TSC Agency Reports - IPHC

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 have prosecuted the fishery and have depended upon the resource since before the turn of the 20th Century. 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 both the port and sea sampling seasonal positions, the following transitions have occurred in 2015 and 2016, or are planned for 2016.

Name	Position	Start Date	End Date
Claude Dykstra	Survey Manager		June 2015
Claude Dykstra	Research Biologist	June 2015	
Anna Henry	Survey Manager	June 2015	
Jim Traub	Database and IT Program Manager*		Sept. 2015
Dr. Steve Martell	Quantitative Scientist		December 2015
Dr. Allan Hicks	Quantitative Scientist	April 2016	
Heather Gilroy	Fisheries Statistics Program Manager*		April 30, 2016
Dr. Josep Planas	Research Program Manager	January 2016	
Dr. Bruce Leaman	Executive Director		August 31, 2016
Dr. David Wilson	Executive Director	August 1, 2016	

*The Commission is in the process of hiring for this position.

II. Surveys

In 2015, fourteen commercial longline vessels, seven Canadian and seven U.S., were chartered by the International Pacific Halibut Commission for survey operations. During a combined 73 trips and 736 charter days, these vessels fished 30 charter regions, covering habitat from southern Oregon to the island of Attu in the Aleutian Islands, and north along and including the Bering Sea continental shelf. All 1,368 survey stations planned for the 2015 survey season were either scouted or completed. Of these stations, 1,360 (99.4%) were considered successful for stock assessment analysis. Approximately 751,340 pounds of halibut, 70,635 pounds of Pacific cod, and 42,532 pounds of rockfish were landed from the standardized survey stations. Compared to the 2014 survey, weight per unit effort (WPUE) increased in Regulatory Areas 2A, 2C, 3B, 4B, 4C, and 4D. WPUE decreased in areas 2B, 3A, and 4A.

The 2015 survey design encompassed both nearshore and offshore waters of Oregon, Washington, British Columbia, southeast Alaska, the central and western Gulf of Alaska, Aleutian Islands, and the Bering Sea continental shelf. These areas were divided into 30 regions, each requiring between 12 and 43 charter days to complete (Table 1). 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 in most areas). As a continued part of a multi-year coastwide effort to expand our survey depth profile and update our calibration with other surveys, the IPHC conducted a standardized grid survey in the eastern Bering Sea (EBS) for 2015. Figure 1 depicts the survey station positions, charter region divisions, and regulatory areas surveyed.

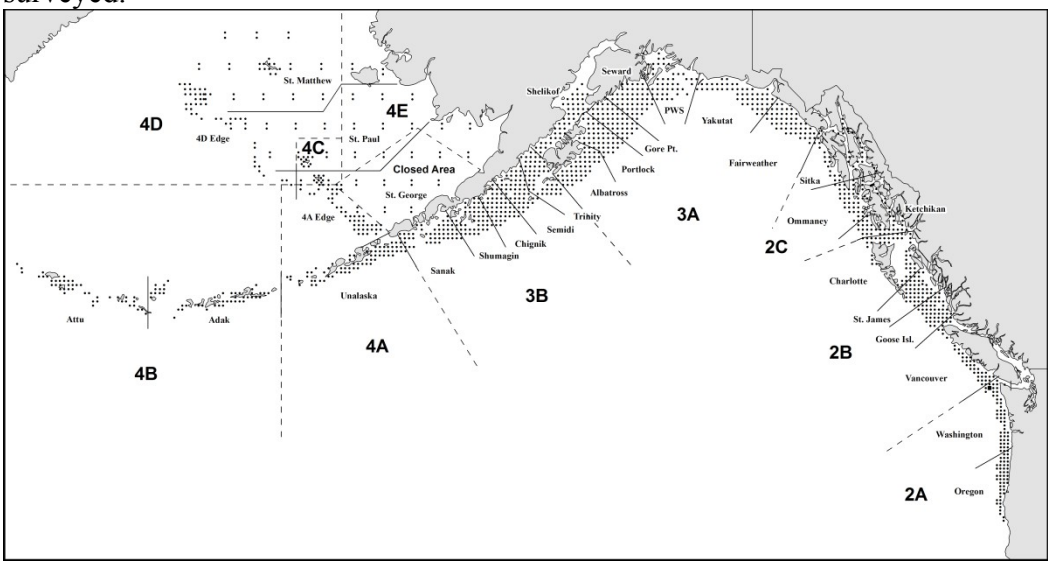

Figure 1. 2015 SSA survey stations with regulatory area (two-character codes) and charter region (formal names) divisions.

III. Reserves

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

A. Pacific halibut and IPHC activities

1. Research

This section provides a brief recap of projects conducted in 2015. Full reports on most projects can be found in the 2015 Report of Assessment and Research Activities (RARA).

Research is conducted within four areas of study which connect to the IPHC mission and support the assessment and management objectives of the Commission. These four areas are 1) assessment and stock identification; 2) management strategy; 3) biology; and 4) ecology.

Ongoing Projects for 2016

Commercial Sex Marking Pilot

Supports: Objective 1 – stock identification and assessment, Objective 2 – harvest policy and management
Priority: High
Start: 2015
Anticipated Ending: 2017
Personnel: T. Loher, I. Stewart, J. Marx

This project is part of a combined program with Project 621.16 to pair marks from commercially caught fish with a positive validation of sex via genetic means, at a much lower cost than direct estimation of the sex ratio of landings via genetic testing.

This project has three primary objectives: a) test a single method of sex marking aboard increasingly larger samples of commercial fishing trips in order to determine its feasibility from a logistical perspective; b) evaluate the additional workload that processing sex-marked catch, and obtaining tissue samples for subsequent genetically-based QA/QC of the physical marking process, is likely to have upon the IPHC's port sampling program; c) generate a small tissue archive that can be subjected to subsequent genetic analysis as an element of Project 621.16.

The 2016 field season will represent a scaling up of sampling relative to 2015. The 2015 design represented a single-port (~eight offloads) effort, wherein vessels marked their fish in advance of offloads that they knew would be sampled. In 2016, we aim to sample 20-30 offloads, representing vessels associated with one of the fleet's fishing vessel owners associations, wherein all vessels from the association mark all of the fish retained during all trips, without prior knowledge of whether those trips will be sampled port-side.

For each sampled offload, the port sampler will record the length and marked sex of each fish (including unmarked individuals) within the sample and collect and preserve a tissue sample. Analysis will include:

- A post-participation debrief with each harvester regarding the marking process, time requirements, ideas for alternate marks, and general willingness to participate again in the future.
- A comparison of the sex ratio at age among the sampled trips with the sex ratio at age among survey legs within the same area during the same year.
- Storage of genetic samples pending the development of Single Nucleotide Polymorhpisms (SNP) assays, which will allow the accuracy of fishermen's marks to be tested directly.

Sample collection protocols are expected to change from prior years, at least in part, due to the requirements for shipping the tissue samples. Tissue samples will be archived until such time as a definitive genetically-based indicator of sex has been developed and is ready for use. When

ready, the samples will be subjected to analysis and the resultant sex ratios compared to those obtained by at-sea catch marking.

Genetic Sexing via Single Nucleotide Polymorhpisms (SNPs)
Supports: Objective 1 – stock identification and assessment, Objective 2 – harvest policy and management
Priority: High
Start: 2015
Anticipated Ending: 2016
Personnel: T. Loher, L. Hauser (UW)

The work will allow for direct and reliable monitoring of sex ratios within the commercial catch. At present, the sex composition of the catch is estimated from IPHC survey data.

The sequencing of Restriction site Associated DNA (RAD tags) has revolutionized genetics by allowing the discovery and genotype-calling of thousands of SNPs in multiple individuals at relatively low cost. The technique takes advantage of the large number of sequences (millions of reads per run) produced by the Illumina HiSeq 2000 sequencer. RAD tag sequencing focuses on sequencing the regions (tags) directly adjacent to specific restriction sites genome-wide. It is therefore possible to sequence a large and reproducible subsection of the genome in many individuals. Given the high success in sexing halibut with microsatellites, we expect to identify several dozen sex-specific SNPs that will allow the development of rapid assays for large samples. Once SNPs highly diagnostic for sex have been identified, we will develop high-throughput assays to allow the screening of larger samples. We will identify about 20 SNPs and re-sequence them in additional individuals. We will optimize these SNPs for use with low quality DNA, allowing the elimination of costly and laborious DNA extraction methods in routine sex surveys. In addition, we will minimize the number of SNPs necessary for 100% sex identification by picking highly discriminatory SNPs from our panel.

Evaluation of Pacific halibut macroscopic maturity stage assignments
Supports: Objective 2 – harvest policy and management, Objective 3 – biology, physiology, and migration
Priority: High
Start: 2008
Anticipated Ending: 2016
Personnel: K. MacTavish, other staff as needed

The staff believes it is necessary to re-evaluate our classification criteria for female gonad maturity stage. The method currently used on the assessment surveys is based on visual criteria established in the early 1990s and modified in 1995. These survey data combined with the age data are important components in the stock assessment model. Four maturity stages are presently assigned to female halibut; immature (F1), maturing (F2), spawning (F3), and resting (F4). The assumption is that once a female halibut has spawned, the gonad transitions to a resting phase, back to maturing, and then to spawning again. Our criteria for classification also assume that the F1 stage is only seen with immature fish, but we are seeing anomalies during the survey that suggest a fish may go back to this stage after achieving other maturity stages, and is therefore not truly immature. This study uses gonad samples collected in 2004. In 2016, research will include:

- Determining the maximum precision for oocyte diameter measurements by oocyte maturation stage;
- Conducting assessment of the prepared slides from the archived gonads using the sampling protocols developed in 2014; and

- Developing the sampling plan required to characterize seasonal maturation, including determination of the value of current summer assessment of halibut maturity stages.

Assessment of mercury and contaminants in Pacific halibut
Supports: Objective 4 – ecosystem interactions and environmental influences
Priority: Medium
Start Date: 2002
Anticipated ending: Continuing
Personnel: C. Dykstra, B. Gerlach (Alaska Department of Environmental Conservation)

The IPHC staff continues its collaboration with the Alaska Department of Environmental Conservation (ADEC) in 2016, collecting halibut tissue samples for analysis of heavy metal and organic pollutant loading. This work has been ongoing since 2002, when results from a collection of halibut samples that year led the Alaska Division of Public Health in 2003 to conclude that the concentrations of heavy metals in Alaskan Pacific halibut were not a public health concern. In 2004 the first results regarding organic pollutants (PCBs, pesticides) were released, demonstrating that halibut had the lowest concentrations of the five species (including salmon and sablefish) examined.

IPHC and ADEC are continuing to qualify the data with physical parameters (age, size, and weight) and additional analyses will be done on the samples. Our involvement in the project has allowed us to provide input on study design and sampling protocols in the field, which will make the resultant information much more robust.

Archival tags: tag attachment protocols
Supports: Objective 3 – biology, physiology, and migration
Priority: High
Start Date: 2013
Anticipated ending: 2017
Personnel: T. Loher

Recovery rates of archival tags affixed to halibut using four different external mounting protocols (three dart-and-tether configurations; one wired to the operculum) are being tested in a field release of "dummy" archival tags. During the summer of 2013, a total of 900 fish were tagged off northern Kodiak Island (Area 3A), with an equal number of fish tagged with each tag attachment type. Fish carrying a dart-and-tether tag were also tagged with a bright pink cheek tag. Rewards of $100 are given for all tags recovered.

***Ichthyophonus* prevalence in halibut**
Supports: Objective 4 – ecosystem interactions and environmental influences
Priority: Low
Start Date: 2012
Anticipated ending: Ongoing
Personnel: C. Dykstra, P. Hershberger (U.S. Geological Survey)

Ichthyophonus is a protozoan parasite from the class Mesomycetozoea, a highly diverse group of organisms having characteristics of both animals and fungi. It has been identified in many marine fish, and is considered a causative agent in herring fishery collapses world-wide, and there is concern over its effects on the success of salmon spawning on major rivers such as the Yukon.

During 2011-2013, samples were collected from halibut caught on the IPHC setline assessment survey over a broad geographic range, with a goal of describing the spatial and

temporal distribution of *Ichthyophonus* prevalence. Limited sampling of small (<50 cm) halibut from the NMFS trawl survey recorded a very low prevalence rate of 2.4%, suggesting that infections establish after some ontogenetic shift in diet, habitat, or behavior. Sampling of larger, adult halibut have shown a wide range of rates, with Prince William Sound showing some of the highest observed in fish.

The prevalence of infection is higher than that which has been observed in studies of other sympatric fish species, including other pleuronectids, suggesting that either susceptibility and/or infection pressures are higher in halibut. While ichthyophoniasis has been shown to reduce growth rate, decrease swimming stamina, and cause mortality in other fish hosts, its effects on Pacific halibut are unknown.

Estimate of length/weight relationship and head/ice/slime adjustment

Supports: Objective 2 – harvest policy and management, Objective 3 – biology, physiology, and migration
Priority: High
Start: 2013
Anticipated Ending: Continuing
Personnel: R. Webster

The purpose of this study is to reexamine the relationship between fork length and net weight, including the estimation of adjustments necessary to convert head-on weight to net weight. The current length-net weight relationship was estimated in 1926. If the relationship varies among regulatory areas, there may be systematic bias in regulatory area estimates of weight or WPUE derived from length measurements. Seasonal variation could affect weight estimates that are made from data collected during only a small part of the year. Therefore, we are collecting data coastwide throughout the season in order to estimate spatial and seasonal variation in the length-to-weight relationship. Data will be collected in 2016 from ports staffed with IPHC samplers throughout the fishing season. The goal is to determine whether seasonal or area-specific length-weight relationships are warranted, or whether the effect of any variation can be incorporated via variation about the existing relationship.

The current relationship used by IPHC between fork length and net weight includes adjustments for the weight of the head, and ice and slime: gross landed weight (gutted, with head, ice, and slime) is assumed to include 12% head weight and 2% ice and slime, which combine to give a multiplier of 0.8624 to convert gross to net weight. However, the industry standard for head, ice and slime deduction is a total of 12%. Therefore we are also collecting data to provide direct estimates of adjustment factors to compare with the currently assumed values, and to assess variability in the weight of heads and ice and slime.

Length-weight relationship at sea

Supports: Objective 2 – harvest policy and management, Objective 3 – biology, physiology, and migration
Priority: High
Start: 2015
Anticipated Ending: Ongoing
Personnel: E. Soderlund

This project integrates with the above port sampling project and obtains the two missing pieces of information on length-weight relationships: estimating shrinkage factors from fresh at-sea lengths and weights to landed lengths and weights. It is particularly important for estimating

removals from bycatch, recreational, and subsistence fisheries where no storage process occurs from capture to weight estimation.

The purpose of this study is to collect data on the IPHC's standardized stock assessment survey for use in estimating the relationship between fork length and net weight, including the estimation of adjustments necessary to convert head-on weight to net weight, as well as estimation of shrinkage (potentially occurring in both length and weight) from time of capture to time of offload. This project will complement the on-going project detailed above, in which samples from commercial deliveries are measured and weighed at the dock, by providing length-to-weight data that is not available at commercial offloads: from U32 fish, round fish, and freshly killed and dressed fish, as well as measurements of shrinkage from the time of capture to final weighing at the time of the offload. The current relationship between fork length and net weight also includes adjustments for the weight of the head, and of ice and slime. We also plan to collect data to provide direct estimates of adjustment factors to compare with the currently assumed values, and to assess variability in the weight of heads and ice and slime to supplement data collected in the Estimate of length/weight relationship and head/ice/slime adjustment project.

Wire tagging of juveniles on NMFS survey
Supports: Objective 1 – stock identification and assessment
Priority: High
Start: 2015
Anticipated Ending: Ongoing
Personnel: L. Sadorus, J. Forsberg

IPHC routinely participates in the NMFS groundfish trawl surveys in the Bering Sea (annual), Gulf of Alaska (biennial), and Aleutian Islands (biennial). Fish caught range in size from about 20 to 100 cm fork length. In response to bycatch-related requests at the 2015 IPHC Annual Meeting to learn more about juvenile halibut distribution and movement, IPHC staff launched a pilot project during the 2015 survey season to test the practicability of wire tagging halibut of all sizes aboard the trawl surveys. In 2015, samplers aboard both the Bering Sea and Gulf surveys wire tagged and released 50% of the viable halibut caught at each station. They also evaluated various aspects of the sampling plan as it was set forth and reported on ways that could make the tagging most effective without creating undue disruption to the survey deck work. Overall, the plan was very successful, with 487 and 1,497 halibut tagged in the Bering Sea and Gulf, respectively.

Given that the pilot was successful and NMFS personnel were receptive to the idea of tagging, the tagging effort on these platforms is scheduled to continue for the next several years.

New projects for 2016

Condition factor of halibut
Supports: Objective 3 – biology, physiology, and migration, Objective 4 – ecosystem interactions and environmental influences
Priority: High
Start: 2016
Anticipated Ending: Ongoing
Personnel: C. Dykstra, J. Planas

Tracking condition factors for the halibut population can provide information on the productivity of the stock in different areas, and can be coupled to reproductive information and/or energetics modeling as we develop our knowledge on these topics further under the

guidance of Dr. Josep Planas, who joined the IPHC staff in January. This information is a component of understanding growth variation in halibut and is also valuable to the development of harvest policy.

Project 2016-02: Early life history studies
Supports: Objective 3 – biology, physiology, and migration
Priority: Medium
Start: 2016
Anticipated Ending: 2016
Personnel: L. Sadorus, I. Stewart, J. Duffy-Anderson (NMFS)

This project is a collaborative effort with NMFS to examine existing NMFS ichthyoplankton data on halibut distribution, survival, diet habits, size/weight, and these factors in relation to environmental variables for halibut in life stages prior to metamorphosis. Current efforts to develop more spatially explicit models for stock assessment and harvest policy analysis and to evaluate the potential factors influencing year-class strength would benefit from an improved understanding of early life history.

This year's focus will be on analysis of components of connectivity between the Gulf of Alaska and the Bering Sea, using existing larval survey and oceanographic data, and is expected to require little or no additional cost to staff time. This effort may ultimately result in proposals for various experiments or other research in future years to fill identified data gaps.

RNA sequencing of gonads
Supports: Objective 3 – biology, physiology, and migration, Objective 4 – ecosystem interactions and environmental influences
Priority: High
Start: 2016
Anticipated Ending: 2017
Personnel: J. Planas

This project aims to provide important direct markers of reproductive activity in halibut gonads. Sex-specific genetic markers are important to the determination of spawning biomass.

A small sample (4-6) of fish, balanced by sex, will be sampled at each maturity stage. Genetic sequencing will be conducted under contract with a commercial lab or UW.

Additional details and future direction for this and related follow-up projects will be developed.

RNA sequencing of skeletal/liver tissue
Supports: Objective 3 – biology, physiology, and migration, Objective 4 – ecosystem interactions and environmental influences
Priority: High
Start: 2016
Anticipated Ending: 2017
Personnel: J. Planas

This project will perform initial screening of skeletal muscle and liver tissue for transcriptome markers associated with growth characteristics. The project directly addresses the issue of determining causes of growth variation in halibut.

A small sample (4-6) of fish, balanced by sex, will be sampled at each maturity stage. Genetic sequencing will be conducted under contract with a commercial lab or UW.

This project is a pilot to determine future activities in experimental examination of the sources of halibut growth variation.

4D Edge PAT tags

Supports: Objective 2 – harvest policy and management, Objective 3 – biology, physiology, and migration
Priority: Medium
Start: 2016
Anticipated Ending: 2017
Personnel: T. Loher

This project will help increase our understanding of the relationship of adult distribution and spawning contributions in the Bering Sea.

The IPHC has a history of conducting PAT tagging in the Bering Sea and Aleutian Islands (BSAI) in order to investigate both seasonal and inter-annual dispersal. These studies have been aimed at gaining greater understanding of the timing of movements within this stock component, identifying winter spawning locations and investigating mixing among regulatory areas in a fishery-independent manner. The results of these experiments have complemented previous large-scale Passive Integrated Transponder (PIT) tagging experiments.

Notable gaps in spatial coverage of PAT tag deployments still exist, however, relative to areas fished by BSAI fleet components. The IPHC currently plans to extend its standardized stock assessment survey into two of these areas during the 2016 and 2017 surveys, presenting a unique opportunity to fill these gaps in understanding. This project will tag halibut at the far-northern 4D Edge expansion stations in 2016; this is to be followed by tagging on Bowers Ridge during the 2017 survey expansion.

The work will be complementary to previous BSAI PAT tagging, using identical tagging and tag program protocols. A total of 32 halibut will be tagged at 4D Edge expansion stations, using PAT tags programmed to detach and report location and download archived environmental data.

Other

Undergraduate internship

This internship is designed to provide research experience and outreach to one undergraduate student per year who would not ordinarily have the skills and qualifications to work at the IPHC. Students are chosen through a highly competitive selection process from schools in both the U.S. and Canada. The intern is assigned a specific research project, and with staff guidance they then design, execute, report, and present their results at the end of the work term. Additionally, interns are assigned support tasks as time allows, that vary from year to year and generally include several different departments within the IPHC. In 2015, the intern was Nicholas Wong from Simon Fraser University. Nicholas worked with marine mammal depredation data collected during the IPHC setline surveys over several years. The data were collected in previous years and did not require a field component, but the intern was still able to spend one trip on the survey and shadow a port sampler for a week. A report on the 2015 intern project is included in the IPHC Report on Assessment and Research Activities 2015 (Wong 2016).

Remote Data Entry

In 2015, the IPHC worked on developing software applications for data entry of commercial and survey data into tablets with the intent of replacing the pencil and paper method currently used in

both programs. IPHC's programmers created and are still developing two applications: eLogs for the port sampling program and EaSEA (Entry At SEA) for the survey program.

The eLogs application was finalized for testing in the field and tablets were deployed with port samplers in select ports in 2014 for testing. Port samplers are using Panasonic Toughpads on which the eLog application was installed. Testing was ongoing throughout the season with fixes to the programming. At the start of the 2015 commercial halibut season all ports receiving Alaskan catch used the eLogs application on their assigned tablet to enter either all or as many of the logs they collected as possible. In 2016, Port samplers are collecting paper logs until they pass a strict set of criteria, at which point, the samplers will enter the log data directly into the eLog application during the skipper interviews.

The EaSEA application was also developed to replace the paper data forms that are currently used on the survey. In 2015 the EaSEA application was pilot tested in the field on two survey trips. Development and testing continued throughout the fall, and a larger scale pilot project will occur in 2016 using the EaSEA application as the main form of data collection on three vessels in the stock assessment survey. The goal is to use the EaSEA program on all vessels in the 2017 survey.

Future research directions

The IPHC staff has identified the following major themes for future research:

1. Reproduction and recruitment.
    a. Better understanding of halibut reproductive biology, growth, swimming performance, and behavior from a physiological perspective.
    b. Application of environmental data to recruitment scenarios and year class strength.
    c. Recruitment drivers – processes that affect recruitment and their relative contributions.
2. Size composition and mortality of released/discarded fish. Currently, little is known about the size/age of discards for some directed fisheries or the appropriate discard mortality rate to be applied. In addition, the increasing use of size restrictions in sport fishery management to more fully achieve harvest goals increases discards, but data collection programs are lacking and implications to the IPHC harvest policy are unclear. Lastly, changes in harvest policy, such as changes in the minimum commercial size limit, require data collection programs so that the impact of the changes in management procedures can be assessed. New tag technology using accelerometers offers great potential for this effort.
3. Full catch accounting. Information on removals from all sources is needed for the best assessment of stock status. Identification of gaps in reporting programs and impediments to progress in achieving full accounting are necessary to reach these goals.
4. Migration studies.
    a. An improved understanding of U26 migration, i.e., rates and timing by area and size of fish, as well as inter- and intra-annual variability. The current wire tag study is part of this effort.
    b. Improvements to archival tag technology for application to smaller halibut. Currently, pop-up satellite tags are limited to fish larger than 75 cm (~8 pounds), and archival

tags to fish larger than 50 cm (~2.2 pounds). Being able to place similar or newer technology tags on smaller halibut would enable collection of movement data for a size range over which data are currently lacking.

2. Assessment

The IPHC conducted a stock assesment in 2015 to report the recent trends and status of the Pacific halibut (*Hippoglossus stenolepis*) resource in the northeastern Pacific Ocean (see Stewart et al. 2016). Commercial fishery landings in 2015 were 24.7 Mlb, up from 23.7 Mlb in 2014. The 2015 setline survey coastwide legal (O32) and total (O32+U32) WPUE were 5% higher than values observed in 2014. Age distributions in 2015 from both the survey and fishery remained similar to those observed in 2011-2014, indicating a relatively stable stock, and no clear evidence of recent strong coastwide recruitments. At the coastwide level, individual size-at-age remains low relative to the rest of the time series, although there has been little change over the last several years.

The 2015 scientific review process produced a number of important recommendations that have been incorporated into this assessment. However, the basic approach used in 2014 remains unchanged: results from four assessment models are combined together into an 'ensemble.' As has been the case since 2012, results from this stock assessment are based on approximate probability distributions derived from the ensemble, thereby incorporating both the uncertainty within each model, as well as the uncertainty among models.

The two long time-series models provide a different perception of current vs. historical stock sizes. The Areas-As-Fleets (AAF) long model suggests the stock is currently increasing gradually and is at 39% of the equilibrium unfished stock size; however the model estimates that current spawning biomass is at only 140% of the minimum values estimated for the 1970s. The coastwide long model also suggests that the stock is currently increasing and at 54% of the equilibrium unfished stock size; however, the current spawning biomass is estimated to be at 236% of the minimum values estimated for the 1970s. The two short models are unable to provide insight into historical dynamics, and also provide differing perspectives of current stock size. These model differences highlight the considerable uncertainty in both the current stock size and trend. The results of the 2015 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010. That trend is estimated to have been a result of decreasing size-at-age, as well as recent recruitment strengths that are smaller than those observed during the 1980s and 1990s. Since that time period, the estimated female spawning biomass is estimated to have stabilized near 200 Mlb, with a slightly increasing trend. The median 2016 estimate of exploitable biomass, consistent with the IPHC's current harvest policy, is 185 Mlb.

Three-year projections were conducted for a range of alternative management actions; and probabilities of various risk metrics are reported in a decision-making table framework. The Blue Line of the decision table (representing the application of the current harvest policy) results in a coastwide total mortality of 38.7 Mlb. The stock is projected to increase gradually, given Blue Line levels of future harvest, and decrease with a greater than 50/100 chance for total mortality exceeding around 43 Mlb.

3. Management

The International Pacific Halibut Commission (IPHC) completed its 92nd Annual Meeting in Juneau, Alaska, on January 29, 2016, with Dr. James Balsiger presiding as Chair.

More than 280 halibut industry stakeholders attended the meeting, with over 80 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.

The Commission recommended, to the governments of Canada and the United States, catch limits for 2016 totaling 29.89 million pounds. The Commission also addressed other regulatory issues and took actions regarding assessment survey expansion and bycatch management. Documents and presentations from the Annual Meeting can be found on the Annual Meeting page of the IPHC website: http://www.iphc.int/meetings-and-events/annual-meeting.html.

Catch Limits

The Commission received harvest advice for 2016 from the scientific staff, Canadian and United States harvesters and processors, and recommended to the two governments the following catch limits for 2016:

IPHC Regulatory Area	Catch Limit (pounds)
Area 2A (California, Oregon, and Washington)	**1,140,000**
Non-treaty directed commercial (south of Pt. Chehalis)	193,364
Non-treaty incidental catch in salmon troll fishery	34,123
Non-treaty incidental catch in sablefish fishery (north of Pt. Chehalis)	49,686
Treaty Indian commercial	365,100
Treaty Indian ceremonial and subsistence (year-round)	33,900
Sport – Washington	214,110
Sport – Oregon	220,077
Sport – California	29,640
Area 2B (British Columbia) (includes sport catch allocation)	**7,300,000**
Area 2C (southeastern Alaska) (combined commercial/guided sport[1])	**4,950,000**
Commercial fishery (3,924,000 catch and 120,000 incidental mortality)	4,044,000
Guided sport fishery	906,000
Area 3A (central Gulf of Alaska) (combined commercial/guided sport[1])	**9,600,000**
Commercial fishery (7,336,000 catch and 450,000 incidental mortality)	7,786,000
Guided sport fishery	1,814,000
Area 3B (western Gulf of Alaska)	**2,710,000**
Area 4A (eastern Aleutians)	**1,390,000**
Area 4B (central/western Aleutians)	**1,140,000**
Areas 4CDE	**1,660,000**
Area 4C (Pribilof Islands)	733,600
Area 4D (northwestern Bering Sea)	733,600
Area 4E (Bering Sea flats)	192,800
Total	**29,890,000**

Fishing Season Dates

The Commission approved a season of March 19 to November 7, 2016, for the U.S. and Canadian quota fisheries. Seasons will commence at noon local time on March 19 and terminate at noon local time on November 7, 2016 for the following fisheries and areas: the Canadian Individual Vessel Quota (IVQ) fishery in Area 2B, and the United States IFQ and CDQ fisheries in Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E. All Area 2A commercial fishing, including the treaty Indian commercial fishery, will take place between March 19 and November 7, 2016. The Saturday opening date was chosen to facilitate marketing.

In Area 2A, eight 10-hour fishing periods for the non-treaty directed commercial fishery south of Point Chehalis, Washington, are recommended: June 22, July 6, July 20, August 3, August 17, August 31, September 14, and September 28, 2016. All fishing periods will begin at 8 a.m. and end at 6 p.m. local time, and will be further restricted by fishing period limits announced at a later date.

Area 2A fishing dates for incidental commercial halibut fisheries concurrent with the limited-entry sablefish fishery north of Point Chehalis and the salmon troll fishing seasons will be established under U.S. domestic regulations by the National Marine Fisheries Service (NMFS). The remainder of the Area 2A CSP, including sport fishing seasons and depth restrictions, will be determined under regulations promulgated by NMFS. Further information regarding the depth restrictions in the commercial directed halibut fishery, and details for the sport fisheries, is available at the NMFS hotline (1-800-662-9825). The Area 2A IPHC licensing procedures did not change.

Regulatory Changes

Charter Halibut Sector Management Measures for Areas 2C and 3A
The Commission received a request from the NPFMC to adopt charter halibut sector management measures in accordance with the NMFS CSP for Areas 2C and 3A. The NPFMC proposal is designed to keep removals by the charter fishery within the limits of the CSP. After consideration of the advice of the Council, Commission staff, Canadian and United States harvesters and processors, and other fisheries agencies, the Commission approved the following measures:

In Area 2C, 1) a one-fish daily bag limit, and 2) a "reverse slot" size limit restriction (≤ 43 inches or ≥ inches).

In Area 3A, 1) a two-fish daily bag limit, 2) a maximum size limit for the second fish of 28 inches, 3) a four-fish annual limit, 3) a vessel limit of one trip per calendar day, 4) a limit of one trip per charter permit per calendar day, and 5) a one-day-per-week closure of halibut charter fishing on Wednesdays throughout the year. In addition, immediately upon landing a halibut a harvest record is required, for which the angler must record the date and regulatory area in ink on the back of the State of Alaska sport fishing license.

The requirement to retain the filleted carcass on board the vessel until the fillets are offloaded will be removed from IPHC regulations. This requirement now appears in the NMFS regulations.

Longline Pot Gear

The NPFMC and NMFS are developing regulations that allow the use of longline pot gear, as defined by the NPFMC, in the IFQ sablefish fishery in the Gulf of Alaska (GOA). The NPFMC recommended that the Commission allow the retention of legal-sized halibut, if unfished halibut IFQ is available, in longline pot gear during the commercial halibut fishery season in the GOA.

The Commission approved longline pot gear, as defined by the NPFMC, as legal gear for the commercial halibut fishery in Alaska when NMFS regulations permit the use of this gear in the IFQ sablefish fishery. The expectation is that NMFS will implement regulations to allow the use of pot gear in the GOA IFQ sablefish fishery in late 2016 or at the beginning of the 2017 fishery.

The Commission intends to review the use of pot gear as legal gear for halibut in this fishery after three years.

Halibut with External IPHC Tags
The Commission approved the exemption of halibut with external IPHC tags from sport daily bag or possession limits, size limits, and season restrictions, and from personal use and subsistence daily bag or catch limits. Such tagged halibut are already exempt from commercial fisheries, and this change was made to ensure IPHC receives information from all tagged halibut that are caught.

Use of the NMFS eLog in Alaska
The Commission approved the explicit addition of the electronic version of the NMFS Groundfish/IFQ Daily Fishing Longline and Pot Gear logbook to the list of acceptable logbooks for use in the Alaskan commercial halibut fishery.

Area 2A Fish Tickets
The Commission approved changing the wording of regulations to make it clear that the Tribal Identification Number and not the Vessel Identification Number should be recorded on the fish ticket in the Area 2A Treaty Indian fisheries.

Other Actions

Discard Mortality Rate
In response to a motion approved by the Conference Board, the Commission directed the staff to re-examine the appropriateness of the 16% discard mortality rate (DMR) currently assigned to halibut released in the U.S. and Canadian directed halibut fisheries. The Commissioners noted that this would be part of a larger evaluation of DMRs that the IPHC and NMFS staffs are currently engaged in.

Nunivak Survey
In response to a Conference Board motion that the IPHC consider the feasibility of including in the annual IPHC setline survey additional sites around Nunivak Island, the Commission directed the staff to look at all available sources of information on abundance and distribution around Nunivak. The Commission invited fishers in that area to participate in the IPHC logbook program as a ready source of such information, and asked the staff to continue its outreach to the communities there.

Harvest Policy Analysis
The Conference Board recommended that the Commission prioritize and assign sufficient resources for the staff and the Management Strategy Advisory Board (MSAB), in conjunction with the Scientific Review Board, to review and update the harvest policy and harvest control rules. The Commission confirmed that such a review is a priority for the staff and the MSAB, and noted that it has provided additional resources for the project in this year's budget.

Halibut Bycatch
The Commission affirmed its commitment to bycatch reduction. The Commission directed the staff to continue its work to quantify bycatch and its impact on the halibut stock, and to promote the reduction of bycatch. The Commission also noted that bycatch management is a primary focus of the IPHC's developing relationship with the NPFMC.

Expanded Survey
The Commission approved the next in a series of expansions to the Commission's standardized stock assessment survey. In 2016, the Commission's survey in the Area 4D Edge will be expanded. The purpose of the expansion series is to reduce potential biases in the surveys among regulatory areas and to encompass depths to which the commercial fishery has recently expanded. The Commission will continue to review survey expansion at the next Annual Meeting.

V. Ecosystem Studies

Oceanographic monitoring of the north Pacific and Bering Sea continental shelf with water column profilers
Supports: Objective 4 – ecosystem interactions and environmental influences
Priority: Medium
Start date: 2009
Anticipated ending: Continuing
Personnel: L. Sadorus, J. Walker

The goal of this project is to measure oceanic properties in the waters over the Alaskan, B.C., and the U.S. west coast continental shelf that can be correlated to catch per unit effort (CPUE) of halibut as well as incidence of other groundfish species. The IPHC operates a survey that covers the area, and water column profilers that measure temperature, salinity, dissolved oxygen, pH, and florescence are deployed at each station. These data provide an annual snapshot of near-shore oceanic conditions as well as valuable observational data for studying halibut distributions in relation to environment, addressing environmentally related catchability in the survey, modeling, and biological studies on recruitment and growth variability.

In particular, understanding the dynamics of the structure of the mixed layer depth – a major Global Ocean Ecosystem Dynamics (GLOBEC) goal – requires in-situ vertical profiling. Since 2001, IPHC has successfully deployed a SeaBird SBE-19 water column profiler during the annual stock assessment survey. A second profiler was added to the program in 2007. In 2009, a National Oceanographic and Atmospheric Administration (NOAA) grant provided for the complete outfitting of all chartered survey vessels, resulting in a complete coastwide deployment. Annual costs are directed towards maintenance and calibration of the profilers, and data preparation necessary for submission to the National Ocean Data Center.

VI. Publications

International Pacific Halibut Commission. 2016. Report of Assessment and Research Activities 2015. http://www.iphc.int/publications/rara/2015/RARA2015_01TOC.pdf

Citations:

Stewart, I.J., Monnahan, C.C., Martell, S. 2016. Assessment of the Pacific halibut stock at the end of 2015. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2015: 188-209.

Wong, N. 2016. Marine mammal depredation on IPHC standardized setline surveys: a look at killer whales and sperm whales as major depredators in Alaska waters. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2015: 418-441.