigation of Pacific halibut dispersal on Bowers Ridge via Pop-up Archival Transmitting (PAT) tags*") involved a study of the migratory behavior of O32 Pacific halibut residing in summer on Bowers Ridge in IPHC Regulatory Area 4B, at both seasonal and interannual time scales. The primary goal of the project is to evaluate relative connectivity between Bowers Ridge, the western Aleutian Islands, and the broader eastern Pacific Ocean. Results will be placed in the context of data obtained from prior satellite-tagging experiments in which more than 200 O32 Pacific halibut have been tagged in the eastern Bering Sea and Aleutian Islands region. A total of 22 fish (13 female; 8 male; 1 of unknown sex) were tagged during July of 2017 with pop-up archival transmitting (PAT) tags: 16 with tags programmed to detach and report in mid-January (i.e., during the spawning season) and 6 with tags programmed report in July (i.e., after 365 days at liberty) of 2018. Final locations were obtained for 18 of these fish (14 during

winter and 4 in July). Seventeen of the reporting locations were on Bower's Ridge, with one tag reporting in winter from the eastern Bering Sea shelf break near St. Matthew Canyon. Analysis of the archived environmental data and generation of at-liberty position estimates is ongoing. Second, **Project 650.22** ("*Larval connectivity*") is aimed at investigating the movement and connectivity of Pacific halibut larvae primarily between the Gulf of Alaska and the Bering Sea, and also within each basin. Larval abundance and distribution, as well as that of 2-year old fish from the same cohort, are being modeled over time and over oceanographic and environmental conditions. Third, **Project 670.11**: "*Wire tagging of Pacific halibut on NMFS trawl and IPHC setline surveys*" involves the tagging of U32 Pacific halibut in order to further understand coastwide migratory and growth patterns of young Pacific halibut. In 2018, 916 Pacific halibut were tagged during the NOAA Fisheries trawl survey (768 fish tagged in the Bering Sea and 148 fish tagged in the Aleutian Islands) and 1,747 Pacific halibut were wire-tagged on the IPHC's FISS. Finally, **Project 675.11** ("*Tail pattern recognition*") is the continuation of a pilot study conducted in 2017 that investigated the identification of individual fish to complement migratory studies by way of photographic recognition of tail patterns. Various pattern-recognition software packages have been used to examine uniqueness and longevity of patterns in tail coloration on both the blind and eyed side of the fish, showing relative promise for identifying the same individuals over time. Cameras were deployed on several vessels during the FISS in 2018 and over 744 tail images of wire tagged U32 fish were collected and are being used to create a database of tail images.

Project 672.12 ("*Condition Factors for Tagged U32 Fish*") continues the study of the relationship between the physiological condition of fish and migratory performance as assessed by tagging in U32 fish in order to better understand the potential use of quantitative physiological indicators in predicting migratory performance. Fat level determinations, blood parameters and biometrical measures are being evaluated for a subset of tagged U32 fish.

Project 672.13 ("*Discard mortality rates and injury classification profile by release method*") is continuing to investigate the relationship between three hook release methods (careful shake, gangion cut and hook stripper) in the longline fishery and associated injuries with the physiological condition of fish and with post-release survival in order to update current estimates of discard mortality rates in the directed longline Pacific halibut fishery. Furthermore, this project is also conducting investigations on the applicability and accuracy of electronic monitoring in capturing release methods and fish condition in vessels without observer coverage. This project has received funding from a grant from the Saltonstall-Kennedy NOAA grant program under project number NA17NMF4270240.

Project 673.13 ("*Sequencing the Pacific halibut genome*") aims at characterizing for the first time the genome of the Pacific halibut to support studies on population genetics, to assist in the identification of genomic regions and genes responsible for temporal and spatial adaptive phenotypic and behavioral characteristics in response to environmental and anthropogenic influences and to provide genomic resolution to genetic markers for sex, reproduction and growth that are currently being investigated. Sequencing efforts are currently under way.

Project 673.14 (*"Identification and validation of markers for growth in Pacific halibut"*) has continued efforts to identify and validate molecular and biochemical markers that are characteristic of specific growth patterns and that will be used to identify different growth trajectories in the Pacific halibut population and evaluate potential effects of environmental influences on growth trajectories. Initial studies have involved evaluating molecular responses of white skeletal muscle

to temperature- and density-induced growth manipulations in juvenile Pacific halibut in captivity. Potential applicable molecular (gene and/or protein) markers for growth are currently being validated for their use in detecting growth trajectories using muscle samples from adult Pacific halibut. The results of this study will contribute to our understanding of the possible role of somatic growth variation in the observed changes in size-at-age in the Pacific halibut population. This project has received funding from a grant from the North Pacific Research Board under project number 1704.

Project 673.15 ("*Influence of thermal history on growth*") is designed to study the thermal profile experienced by fish at sea as assessed by electronic archival tagging and otolith microchemistry in order to investigate the relationship between growth patterns (or productivity) and spatial and temporal variability in environmental conditions for growth. This study will allow us to relate temperature histories that are experienced by individual fish to the growth patterns that they display, to examine spatial and temporal trends in rearing conditions and growth, and to extend thermal analyses to untagged Pacific halibut via otolith microchemical analyses. In addition, the data are expected to provide information regarding dispersal of U32 Pacific halibut, both seasonally and ontogenetically. During the 2018 FISS a total of 255 externally-attached electronic archival tags were deployed coast wide and 13 fish were tagged with PAT tags in the western Aleutian Islands. Additional tag releases are anticipated in 2019. Given that these fish are relatively small when tagged, and therefore only weakly selected to the target longline fishery, recapture rates are expected to be modest over their first 2-3 years post-release. One fish was recovered during 2018; the PAT tags are programmed to report during the summers of 2019 and 2020.

Project 674.11 ("*Full characterization of the annual reproductive cycle in adult female Pacific halibut*") aims at fully characterizing the annual reproductive cycle of female and male Pacific halibut in order to advance our understanding of sexual maturation in this species and to improve maturity assessments and maturity-at-age estimates. Sample collection in the Portlock area in the central Gulf of Alaska began as a pilot study in June 2017 and subsequently initiated fully in September 2017 and continued on a monthly basis through its successful completion in August 2018, for a . A variety of biological measures and samples were collected from thirty females and thirty males at each month for physiological analyses of reproductive parameters throughout an entire annual reproductive cycle. The results of this project will greatly assist in improving our estimates of the actual spawning biomass. In June 2019, additional samples from female and male Pacific halibut will be collected from the Portlock area in order to conduct a temporal analysis of maturity during three consecutive years from 2017 until 2019.

In addition to the continuing research projects described above, the IPHC will begin work in 2019 on five new projects that will cover specific research needs:

Project 2019-01 ("*Integrating migration and genetics research to refine Pacific halibut population structure, distribution and movement*") proposes performing studies to improve our understanding of spawning site contributions to nursery areas in relation to year-class and recruit survival and strength, as well as of the relationship between nursery origin and adult distribution and abundance over temporal and spatial scales through the application of genetic, approaches to address management-relevant questions on population structure, distribution and movement.

Project 2019-02 ("*Whale detection methods relevant for Pacific halibut*") proposes testing electronic monitoring-based methods to detect whale presence in the directed longline Pacific

halibut fishery. This study will be performed in the framework a Bycatch Reduction Engineering Program (BREP-NOAA)-funded study led by the Alaska Longline Fishing Association in which IPHC is a collaborating partner.

Project 2019-03 ("*Adult Pacific halibut captive holding studies*") proposes performing studies on captive adult Pacific halibut to establish or validate measures or protocols required for other ongoing projects, such as (1) determining the permanence of individual tail markings for tracking individual movement rates, (2) calibrating measures of fat content for condition factor determinations and of stable isotope (C^{13} and N^{15}) ratios for inferring growth and dietary information, (3) calibrating O^{18} otolith signatures with environmental temperature and (4) producing larvae for behavioral studies.

Project 2019-04 ("*Use of LEDs to reduce Pacific halibut catches before trawl entrainment*") proposes evaluating if artificial illumination (e.g. LEDs) in trawl gear can reduce Pacific halibut bycatch before trawl entrainment in relation to the physiological condition of the fish. This study will be performed in the framework of a Bycatch Reduction Engineering Program (BREP-NOAA)-funded study led by Pacific States Marine Fisheries Commission in which IPHC is a collaborating partner.

Project 2019-05 ("*Improving the characterization of discard mortality of Pacific halibut in the recreational fisheries*") proposes determining mortality rates of discarded Pacific halibut in the Pacific halibut recreational fisheries. This study will be conducted with partial funding from a grant from the National Fish and Wildlife Foundation awarded to IPHC in collaboration with academic and industry partners.

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 commercial fishery data collection program. Ongoing data collections projects that are continuing in 2019 include the following:

IPHC FISS

The IPHC fishery-independent setline survey provides catch information and biological data on Pacific halibut that are independent of the commercial fishery. These data, which are collected using standardized methods, bait, and gear during the summer of each year, provide an important comparison with data collected from the commercial fishery.

Biological data collected on the FISS (e.g., the size, age, and sex composition of Pacific halibut) 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.

The Commission has conducted the FISS in selected areas during most years since 1963. The majority of the current FISS station design and sampling protocols have been consistent since 1998.

Environmental data collection aboard the IPHC FISS using water column profilers

PIs: Lauri Sadorus, Jay Walker

The IPHC collects oceanographic data using water column profilers during the IPHC FISS. The profilers collect a suite of oceanographic data, including pressure (depth), conductivity (salinity), temperature, dissolved oxygen, pH, and fluorescence (chlorophyll concentration). The IPHC has operated profilers since 2000 on a limited basis, and coastwide since 2009.

IPHC aboard National Marine Fisheries Service groundfish trawl surveys in the Gulf of Alaska, Bering Sea, and Aleutian Islands

PI: Lauri Sadorus

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 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 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 commercial fishery.

Commercial fishery sampling program

The IPHC positions field staff to sample the commercial landings for Pacific halibut in Alaska, British Columbia, Washington, and Oregon. Sampling of commercial landings involves collecting Pacific halibut otoliths, tissue samples, fork lengths, weights, logbook information, and final landing weights.

The collected data are used in the stock assessment and other research and 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.

2. Assessment

The 2018 stock assessment produced the following scientific advice regarding the Pacific halibut stock:

1. Fishing intensity: The IPHC does not have an explicit coastwide fishing intensity target or limit reference point, making it difficult to determine if current levels of fishing intensity are consistent with the interim harvest strategy policy objectives. However, given the healthy female spawning biomass and the TAC set for 2018 only being marginally higher than the levels estimated to maintain biomass at or near current levels of 43%, on the weight-of-evidence, the stock is classified as **not subject to overfishing**.
2. Spawning biomass: Female spawning stock biomass of Pacific halibut at the beginning of 2018 was estimated to be 43% (27–63%) of the SB_0 (unfished levels) defined by the interim harvest strategy policy. The probability that the stock is below the SB_{30} level (IPHC trigger) is estimated to be 11%, with less than a 1% chance that the stock is below SB_{20} (IPHC limit reference point). Thus, on the weight of evidence available, the Pacific halibut stock is determined to be **not overfished** (SB_{2019} > SB20%).
3. Outlook: The stock is projected to decrease over the period from 2019-22 for all TCEYs greater than 20 million pounds (~9,070 t), corresponding to a Spawning Potential Ratio (SPR) of 64%. At the reference level (SPR of 46% and a TCEY of 40 Mlbs or 18,140 t) the probability of at least a 5% decrease in stock size increases over time from 37% (2020) to 86% (2022). There is a one third chance (<34/100) that the stock will decline below the threshold reference point (SB30%) in projections for all the levels of fishing intensity up to an SPR of 40% evaluated over three years.

For more information on the 2018 stock assessment and the fishery status, as well as the harvest decision table indicating levels of risk associated with various levels of removals, please refer to papers IPHC-2019-AM095-09 and IPHC-2019-AM095-10 (https://iphc.int/uploads/pdf/am/2019am/iphc-2019-am095-09.pdf and

https://iphc.int/uploads/pdf/am/2019am/iphc-2019-am095-10.pdf), which can be found on the meeting page at the IPHC website.

3. Management

The International Pacific Halibut Commission (IPHC) completed its 95th Annual Meeting (AM095) in Victoria, British Columbia, Canada, on 1 February 2019, with Mr. Paul Ryall of Canada presiding as Chairperson. More than 200 Pacific halibut industry stakeholders attended the meeting, with over 140 more participating via the web. All of the Commission's public and administrative sessions during the meeting were open to the public and broadcast on the web. Documents and presentations from the Annual Meeting are available on the Annual Meeting page on the IPHC website: https://www.iphc.int/venues/details/95th-session-of-the-iphc-annual-meeting-am095.

Regulatory Changes: Fishery Limits and Fishing Periods

The fishery regulations approved by the IPHC, including fishery limits and fishing periods, will be recommended to the Contracting Parties for implementation according to their domestic law and regulation, in accordance with the Convention[1].

Fishery Limits

The Commission adopted distributed mortality (TCEY) values for each IPHC Regulatory Area as shown in **Table 3**.

Table 3. Distributed mortality (TCEY) by IPHC Regulatory Area

IPHC Regulatory Area	***Distributed mortality limits (TCEY) (net weight*)***	
	Metric tons (t)	**Pounds (lb)**
Area 2A (California, Oregon, and Washington)	748.43	1.65M
Area 2B (British Columbia)	3,098.04	6.83M
Area 2C (southeastern Alaska)	2,875.78	6.34M
Area 3A (central Gulf of Alaska)	6,123.50	13.50M
Area 3B (western Gulf of Alaska)	1,315.42	2.90M
Area 4A (eastern Aleutians)	879.97	1.94M
Area 4B (central/western Aleutians)	657.71	1.45M

[1] *The Convention between Canada and the United States of America for the Preservation of the [Pacific] Halibut Fishery of the Northern Pacific Ocean and Bering Sea*.

Areas 4CDE (Bering Sea)	1,814.37	4.00M
Total	**17,513.20**	**38.61M**

*"net weight" of a Pacific halibut means the weight of Pacific halibut that is without gills and entrails, head-off, washed (without ice and slime). If a Pacific halibut is weighed with the head on or with ice and slime, the required conversion factors for calculating net weight are a 2 percent deduction for ice and slime and a 10 percent deduction for the head.

The Commission adopted the mortality limits for each Contracting Party, by IPHC Regulatory Area and sector, as shown in Table 4.

Table 4. Mortality table projected for the 2019 mortality limits by IPHC Regulatory Area, in millions of pounds

Sector	IPHC Regulatory Area								
	2A	**2B**	**2C**	**3A**	**3B**	**4A**	**4B**	**4CDE**	**Total**
Commercial discard mortality	0.02	0.13	NA	NA	0.19	0.09	0.02	0.04	**0.50**
O26 Bycatch	0.13	0.27	0.03	1.28	0.36	0.18	0.22	1.87	**4.33**
Non-CSP Recreational (+ discards)	NA	0.08	1.38	1.74	0.00	0.01	0.00	0.00	**3.21**
Subsistence	NA	0.41	0.44	0.22	0.01	0.01	0.00	0.06	**1.14**
Total Non-FCEY	0.15	0.88	1.85	3.24	0.57	0.29	0.24	1.96	**9.18**
Commercial discard mortality	NA	NA	0.06	0.31	NA	NA	NA	NA	**0.37**
CSP Recreational (+ discards)	0.60	0.84	0.82	1.89	NA	NA	NA	NA	**4.16**
Subsistence	0.03	NA	NA	NA	NA	NA	NA	NA	**0.03**
Commercial Landings	0.86	5.10	3.61	8.06	2.33	1.65	1.21	2.04	**24.88**
Total FCEY	**1.50**	**5.95**	**4.49**	**10.26**	**2.33**	**1.65**	**1.21**	**2.04**	**29.43**
TCEY	**1.65**	**6.83**	**6.34**	**13.50**	**2.90**	**1.94**	**1.45**	**4.00**	**38.61**
U26 Bycatch	0.00	0.02	0.00	0.37	0.11	0.10	0.01	1.12	**1.73**
Total Mortality	**1.65**	**6.85**	**6.34**	**13.87**	**3.01**	**2.04**	**1.46**	**5.12**	**40.34**

Fishing Periods (season dates)

The Commission adopted an overall fishing period (season) of 15 March – 14 November 2019 for all commercial Pacific fisheries in Canada and the USA. In IPHC Regulatory Area 2A, the tribal commercial fisheries and the incidental Pacific halibut fisheries will occur within these dates, and the non-tribal directed commercial fishery will consist of 10-hour derby fishing periods, including 26 June, 10 July, 24 July, 7 August, 21 August, 4 September, and 18 September, with other possible dates to be determined by the IPHC Secretariat.

Other Actions

Harvest Strategy Policy

The Commission provided direction to the IPHC Secretariat and the Management Strategy Advisory Board (MSAB) for further work on harvest strategy policy development, noting that scale and distribution components will be evaluated and presented no later than at the 97th Annual Meeting (AM097) in 2021, for potential adoption and subsequent implementation as a harvest strategy.

Expanded fishery-independent setline survey (FISS)

The IPHC approved the last in a series of expansions to its annual FISS. The purpose of the expansion series is to provide more accurate and precise estimates among regulatory areas and to encompass all depths over which the stock is distributed. In 2019, the FISS in IPHC Regulatory Areas 3A and 3B will be expanded beyond the standard grid of FISS stations fished each year.

Upcoming Meetings

The IPHC's 95th Interim Meeting will be held 25-26 November 2019, in Seattle, Washington. The IPHC's 96th Annual Meeting (AM096) is planned for 3-7 February 2020 in Anchorage, Alaska, and the 97th Annual Meeting (AM097) is planned for 25-29 January 2021 in Victoria, British Columbia.

Commission Membership

United States Government Commissioner Mr. Chris Oliver was elected Chairperson for the coming year. Canadian Government Commissioner Mr. Paul Ryall was elected Vice-Chairperson. The other Canadian Commissioners are Mr. Neil Davis and Mr. Peter DeGreef. The other US Commissioners are Mr. Robert Alverson and Mr. Richard Yamada.

Meeting Report

The Report of the 95th Session of the IPHC Annual Meeting (AM095) has been published and posted at the Annual Meeting page of the IPHC website: https://www.iphc.int/uploads/pdf/am/2019am/iphc-2019-am095-r.pdf. The Report includes details on all the decisions, recommendations, and requests made by the Commission during the Annual Meeting.

V. Ecosystem Studies

[See the description of "Environmental data collection aboard the IPHC FISS using water column profilers" in the Research section on ongoing IPHC data collection projects above.]

VI. Publications

International Pacific Halibut Commission. 2018. Annual Report 2018. https://www.iphc.int/uploads/pdf/ar/iphc-2018-annual-report.pdf