

Appendix

IPHC research program: Review of 2001 projects and proposals for 2002

The International Pacific Halibut Commission Staff
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Introduction

This document reviews research conducted by the IPHC staff in the past year and proposed for the upcoming year. The report is divided into two sections, with the first section reviewing the status of research projects conducted 2001. The second section presents the staff research proposals for 2002. Information is provided on when each project began, the anticipated completion date, the annual cost and total cost, a description of the costs, and the purpose of the project. This report does not include ongoing staff tasks such as data collection and processing that are necessary for the management of the fishery.

Research projects are organized into three funding categories that reflect availability and source of research funds. Limited research requiring cash outlay is possible under the basic \$2.6M (as of 2001) government appropriations, although a number of programs can be conducted using only the staff resources that are supported by the appropriations. The three funding categories are:

- 1) **Appropriations:** Necessary research projects of high priority that can be conducted under the basic \$2.6 million budget;
- 2) **Supplemental:** Necessary research projects of high priority that can only be conducted with revenues generated by survey fishing in 2002, grants or contributions, or carry-over from 2001; and
- 3) **Contract:** Agreements to conduct specific research projects. In this report, contracts are shown for projects where the IPHC staff is the principle investigator, and projects that IPHC has contracted to other investigators.

The summary report also shows the program to which the project belongs. Internally, the staff is organized into three programs; (1) Fishery Statistics and Regulations, (2) Biological Research and Fishery Management, and (3) Stock Assessment. These programs are directed by a manager, who works with program staff to determine priorities, work objectives and staffing needs, and ensures timely project completion.

Throughout this report the status of projects is stated as being either completed, continuing, or deferred. To be completed, a project has been fully analyzed and the results reported in the RARA, the IPHC report series or an outside peer-reviewed journal. Continuing projects are those which are still underway, with the staff performing analysis or writing the report. A project is deferred when it is postponed until the following year.

Nearly all of the research done by the staff is directed toward one of three continuing objectives of the Commission:

- i) improving the annual stock assessment and quota recommendations;
- ii) developing information on current management issues;
- iii) adding to knowledge of the biology and life history of halibut.

In each of these areas our routine work program applies the best information and methods available, and our research program aims to improve the information and methods by answering the most important outstanding questions.

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SECTION I: REVIEW OF RESEARCH CONDUCTED IN 2001

Research conducted by the IPHC staff during 2001 covered a myriad of subjects, from chalky halibut investigations to bycatch to issues that bear on the stock assessment. Most of the projects were conducted as part of the normal staff duties, with no additional funding required outside of staff salaries. Funding for projects outside of staff salaries came from supplemental funding, and are outlined below.

Staff Research

Eight projects are listed on the following page as being completed in 2001, although all of these are considered as ongoing research, to be conducted in 2002 and subsequent years. For example, we are expecting to assist the Alaska Fisheries Development Foundation (AFDF) or other industry group in 2002 with the funding of a project further examining chalky halibut. Staff efforts in the PIT tagging project in 2001 were focused on establishing baseline information on tagging location, shedding, and mortality rates, setting the stage for the comprehensive project planned for 2002. The programs for undergraduate internships, water column profilers and trophic status studies on the assessment surveys, and staffing of the NMFS trawl survey are also planned for 2002. The post-doctoral fellowship was filled later in the year than expected, but the position is continuing into 2002, after which it will be converted to full-time status.

Contract Research

IPHC was party to two contracts in 2001. In the first (Project #614), IPHC port samplers picked up copies of the NMFS hook-&-line catcher vessel and sablefish logbook sheets during their dockside logbook interviews. The samplers perform some editing to the logs, which are then sent to the Seattle office and forwarded on to the NMFS lab in Auke Bay, Alaska. IPHC was paid \$7,000 in 2001, the fourth year in a five-year contract.

The second contract (Project #611) entailed describing all IPHC setline charters that are represented in the setline database. The project, with Mr. Dan Randolph, is resulting in a report to be published in the IPHC report series. For each charter, and to the extent that the information can be located, the report will include: (1) purpose of the charter; i.e., general nature of the project and survey objectives; (2) how fishing locations were chosen; (3) gear, bait, and fishing procedures; (4) number of stations fished and skates hauled; and (iv) catch sampling and data recording protocol. The information was obtained from records and reports of the Commission and personal interviews, and checked by examining the data actually present in the database. The report included an annotated list of the documents from which the information came.

**Budget Summary for 2001 Projects Funded
Through Supplemental Revenues**

Project Acct #	Project Title	Proposed	Actual
410	Chalky halibut investigations – time development of pH changes	\$ 2,000	\$ 6,824
411	PIT Tagging Study – tag selection & retention	75,500	45,272
412	PIT Tagging Study – field experiment	60,000	0
413	PIT Tagging Study – field detection experiment	10,000	0
602	Spatial and ontogenetic variability in the trophic status.....	30,000	7,356
604	NMFS trawl survey: at-sea data collection & IPHC data base.....	35,000	29,227
607	Graduate student	20,000	0
608	Update halibut viability video used in NMFS observer training	500	0
609	Post-doctoral fellowship	52,000	17,115
610	Deployment of a water column profiler	1,500	2,570
616	Field testing of halibut excluder gear for cod trawls (Groundfish.....	50,000	45,932
618	Undergraduate internships	20,000	23,925
	GRAND TOTAL	\$ 356,500	\$ 178,221

Other 2000/2001 Research – Contracts

Project Acct #	Project Title	Income	Expense
611	Description of 1963-1999 setline charters from IPHC data base	\$ 0	\$ 20,000
614	NMFS catcher vessel logbook and sablefish data collection	7,000	0
	GRAND TOTAL	\$ 7,000	\$ 20,000

Summary of 2000/2001 Research Projects and Status

I. FUNDED THROUGH APPROPRIATIONS

Project		
Acct. #	Project Title	Status
<i>Program: Biological Research and Fisheries Management</i>		
—	Pacific halibut aging manual	Completed
—	Monitoring changes and discrepancies in application of aging criteria using otolith images in a computer paint program	Continuing
—	Otolith break-and-burn percentage agreement	Continuing
—	Changes in assigned ages over time due to changes in application of criteria and equipment	Continuing
—	Otolith exchange with eastern Canadian branch of DFO	Continuing
—	Otolith marginal increment analysis	Continuing
—	Incidence of crystallized otoliths from the SSA surveys	Continuing
—	Sport halibut fishery review	Continuing
—	Prior hook injury (PHI) study on setline surveys	Continuing
—	Hook-size/bait-size comparison	Continuing
—	Documentation of historical special setline experiments	Continuing
—	Analysis of 1998-1999 special setline experiments	Continuing
—	Time stratified sampling by observers for halibut viability and length	Deferred
<i>Program: Stock Assessment</i>		
—	The 2001 stock assessment	Completed
—	Development of a less variable harvest policy	Continuing
—	Review and analysis of historical IPHC tagging data	Continuing
—	Investigation of changes in setline survey selectivity	Continuing
—	Influence of near bottom ocean conditions on juvenile halibut growth	Completed
—	Rescue of IPHC hydrographic data back to 1935	Completed
—	Density-dependent and –independent control of halibut growth and recruitment	Continuing
—	Bait and hook effects on setline catchability and selectivity	Continuing
—	Misclassification of ages	Continuing
—	Development of a Geographic Information System (GIS)	Continuing
—	Discard mortality rates and bycatch length frequency estimates	Continuing
—	Halibut bycatch mortality and length composition, 1974-2000	Completed
<i>Program: Fishery Statistics and Regulations</i>		
—	The effects of changing gear in the halibut fishery following IQs	Deferred
—	Impacts of extending the commercial fishery season	Completed
—	IPHC statistical area documentation	Continuing
—	Review of port sampling, 1994 to present	Deferred
—	Verification of the commercial catch database, 1974 to present	Continuing

II. FUNDED THROUGH SUPPLEMENTAL REVENUES

Project		
Acct. #	Project Title	Status
<i>Program: Biological Research and Fisheries Management</i>		
410	Chalky halibut investigations – time development of pH changes	Completed
411-13	PIT tagging study: 2001 field trials	Completed
607	Graduate student (carryover from 1999/2000)	Deferred
608	Update halibut viability video used in NMFS observer training (carryover from 1999/2000)	Deferred
609	Post-doctoral fellowship	Completed
617	Field testing of halibut excluder gear for cod trawls (carryover from 1999/2000)	Completed
618	Undergraduate internships	Completed
<i>Program: Stock Assessment</i>		
602	Spatial and ontogenetic variability in the trophic status of Pacific halibut	Continuing
604	NMFS trawl survey: at-sea data collection & IPHC data base management	Completed
610	Deployment of a water column profiler	Completed

III. CONTRACTS

Project		
Acct. #	Project Title	Status
611	Description of 1963-1999 setline charters from IPHC database	Completed
628	NMFS catcher vessel logbook and sablefish data collection	Completed

2000/2001 Research-Related Publications

Current and former IPHC staff members are indicated in bold type

- Chen, D. G.** 2001. Detecting environmental regimes in fish stock-recruitment relationships by fuzzy logic. *Can. J. Fish. Aquat. Sci.* 58(11):
- Chen, D. G.** and J. Irvine. 2001. A semiparametric approach to analyze stock-recruitment relationship with environmental effects and fishery interventions. *Can. J. Fish. Aquat. Sci.* 58:1178-1186.
- Chen, D. G.**, Irvine, J.R. and Cass, A. Incorporating allee effects in salmon stock-recruitment model and applications for determining reference. Accepted to the *Canadian Journal of Fishery and Aquatic Sciences*.
- Clark, W. G.** 2001. In press. F35% revisited ten years later. *North American Journal of Fisheries Management*.
- Geerneart, T. G., Gilroy, H. L., Kaimmer, S. M., Williams, G. H., and Trumble, R. J.** 2001. Feasibility study that investigates options for monitoring bycatch of the short-tailed albatross in the Pacific halibut fishery off Alaska. Prepared for the National Marine Fisheries Service in completion of contract reference order number 40HANF000046.
- Hare, S. R.** and Mantua, N. J. 2001. An historical narrative on the Pacific Decadal Oscillation, interdecadal climate variability and ecosystem impacts. Report of a talk presented at the 20th NE Pacific Pink and Chum workshop, Seattle, WA, 22 March 2001.
- Hollowed, A.B., **Hare, S. R.**, and Wooster, W. S. 2001. Pacific-basin climate variability and patterns of Northeast Pacific marine fish production (pdf file). *Prog. Oceanogr.* 49:257-282.
- Irvine J. R., Parken, C. K., **Chen, D. G.**, Candy, J., Ming, T., Supernault, J., Shaw, W. and Baily, E. 2001. 2001 assessment of stock status for coho salmon from the interior Fraser River. *Canadian Stock Assessment Secretariat Research Document*, 2001/083, pp 68.
- Leaman, B.M.** 2001. Resource management and environmental issues concerning live halibut landings. pp. 155-157 *In* B. C. Paust and A. A. Rice (eds.) *Marketing and Shipping Live Aquatic Products: Proceedings of the Second International Conference and Exhibition*, November 1999, Seattle, WA. University of Alaska Sea Grant. AK-SG-01-03. 320 p.
- Lluch-Cota, D.B., Wooster, W. S., and **Hare, S. R.** 2001. Sea surface temperature variability in coastal areas of the Northeastern Pacific related to the El Niño-Southern Oscillation and the Pacific Decadal Oscillation (pdf file) (Word version available here) *Geophys. Res. Lett.* 28:2029-2032.

Mantua, N. J. and **Hare, S. R.** In Press. The Pacific Decadal Oscillation. *J. Oceanography*.

Parker, S. J., Berkley, S. A., Golden, J. T., Gunderson, D. R., Heifetz, J., Hixon, M. A., Larson, R., **Leaman, B. M.**, Love, M. S., Musick, J. A., O'Connell, V. M., Ralston, S., Weeks, H. J. and Yoklavich, M. M. 2000. Management of Pacific rockfish: American Fisheries Society Policy Statement. *Fisheries* 25(3):22-30.

SECTION II: RESEARCH PROPOSED FOR 2002

The IPHC staff has identified 16 research projects for 2002 which require funding from outside Commission appropriations. Several are continuing projects, having been initiated in 2001 or earlier. We are proposing to continue these projects in 2002. Nine projects are new to the list, including two that have been underway for two years but are only now requiring funding for additional supplies. All projects requiring funding in 2002 are summarized in the table on the next page. Also shown are two contract projects that provide revenue and no costs other than staff salaries. The table also shows Line Numbers (e.g., S.2) for reference to the detailed descriptions which follow on subsequent pages.

During the 2001 Annual Meeting, the Commission requested that the staff develop research that seeks to answer questions about the origins of adult halibut in some areas, especially in Area 2B, the processes that deliver them to those areas, and how the variability in the ocean environment affects recruitment. The staff has created a set of projects for 2002 that attempt to examine several aspects of these relationships, and are listed below. In addition, other projects are being designed for 2003 that may further add to this focus.

Projects in 2002

- S.2 – *PIT tagging study (page 25).*
- S.8 – *Analysis of spatial recruitment dynamics using otolith elemental fingerprints (Phase 1) (page 27).*
- S.9 – *Genetic population structure assessed via mitochondrial DNA and nuclear microsatellite diversity (Phase 1) (page 28).*
- S.10 – *Pop-up, satellite-transmitting archival tags (PSTATS) to study halibut movements (page 29).*
- S.14 – *Spatial and ontogenetic variability in the trophic status of Pacific halibut (page 31).*
- S.15 – *Expansion of the water column profiler (page 32).*

Additional Projects for 2003

- I. *PIT tag sampling to elucidate seasonal migration patterns of adult Pacific halibut (page 34).*
- II. *Group-level breeding site fidelity of Pacific halibut assessed using otolith elemental fingerprints (page 35).*

**Budget Summary For Projects Proposed For 2002
Which Require Funding**

Line No.	Project Title	Proposed
<i>Field Experiments¹</i>		
S.1	Chalky halibut research (#410)	\$ 30,000
S.2	PIT Tagging Study – Tag selection and retention experiments (#411)	15,000
S.2	PIT Tagging Study – Field experiment/releases (#412)	304,000
S.2	PIT Tagging Study – Dockside detection/recoveries (#413)	420,000
S.3	Bait quality studies (#414)	92,000
<i>Sub-Total</i>		<i>\$ 861,000</i>
<i>Other Research</i>		
S.4	Graduate student (#607)	\$ 2,670
S.5	Post-doctoral fellowship (#609)	43,000
S.6	Undergraduate internships (#618)	25,000
S.7	Update halibut viability video used in NMFS observer training (#608)	500
S.8	Analysis of spatial recruitment dynamics using otolith elemental...(#620)	20,000
S.9	Genetic population structure assessed via mitochondrial DNA and...(#621)	13,000
S.10	Pop-up, satellite-transmitting archival tags (PSTATS) to study...(#622)	50,000
S.11	Halibut age validation proposal utilizing ¹⁴ C radiocarbon (#624)	25,000
S.12	Otolith marginal increment analysis (#626)	2,000
S.13	GIS applications to Pacific halibut (#623)	5,700
S.14	Spatial and ontogenetic variability in the trophic status of Pacific... (#602)	30,000
S.15	Expansion of the water column profiler project (#610)	1,500
S.16	NMFS trawl survey: at-sea data collection & IPHC data base mgmt. (#604)	30,000
<i>Sub-Total</i>		<i>\$ 248,370</i>
<i>GRAND TOTAL</i>		<i>\$ 1,109,370</i>

¹Proposed budget amount does not include any expected revenue generated from the sale of fish.

Other 2001/2002 Research – Contracts

Line No.	Project Title	Income	Expense
C.1	Retrospective studies of climate impacts on Alaska Steller....(#801)	\$ 6,000	0
C.2	NMFS catcher vessel logbook and sablefish data collection (#802)	7,000	0
<i>GRAND TOTAL</i>		<i>\$ 13,000</i>	<i>0</i>

Summary List of Proposed 2001/2002 Research

I. FUNDED THROUGH APPROPRIATIONS

Line		
No.	Project Title	Page
<i>Biological Research and Fisheries Management Program</i>		
A.1	Monitoring changes and discrepancies in application of aging criteria using computerized otolith images	115
A.2	Otolith break-and-burn percentage agreement	115
A.3	Changes in assigned ages over time due to changes in application of criteria and equipment	115
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A.11	Time stratified sampling by observers for halibut viability and length	118
<i>Fishery Statistics and Regulations Program</i>		
A.12	The effects of changing gear in the halibut fishery following IQs	119
A.13	Impacts of extending the commercial fishery season	119
A.14	IPHC statistical area documentation	119
A.15	Review of port sampling, 1994 to present	120
A.16	Verification of the commercial catch database, 1974 to present	120
A.17	Development of an interagency Electronic Fishery Information Collection and Management Program in Alaska	120
A.18	Preliminary assessment of mercury incidence in Pacific halibut	121
A.19	Examination of the hook by hook information from the stock assessment surveys ..	121
<i>Stock Assessment Program</i>		
A.20	The 2002 stock assessment	122
A.21	Addition of NMFS trawl survey data to the stock assessment	122
A.22	Development of a medium-term harvest policy	122
A.23	Development of a formal medium-term recruitment forecast	123
A.24	Misclassification of ages	123
A.25	Estimation of halibut abundance from mark-recapture data	123
A.26	Recruitment variability and the spatial distribution of juvenile halibut in the eastern North Pacific	124
A.27	Geostatistics/GIS methods for halibut spatial/temporal distribution	125
A.28	Density-dependent and independent control of halibut growth and recruitment	125
A.29	Discard mortality rates and bycatch length frequency estimates	125
A.30	Halibut bycatch mortality and length composition, 1974-2000	126

II. FUNDED THROUGH SUPPLEMENTAL REVENUES

Line		
No.	Project Title	Page
<i>Biological Research and Fisheries Management Program</i>		
S.1	Chalky halibut research (# 410)	127
S.2	PIT tagging study – Tag selection & retention experiment (#411)	127
S.2	PIT tagging study – Field experiment/releases (#412)	128
S.2	PIT tagging study – Dockside detection/recoveries (#413)	128
S.3	Bait quality studies (#414)	128
S.4	Graduate student (#607)	128
S.5	Post-doctoral fellowship (#609)	128
S.6	Undergraduate internships (#618)	129
S.7	Update halibut viability video used in NMFS observer training (#608)	129
S.8	Analysis of spatial recruitment dynamics using otolith elemental fingerprints (phase 1) (#620)	129
S.9	Genetic population structure assessed via mitochondrial DNA and nuclear microsatellite diversity (phase 1) (#621)	130
S.10	Pop-up, satellite-transmitting archival tags (PSTATS) to study halibut movements (#622)	131
S.11	Halibut Age Validation Proposal Utilizing ¹⁴ C Radiocarbon (#624)	132
S.12	Otolith marginal increment analysis (#626)	132
<i>Fishery Statistics and Regulations Program</i>		
S.13	GIS applications to Pacific halibut (#623)	133
<i>Stock Assessment Program</i>		
S.14	Spatial and ontogenetic variability in the trophic status of Pacific halibut (#602)	134
S.15	Expansion of the water column profiler project (#610)	134
S.16	NMFS trawl survey: at-sea data collection and data base management (#604)	135

II. CONTRACTS

Line		
No.	Project Title	Page
<i>Stock Assessment Program</i>		
C.1	Retrospective studies of climate impacts on Alaska Steller sea lions	136
C.2	NMFS catcher vessel logbook and sablefish data collection	136

PROJECTS FUNDED THROUGH APPROPRIATIONS

Biological Research and Fishery Management Program

A.1 Monitoring changes and discrepancies in application of aging criteria using computerized otolith images

Status: Continuing

Cost: Staff Salaries

Start Date: 1999

Anticipated ending: 2002

Personnel: Forsberg, Wischniowski, Blood

This study will compare between and within reader consistency in application of aging criteria. There is no permanent record of any particular age interpretation. A reader cannot replicate 100% of his or her own ages, let alone another reader's. In these cases of disagreement, whether with oneself or another reader, the reader(s) must be interpreting the growth patterns differently, and it may not be clear why, or where the discrepancy(s) occur(s). Even when two readers assign the same age to a given otolith, it cannot be assumed that they have "read" or interpreted the same marks as annuli. A series of scanned otolith photos and a computer paint program will be used. For each image, readers will mark what they are interpreting as annuli and save the marks in an overlay. Each reader would repeat the process after a period of time and the overlays would be compared within and between readers for discrepancies in application of aging criteria.

A.2 Otolith break-and-burn percentage agreement

Status: Continuing

Cost: Staff Salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Forsberg, Wischniowski, Tobin

Repeat of Bill Clark's 1995 break and burn study. Double blind readings of broken and burnt otolith sections will be compared for percent agreement. Sample will be a subset of the 1999 survey otolith collection. Percent agreement values will be incorporated into IPHC aging quality control standards. Manuscript in draft form.

A.3 Changes in assigned ages over time due to changes in application of criteria and equipment

Status: Continuing

Cost: Staff Salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Forsberg, Blood, Wischniowski

Current readers will age a set of archived otoliths that were originally aged 20-25 years ago and current and original ages will be compared and examined for changes/shifts in the age distribution due to different aging practices. These otoliths will then be aged again using an old Bausch & Lomb microscope to test for differences in ages due to equipment.

A.4 Otolith exchange with eastern Canadian branch of DFO

Status: Continuing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Forsberg, Williams

IPHC has been involved with several otolith exchanges over the years to compare aging methods with various agencies. The Committee of Age Reading Experts (CARE) encourages age determination units to regularly exchange otoliths to gain new perspectives on age reading. Atlantic halibut otoliths were provided for IPHC age-readers in the early 1980s, but a larger scale exchange would be useful to compare the aging methods, criteria, and time of formation of annuli between Atlantic and Pacific halibut. Otolith exchange was expected but did not occur in 2001, but is anticipated in 2002.

A.5 Incidence of crystallized otoliths from the 1998-99 setline surveys

Status: Continuing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Tobin, Forsberg

Crystallization of the otolith, a defect that occurs throughout the range of Pacific halibut, impairs the readability of the earbone to the point of rejection from the age reading collection. The cause of crystallization is unknown though various hypotheses have been suggested ranging from pollution effects to genetic defects. In 1998 and 1999 the incidence of crystallized otoliths was recorded during otolith collection on the stock assessment surveys. This project will examine the occurrence rate among areas and years, and with sex and age of fish. The project was deferred in 2001 due to a change in Kong's job responsibilities.

A.6 Sport halibut fishery review

Status: Continuing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Blood

This report will document the changes in the sport halibut fishery since Skud's report which identified the process which recognized the sport fishery in 1973. Topics will include early attempts to estimate the catch in Alaska and British Columbia, voluntary log book program, sport fish questionnaires, Area 2A catch sharing plan, and separation of allocation from IPHC regulations. This project was postponed from 1998-1999.

A.7 Prior hook injury (PHI) study on setline surveys

Status: Continuing

Cost: Staff salaries

Start Date: 1997

Anticipated ending: Ongoing

Personnel: Williams

Data on the presence and severity of prior hook injuries on halibut caught on the 1999 setline surveys will be analyzed. This continues the data collection and analysis which began with the 1997 surveys. This work will continue for several years to see if the incidence of prior hooking injuries decreases, as the halibut careful release program for longline fisheries should cause fewer release injuries of bycaught halibut.

A.8 Hook-size/bait-size comparison

Status: Continuing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Kaimmer

This project will follow up on work conducted in 2000, which was spoiled by extremely high catch rates on the first day, necessitating fishing the remainder on very poor ground. The project compares halibut catches (CPUE) on two sizes of hook (14/0 and 16/0) with two sizes of chum bait (2.5 oz and 5 oz). This project will require two vessel charters, one in Area 3A and one in Area 2B. We learned from the 1998 special experiments that bait size affects CPUE and hook size affects size distribution. This project will give a definitive estimate of the combined effects of bait and hook size on halibut CPUE and size composition. There may not be staff time available for this in 2002, but it may piggyback on the tagging experiment.

A.9 Documentation of historical special setline experiments

Status: Continuing

Cost: Staff salaries

Start Date: 2001

Anticipated ending: 2002

Personnel: Kaimmer

The Commission has conducted a number of special experiments – those with specific objectives separate from stock assessment surveys – over the years. We will consolidate into a single source the objectives, results, data formats, and caveats for each experiment, and evaluate the overall performance of the special experiments. The report will also summarize or give references to any written reports resulting from the experiments. This effort will include an investigation of the IPHC data base, and more properly archiving some data sets which do not fit into the current IPHC data format (including camera observations, hook timer data, and mortality study information).

A.10 Analysis of 1998-1999 special setline experiments

Status: Continuing

Cost: Staff salaries

Start Date: 2001

Anticipated ending: 2002

Personnel: Kaimmer, Williams

The first phase summarizes fishing effort and results from special setline experiments conducted during the summer of 1998. These experiments included bait size, bait type, bait quality and gear type comparisons. The report will include analyses of catches by numbers, pounds, and size of fish caught. The second phase summarizes the winter/summer experiment comparing a standard chum salmon bait to two sizes each of squid and pollock bait, and discussing the usefulness of these baits as possible alternates to the chum currently used in the grid surveys.

A.11 Time stratified sampling by observers for halibut viability and length

Status: Deferred from 1999

Cost: Staff salaries

Start Date: 1999

Anticipated ending: 2002

Personnel: Williams

The objective of this project is collect halibut bycatch length and viability data independent of species composition sampling on trawl catcher/processors. This information will improve the accuracy of halibut viability data collected by observers. Observers will be tasked with conducting special halibut length/viability (L/V) sampling during a portion of their vessel assignment in lieu of their regular (traditional) sampling for halibut length and viability. During a special sampling period, sampling the catch from an individual haul for species composition will occur from basket samples, as has been past practice. L/V sampling of halibut bycatch will be conducted from the same hauls as the basket samples, but during specific separate time intervals, rather than at the observer's discretion. This project was postponed from 1999 because it conflicted with the Observer Program workload.

Fishery Statistics and Regulations Program

A.12 The effects of changing gear in the halibut fishery following IQs

Status: Continuing

Cost: Staff salaries

Start Date: 2001

Anticipated ending: 2002

Personnel: Leaman, Gilroy, Kong

Many more vessels now fish for combinations of sablefish and halibut, and to a much lesser extent, Pacific cod and rockfish. This has resulted in associated changes in the type and quantity of gear used in harvesting halibut, particularly as it concerns hook size and spacing. The second major issue is the distribution and timing of fishing effort within the 8-month season. GIS will aid in the analysis of fishing distribution. These issues have been previously examined for the Area 2B fishery after Canada implemented IVQs, but it is time to examine the impact of these changes on data obtained from the fishery off Alaska and used in the stock assessment. Limited progress on this project in FY 2001 due to commitments on data rationalization and expanded responsibility for Gilroy. Major activities on this project will be completed in 2002.

A.13 Impacts of extending the commercial fishery season

Status: Initial report - completed

New report – completed

Cost: Staff salaries

Start Date: 1999

Anticipated ending: 2002

Personnel: Leaman, Gilroy, Sadorus, Clark, other agency and industry personnel

The initial report was presented to the Commissioners and industry at the 2000 Annual Meeting. The Commission staff was asked to continue to review the possibilities of an extended fishing season. The Conference Board acknowledged that the interception of migrating fish during winter fishing is a serious concern to the staff but requested that further measures be reviewed to allow partial winter fishing. Summary report addressing points raised by Conference Board prepared and reviewed with industry Research Advisory Board in September, 2001. Revised report will be presented to 2002 Annual Meeting.

A.14 IPHC statistical area documentation

Status: continuing

Cost: Staff salaries

Start Date: 1999

Anticipated ending: 2002

Personnel: Gilroy, Leickly, Kong

The project is to document the baseline and finer resolution IPHC statistical areas, especially from the inside areas of British Columbia and SE Alaska. The finer resolution statistical areas are now being used to provide more detailed commercial catch data to the industry. Completed parts of this project include defining polygons for each statistical area (1999) and plotting statistical areas in GIS (2001). Documentation of historical and current statistical area definitions will be completed in 2002.

A.15 Review of port sampling, 1994 to present

Status: Deferred in 2001

Cost: Staff salaries

Start Date: 2002

Anticipated ending: 2003

Personnel: Hutton

Report on the changes that have occurred in the commercial catch sampling and port sampling program from 1994 to the present. For example, the report will review the changes made to the program due to the implementation of the IFQ fishery in Alaska, the changes in the method of logbook data collection in the U.S., as well as changes in the Canadian program. This is an update of Technical Report 32. Work in 2001 was deferred due to staff changes.

A.16 Verification of the commercial catch database, 1974 to present

Status: Continuing

Cost: Staff salaries

Start Date: 1999

Anticipated ending: Ongoing

Personnel: Gilroy, Kong, Taheri

The project is to make records of the commercial landing and fishing logbook data available for stock assessment in an on-line log-dealer relational database system and to update commercial-catch databases (and all databases) with current and historical statistical areas. The project includes summarizing data and providing tables of commercial catch by year, fishing period, regulatory area, detailed statistical area, and landing port. Results will appear in printed form and on the IPHC homepage. Little was accomplished on this project in 2001 due to other commitments.

A.17 Development of an interagency Electronic Fishery Information Collection and Management Program in Alaska

Status: New

Cost: Staff salaries, possibly travel costs if they are not included in grant (\$1,500)

Start Date: 2002

Anticipated ending: Ongoing

Personnel: Gilroy, Taheri, Vienneau

IPHC staff are involved in a cooperative interagency group that will be working with a contractor hired by the Pacific States Marine Fisheries Commission (PSMFC) to analyze the requirements of electronic reporting of fishery information by Alaska Department of Fish and Game, National Marine Fisheries Service and IPHC. The immediate goal is reporting of groundfish and halibut landings. The IPHC data involved are the fish ticket records.

A.18 Preliminary assessment of mercury incidence in Pacific halibut

Status: New

Cost: Staff salaries and possibly costs of assays

Start Date: 2002

Anticipated ending: 2003

Personnel: Dykstra (possibly with other agency and industry personnel)

Recent reports from health officials and media have raised the profile of mercury contamination in fish. The staff is currently attempting to determine what specific information is available on mercury contamination in halibut. In 2002, the staff proposes to further examine mercury incidence in halibut from a sub sample of survey and/or commercially caught fish. A cross section of samples will give us a better understanding of this issue and how it relates to the halibut resource and may help identify further areas of investigation. Scope of the project will be decided once available information is reviewed.

A.19 Examination of the hook by hook information from the stock assessment surveys

Status: New

Start Date: 2001

Cost: Staff salaries

Anticipated ending: 2002

Personnel: Rob Kronlund (DFO/PBS), Geernaert, Ranta

The project is preparing a report comparing the complete hook-by-hook information that was entered in 1993 and 1995 to the current estimate that uses the 20-hook subsample. IPHC staff is providing DFO data from the 2000/2001 survey logbooks. This new information compares 20-hook estimates to what was actually recorded on each set. IPHC staff is also assisting DFO decipher data base inconsistencies and coding.

Stock Assessment Program

A.20 The 2002 stock assessment

Status: Ongoing

Cost: Staff salaries

Start Date: 1926

Anticipated ending: Ongoing

Personnel: Clark, Hare, Chen

The annual stock assessment process comprises a large amount of work including preparation of IPHC data, estimation of bycatch by length in other fisheries, model development and validation, model fitting, examination of residuals, comparison of alternative model specifications, sensitivity tests, evaluation of harvest strategy, incidental analyses, and reporting.

A.21 Addition of NMFS trawl survey data to the stock assessment

Status: Ongoing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Clark

Staff estimates of setline CEY are based on a simple age-structured model fitted to survey and commercial setline data. It is possible to add NMFS trawl survey data to the fit, and that was attempted in the 2000 assessment but the fits were very poor. The effort will be repeated with the 2001 trawl data included and the results written up (but not used for CEY estimates).

A.22 Development of a medium-term harvest policy

Status: Continuing

Cost: Staff salaries

Start Date: 2001

Anticipated ending: continuing

Personnel: Hare, Clark

Staff quota recommendations are calculated by applying a judiciously chosen harvest rate to an estimate of present exploitable biomass. The harvest rate policy was developed on the basis of its performance over a long time horizon and with the explicit goal of avoiding reaching the minimum stock sizes seen in the 1930s and 1970s. On the basis of recent work, new insights have been developed on the factors controlling growth and recruitment which together determine productivity of the stock. The aim of this project is to reevaluate the harvest policy with the dual goals of projecting expected harvest levels over the next 5-7 years and stabilizing the quotas, while continuing to avoid driving the stock near its historical minimum size.

A.23 Development of a formal medium-term recruitment forecast

Status: New

Cost: Staff salaries

Start Date: 2002

Anticipated ending: Ongoing

Personnel: Hare, Clark, Chen

Confidence in projected safe harvest levels over the medium term requires confidence in projections of expected recruitment over the next 1-7 years. Industry and stakeholders also have great interest in the IPHC recruitment predictions. A number of new methods of predicting recruitment have been developed over the past few years. The goal of this project is to create a forum for assembling and describing these models and evaluate them in a formal time series analysis framework. It is expected that an official IPHC best guess recruitment forecast will be produced along with associated confidence bounds.

A.24 Misclassification of ages

Status: Ongoing

Cost: Staff salaries

Start Date: 2000

Anticipated ending: 2002

Personnel: Chen, Clark, Forsberg

Halibut age readings (either surface or break-and-burn) are somewhat variable, and using them at face value misrepresents the age composition of the landings. In particular, it leads to underestimates of the strength of large year-classes. The error can be corrected by estimating a misclassification matrix and incorporating it into the assessment model. We have assembled datasets of independent readings by both methods for this purpose, but the analysis has not been finished.

A.25 Estimation of halibut abundance from mark-recapture data

Status: Ongoing

Cost: Staff salaries (analysis only)

Start Date: 2001

Anticipated ending: Ongoing for several years at least

Personnel: Chen, Clark, Leaman

The IPHC has conducted many tagging programs since the 1920s. The IPHC has also conducted at least five reviews of these programs, again with differing objectives. However, many of these reviews did not account for the issues of non-reporting or differential reporting of tags by areas, fishing effort effects on recovery probabilities, the relationship of initial tag releases and the density of fish in given areas, and the effect of seasonal migratory patterns on the analysis of recoveries were not always considered. A changed paradigm for the area-specific impacts of juvenile bycatch,

questions concerning the effects of changing seasonal distribution of fishing effort, potential halibut distribution changes with climatic shifts, and the utility of juvenile surveys in specific areas have all prompted concerns about halibut movements.

The project is in progress from 2001. For the year of 2001, a progress report will be produced as a starting point for the mass-marking experiment from year 2002. For the coming years, we propose for two research directions: one is to continue the review of IPHC historical tagging experiments and another is to use the information from the review to frame an analytical model for the mass-marking experiment the IPHC will conduct from 2002. We will mainly conduct research on mark-recapture estimates based on short-term recoveries (Petersen-type), estimates based on long-term recoveries (A model is being developing and will be detailed in the RARA), and estimates based on long-term recoveries from multiple (an extended Seber-Jolly type model).

A.26 Recruitment variability and the spatial distribution of juvenile halibut in the eastern North Pacific

Status: New

Cost: Staff salary

Start Date: 2002

Anticipated Ending: 2004

Personnel: Loher, Clark, Hare

Abundance of Pacific halibut has long been assumed to follow a stock-recruitment relationship (i.e., recruitment strength primarily a function of spawning abundance), and the nature of the apparent stock-recruitment relationship has been an important consideration in choosing harvest strategies. However, recent analyses suggest that recruitment strength may be more strongly linked with environmental parameters (the Pacific Decadal Oscillation, or “PDO”) than stock size, *per se*. The mechanism(s) of such a link remain unknown, and questions exist regarding the age at which year-class strength is “fixed”. Recruitment strength may be set at a number of different age-classes and the processes governing survivorship at each age are likely to be different. While the nature of the PDO-recruitment relationship suggests that year-class strength is set at young age, perhaps during the first year of life, analyses that used trawl survey data from IPHC index stations failed to find a close relationship between the abundance of fish <40cm and recruitment strength at age-8. However, these data did not include the Aleutians or the Bering Sea north of Bristol Bay. It is possible that substantial numbers of larvae are carried to these northern and western regions in some years by unusually strong ocean currents, and that early juvenile halibut use these regions as nursery habitat, moving into Bristol Bay and the northern Gulf of Alaska at later ages. Alternatively, weak current regimes might cause larvae to be retained in the southern portion of their range; resulting in greater settlement in southeast Alaska and British Columbia. In both scenarios, strong recruitment might be the result of increases in the total geographic range of juvenile halibut, even if local juvenile population densities remain stable. During this project we will analyze NMFS trawl survey data in order to identify the spatial extent of the juvenile halibut population over the last 20 years and to determine whether age-specific distributions have remained stable over time or demonstrate substantially spatial variability. NMFS trawl surveys have had a greater geographic coverage than the IPHC index stations, and have been conducted regularly since ~1980.

A.27 Geostatistics/GIS methods for halibut spatial/temporal distribution

Status: continuing

Cost: Staff salaries

Start Date: 2002

Anticipated ending: Ongoing

Personnel: Chen, Leickly

The simple questions in halibut fishery management can be: 1) what is the abundance of this stock; 2) how is it distributed; and 3) how good is the estimate. The IPHC has been using survey and commercial data to estimate halibut abundance (the 1st question) in the stock assessment. This new project is intended to answer the second and third questions. This project will use geo-statistics/GIS techniques to estimate the spatial-temporal halibut distribution (the 2nd question) and the associated variance (the 3rd question). Further to the questions, a statistical test of temporal and spatial changes in halibut distribution will be developed and relationships with environmental conditions will be investigated.

A.28 Density-dependent and independent control of halibut growth and recruitment

Status: continuing

Cost: staff salary, some travel

Start Date: 1998

Anticipated ending: Ongoing

Personnel: Hare, Clark, Loher

The specific mechanisms driving the observed interdecadal trends in halibut growth and recruitment remain largely unexplained though more specific hypotheses have been developed in the past two years. Work towards better understanding whether density-dependent (intra- or inter-specific) or density-independent factors are responsible continues and remains the core research focus of the fisheries oceanography project. In keeping with the NOAA movement towards ecosystem considerations in fisheries management, we will attempt to derive a framework whereby the results of fisheries oceanography investigations can provide useful input for management purposes, such as determining safe harvest levels or forecasting near-term recruitment. Part of this project includes maintenance of the near bottom "Ocean Bottom Properties" database, first assembled in 1997 (and described in the 1997 RARA) and maintained and updated as additional data become available. This database has proven to be extremely useful to researchers around the north Pacific.

A.29 Discard mortality rates and bycatch length frequency estimates

Status: Continuing

Cost: Staff salaries

Start Date: 1991

Anticipated ending: ongoing

Personnel: Chen, Williams

The IPHC staff assembles halibut bycatch data from the NMFS observer program and calculates discard mortality rates by gear, area, and target fishery for the groundfish fisheries in Alaskan waters. NMFS applies these values to total halibut bycatch to calculate total halibut bycatch mortality. DFO supplies this information for Canadian groundfish fisheries, and IPHC staff reviews the information. Estimates of the size composition of the bycatch mortality are also estimated from the collected data. Bycatch estimates are now routinely input to the annual stock assessment. The IPHC has long emphasized methods of reducing bycatch, and the staff works with the NPFMC process to assist with information and evaluation of potential programs such as VBA. Staff members train and debrief observers from the Alaskan fisheries, and work with the Observer Program to improve halibut bycatch sampling procedures.

A.30 Halibut bycatch mortality and length composition, 1974-2000

Status: Nearly Completed

Cost: Staff salaries

Start Date: 1998

Anticipated ending: 2001

Personnel: Hare, Williams

This report will document the changes in procedures used to tabulate estimates of bycatch discard mortality as well as to compile the bycatch mortality length compositions used in the annual stock assessment. The last IPHC Technical Report on bycatch estimates was produced over 10 years ago, thus this report will provide a timely update of the official IPHC bycatch estimates for the past 25 years.

SUPPLEMENTAL PROJECTS

Biological Research and Fishery Management Program

S.1 Chalky halibut investigations in cooperation with an industry group

Project Account No.: 410

Status: New

Cost: \$30,000

Start Date: 2002

Anticipated ending: 2002

Personnel: Kaimmer, Leaman, Williams

At the 2001 Annual Meeting, the Commission discussed a proposal by the Alaska Fisheries Development Foundation (AFDF) to conduct a chalky halibut study. Provisional approval was given for matching funds of approximately \$30,000 for a project to be conducted during the 2001 fishing season. AFDF was unable to organize an effort this year but is expecting to conduct research in 2002. Alternatively, this project may be conducted with another industry group.

S.2 PIT Tagging study: tag retention, field trials and dockside detection

Project Account No.: 411 (Tag retention/shedding)

412 (Field experiment/releases)

413 (Dockside detection/recoveries)

Status: New

Cost: Project 411 - \$ 15,000

Project 412 - \$ 304,000

Project 413 - \$ 420,000

Anticipated ending: 2002

Personnel: Williams, Kaimmer, Geernaert, Chen, Clark, Loher, Leaman, Blood, Forsberg, Sadorus, Dykstra, Van Wormer, Ranta, sea samplers, scan samplers.

The staff will be undertaking a large-scale marking experiment using PIT (passively induced transponder) tags in 2002. In 2001, pilot work evaluated the appropriate tag shape and insertion point, conduct tests of tagging mortality and tag retention, and the configuration of detection equipment in the fish plants. The staff also conducted two charters to establish baseline tagging capability and rates, and one other vessel cruises to further examine tagging locations. Additionally, one vessel trip evaluated detection capability under normal offloading conditions.

The effort in 2002 will utilize the stock assessment survey vessel and samplers for tagging and releases. Approximately 50,000 fish will be tagged with PIT tags. Recoveries in ports will be conducted by a new group of samplers devoted to scanning halibut heads following removal by plant personnel. Much of the cost of these projects are due to tags (\$3 per tag), equipment, and personnel.

S.3 Bait quality study

Project Account No.: 414

Status: Ongoing

Cost: \$92,000 in expenses; estimated \$92,000 in revenue from fish sales

Start Date: 2002

Anticipated ending: 2002

Personnel: Dykstra, Kaimmer, Chen

Preliminary data from the 1998 special experiments indicated that quality of chum salmon affects the CPUE of halibut, and that quality varies by run and by market grade. The IPHC uses a number of different bait 'batches' during survey grid fishing. Although we assume equal catchability between batches, some studies have shown large, and in some cases significant, differences in the fishing power of different batches of chum salmon bait. The study would be in three parts. First, baits used in grid surveys would be identified and tracked. Second, a field experiment would determine fishing power differences between these baits. Fish sales from this portion of the study are expected to generate \$92,000 in revenues. Third, amino acid analysis would be used to try to determine amino acid differences which correlate with differences in fishing power.

S.4 Graduate student

Project Account No.: 607

Status: New (carryover from 2001)

Cost: \$2,670

Start Date: 2002

Anticipated ending: 2002

Personnel: Leaman, Clark

We propose to hire a graduate student in FY 2000/2001 to assist staff in project analyses. The specific assignment will be determined based on staff needs. The project was deferred in 2001, as no suitable candidates were identified. An advertising process will be initiated with a view to filling this position in fall 2002.

S.5 Post-doctoral fellowship

Project Account No.: 609

Status: Continuing

Cost: \$43,000

Start Date: 2001

Anticipated ending: 2002

Personnel: Leaman, Clark

A post-doctoral fellowship began in FY 2000/2001, filled by Dr. Timothy Loher. Dr. Loher has prepared an outline of two major research directions: metapopulation studies and trophodynamic studies. This outline was reviewed and refined by Commission research staff and a more restricted set of programs included in the Staff's research proposals for 2002.

S.6 Undergraduate internships

Project Account No.: 618

Status: Continuing

Cost: \$25,000 for two interns

Start Date: 2002

Anticipated duration: May-August

Personnel: Sadorus, Van Wormer, Chen, Vienneau, other staff support as needed

Two undergraduates will be selected through the intern/co-op programs at Oregon State University and University of Victoria to do a combination of office and at-sea work based out of the Commission offices during the summer months. The program includes various pre-determined office tasks as well as being assigned a research project then designing and executing said project. A final report and presentation are given at the conclusion of the employment term.

S.7 Update halibut viability video used in NMFS observer training

Project Account No.: 608

Status: New (carryover from 2001)

Cost: \$500

Anticipated ending: 2002

Personnel: Williams, Kaimmer, other staff

A training video was prepared several years ago by IPHC staff with the purpose of improving consistency in observer determination of viability of halibut bycatch on longlines. Changes in viability categories which were implemented in 2000 render the video ineffective as a training tool. Staff will revise the audio portion of the tape, and add additional video footage taken on trawlers to expand the usefulness of the tape.

S.8 Analysis of spatial recruitment dynamics in Pacific halibut using otolith elemental fingerprints: Phase 1

Project Account No.: 620

Status: New

Cost: \$20,000

Start Date: 2002

Anticipated Ending: 2002

Personnel: Loher, Wischniowski, temporary staff

Previous IPHC research suggests that important settlement and nursery grounds for the eastern Atlantic halibut population are located primarily in the northern Gulf of Alaska, from southeast Alaska to the southern Alaska Peninsula, and on the shallow coastal shelf of the southeastern Bering Sea. Following ~2 years of residence on the nursery grounds, juveniles are believed to migrate in a southeasterly direction, arriving on the fishing grounds as 4-5 year-olds. While this model of movement is supported by IPHC tagging studies, little information exists regarding the average distance that juveniles migrate or the extent to which various fishing grounds are supplied by specific nurs-

ery areas or are populated by a mixture of individuals reared throughout their geographic range. The answers to these questions may have important ramifications on future management of the directed fishery and halibut bycatch in other fisheries. In addition, knowing the relative importance of each nursery will enhance our ability to predict the impact of coastal development and resource extraction on regional recruitment patterns. For example, if a number of individual fishing grounds are primarily dependent upon a single nursery to generate future recruitment, then the impact of activities that alter habitat quality or survival of juvenile halibut in the source nursery will be felt disproportionately by fishers on the affected ground(s). Likewise, localized bycatch has the potential to adversely affect different areas of the fishery to different degrees, depending on juvenile movement patterns. During the first phase of this project, otoliths will be collected from juvenile halibut at 6 nurseries across the Gulf of Alaska and Bering Sea, and will be chemically analyzed to determine if their microelemental composition varies with location, thereby generating a “natural tag” that is unique to each nursery. If unique elemental fingerprints are apparent, techniques will be developed in future phases of the project so that otoliths extracted from adult fish can be analyzed to reveal each fish’s nursery origin, allowing us to determine which areas(s) of coastline serve as nursery grounds for various regions in the fishery.

S.9 Genetic population structure of Pacific halibut assessed via mitochondrial DNA and nuclear microsatellite diversity: Phase 1

Project Account No.: 621

Status: New

Cost: \$13,000

Start: 2002

Anticipated Ending: 2003

Personnel: Loher, temporary staff

The eastern north Pacific halibut resource is presently managed under the assumption that a single panmictic population (i.e., a fully mixed population in which members from all geographic regions regularly interbreed) exists from California through the eastern Bering Sea. This assumption rests largely upon studies that indicate northeasterly larval drift throughout the Gulf of Alaska and into the Bering Sea, balanced by southwesterly migration of juveniles and adults over broad geographic expanses. In addition, limited genetic studies have failed to demonstrate significant difference between northern and southern stock components. Thus, management of the fishery has been separated into two broad regions in the Pacific Northwest and Gulf of Alaska (Areas 2 and 3), with the Bering Sea and Aleutian Islands (Area 4) functionally treated as an extension of the Gulf of Alaska. However, there is reason to hypothesize that population structure is more complex, and that the Bering Sea may represent a functional stock component that could be managed independently. Oceanographic data suggest that larvae spawned in the southeast Bering Sea should remain in the Bering Sea gyre, and the juveniles that migrate from Bristol Bay into the Gulf may simply represent fish that were spawned south of the Alaska Peninsula and were transported into the Bering Sea as larvae. Previous genetic studies have failed to sample the Bering Sea appropriately and have used genetic markers that lacked the resolution required to identify stock units. No previous research has analyzed fish captured on the spawning grounds, the point in the annual movement cycle that actually defines the genetic stock unit. During this project, tissue samples will be collected from halibut

on the spawning grounds at 6 locations between Cape St. James, BC and the southeast Bering Sea shelf-break. Genetic differentiation will be assessed using mitochondrial DNA and nuclear microsatellites, and results from the two markers compared. Samples from the western Bering Sea (Russia) will be included in the analyses if they can be obtained.

S.10 Pop-up, satellite-transmitting archival tags (PSTATS) to study halibut movements

Project Account No.: 622

Status: New

Cost: \$50,000

Start: 2002

Anticipated Ending: 2002

Personnel: Loher, Kaimmer, Geerneart, sea samplers

Present day halibut fisheries harvest fish throughout the continental shelf of Canada and the U.S. on the species' summer feeding grounds. During the winter months, most of these fish depart the relatively shallow waters of the shelf to aggregate and spawn in deeper waters along the shelf-edge, at spawning grounds that stretch from at least the Queen Charlotte Islands through the Bering Sea and westward. This general pattern of seasonal migration has been recognized for decades, if not centuries, but a number of questions regarding seasonal behavior remain unanswered. At exactly what time of the year do halibut begin their migrations, how far do they travel between feeding and spawning grounds, and how long does the journey take? Do fish remain within their local coastal region to spawn, simply moving offshore of their feeding grounds, or do they travel substantial distances along the coast to reach their final destination? Once fish reach the spawning grounds, do they remain near the bottom, or move up into the water column to feed? Until quite recently, these were questions that were exceedingly difficult to answer, but recent advances in tag technology are providing a tool that can be used to uncover some of these mysteries. Electronic pop-up, satellite-transmitting archival tags (PSTATS) can record ambient temperature, depth, and a number of other water-column parameters while attached to fish. The tags are programmed to release from the fish on a pre-determined date, float to the surface, and emit a satellite signal that indicates the tag location and downloads all of the temperature and depth data to the satellite. The result is a record of the fish's spawning location, along with important environmental and behavioral data throughout the fish's time at liberty. IPHC will tag ~12 adult halibut with PSTATS during the 2002 summer set line survey in the Gulf of Alaska, programming the tags to release during the winter of 2003. In a cooperative program, researchers associated with USGS and the University of Alaska, Fairbanks, are expected to tag additional adult halibut in the southeastern Bering Sea using the same type of tag, also programmed to release during winter of 2003. Information collected from the tags will be used to enhance our understanding of seasonal movement patterns in the species.

S.11 Halibut age validation proposal utilizing ^{14}C radiocarbon

Project Account No.: 624

Status: New

Cost: \$25,000

Start: 2002

Anticipated Ending: 2003

Personnel: Wischniowski, Piner (NMFS/NWR), Leaman, Loher

Radiocarbon, or ^{14}C bomb carbon, has been used successfully in the past on several fish species as a validation of absolute age assignment. It is of fundamental importance to verify the routine procedure of using repeated formations of microstructure in the otolith as a valid method of assessing aging assignment throughout all age classes of the species in question. To proceed with a radiocarbon validation study for halibut, the IPHC will first have to construct a radiocarbon curve created from preferably young-of-the-year or one-year-old juveniles. This curve will incorporate animals from the time frame of the 1950's to the early 1970's when ^{14}C concentrations were on the upraise due to thermal nuclear activity. The curve will convey a ^{14}C concentration in correlation to time, to which older individuals of a variety of age classes can be cross referenced to. This will result in two mutually exclusive age assessments, and will allow the IPHC to validate the assignment of age determination by the means of the formations of microstructure in the otolith. This will be a collaborative validation study funded between the IPHC and NMFS-FRAM. Costs to complete the study are based on otolith preparation and accelerated mass spectroscopy (AMS) time.

S.12 Otolith marginal increment analysis

Project No.: 626

Status: Continuing

Cost: \$2,000

Anticipated ending: 2002

Personnel: Blood, Wischniowski, Forsberg

This project has the objective of improving reliability of the age determination for Pacific halibut. Timing of annulus formation was first studied in the 1930s by Dunlop. Recent research on halibut age validation suggests Dunlop's early results were incomplete. Otoliths are being collected coast wide by IPHC surveys and domestic observers. Timing of annulus formation is critical to assigning accurate age and prevent smearing of strong year classes over weak ones. For this study, we are collaborating with observer programs in both Canada and the United States. Selected observers on board groundfish vessels will collect several halibut otoliths per month. Data collection and otolith processing will occur in 1999-2001. Analysis will occur in 2002. We will use the otoliths collected to observe when during the year the halibut deposit annual growth rings. We will also investigate whether the timing varies by area and sex.

Fishery Statistics and Regulations Program

S.13 GIS applications to Pacific halibut

Project Account No.: 623

Status: Continuing

Cost: \$ 5,700

Start Date: 2000

Anticipated ending: Ongoing

Personnel: Leickly, Gilroy, Kong

Geographical information systems (GIS) have been successfully used elsewhere in the analysis of fishery stock distributions, satellite imagery, demographics, and physical phenomenon such as depth and temperature. This project will develop a GIS system which will link habitat information with IPHC database records and develop a dynamic system for assessing habitat that can be compared with historical habitat measures previously developed using pencil and paper plotting techniques. In 2001, GIS software was acquired, knowledge was gained on implementing the program, and possible projects were reviewed. The development of the IPHC GIS will be documented in the Report of Assessment Research Activities (RARA), 2001.

IPHC statistical areas were made available in GIS in 2001. One of the future tasks will be to determine statistical areas from the latitude/longitude location entered into the database. Currently, samplers code statistical areas by hand of fishing logbook information. Other applications are documented in the RARA.

Stock Assessment Program

S.14 Spatial and ontogenetic variability in the trophic status of Pacific halibut

Project Account No.: 602

Status: Continuing

Cost: \$30,000, staff salaries, and sample collection during assessment survey

Start Date: 1999

Anticipated ending: Continuing

Personnel: Hare, Kline

This project will attempt to define spatial and ontogenetic variability in the trophic status of Pacific halibut using natural stable isotope abundance of carbon and nitrogen which is hypothesized to vary over its distribution in the northeast Pacific. Natural stable isotope abundance is a useful research tool for fish ecology because of the predictable relationships of isotope signatures among food web constituents and isotopic gradients existing in the study area. Increase in trophic level is hypothesized to explain the large decrease in growth rate exhibited by halibut since the 1976-1977 regime shift that also affected many species in the region. Ontogenetic shifts in isotope signature are expected to indicate a shift to feeding offshore as adults. This will provide a linkage to the regime shift because changes in zooplankton abundance have been noted offshore near the continental shelf break. Showing a relationship to this carbon source through isotope matching will provide the first line of evidence for a mechanism for explaining changing halibut growth patterns. 2001 was the third year of sample collection; analysis of these data will begin to allow us to estimate interannual variability in trophic level.

S.15 Expansion of the water column profiler project

Project Account No.: 610

Status: Continuing

Cost: \$1,500 for service and additional equipment plus staff salaries

Start date: 2000

Anticipated ending: Continuing

Personnel: Hare

The IPHC maintains one of the most extensive sampling platforms in the north Pacific. This platform offers enormous potential for collection of valuable oceanographic data. In particular, understanding the dynamics of the structure of the mixed layer depth – a major GLOBEC goal - requires *in situ* vertical profiling. Use of this platform for oceanographic data collection capabilities not only would benefit the scientific community at large, but demonstration of sampling feasibility may also create other funding opportunities for collaborative research. In 2001 and 2002, the IPHC successfully deployed a SeaBird SBE-19 water column profiler from a commercial fishing vessel participating in the annual stock assessment survey. Beginning in 2002, we hope to expand the program to six profilers deployed aboard vessels fishing selected areas. This work will be in collaboration with NOAA's PMEL and funding will be sought from GLOBEC.

S.16 NMFS trawl survey: at-sea data collection and data base management

Project Account No.: 604

Status: ongoing

Cost: \$30,000 for at-sea otolith collection; staff salaries for database work

Start Date: 1996

Anticipated ending: ongoing

Personnel: Sadorus, Ranta, Clark

A series of NMFS trawl survey data on halibut, parallel to our setline data, would be extremely valuable to IPHC as a second fishery-independent data source for stock assessment. Trawl data are particularly useful because they include large numbers of juveniles (ages 3-7) that do not appear in large numbers in the setline survey. Since 1996 IPHC staff have collected otoliths on the triennial surveys. The halibut age data are incorporated into a copy of the NMFS haul data, expanded to estimates of relative abundance and age/size composition by IPHC area (NMFS calculates estimates by INPFC area), and stored in a database at IPHC. The task in this project is to add recent data. Summer 2001 includes the Gulf of Alaska and Bering Sea shelf surveys.

CONTRACT PROJECTS

Fishery Statistics and Regulations Program

C.1 Retrospective studies of climate impacts on Alaska Steller sea lions

Project Account No.: 627

Status: New

Cost: Staff time (NOAA funded project)

Revenues: \$6,000

Start Date: 2002

Anticipated ending: 2003

Personnel: Hare, Mantua, Marzban

In order to better understand the role of climate in the dynamics of Alaska's western and eastern Steller sea lion (SSL) populations, we have received funding to conduct a retrospective study of time series for SSL abundance, distribution and recruitment, multiple components of Alaska SSL marine ecosystems, local environmental conditions, and large scale climate forcing. As a starting point we will apply Hare and Mantua's (2000) multivariate principal component analysis (PCA) methodology to evaluate linkages. To go beyond the sharp constraints posed by linear statistical methods we will also apply nonlinear statistical analysis (e.g. non-linear PCA using neural nets) to our data matrix. This project is in collaboration with Nathan Mantua from JISAO and Caryn Marzban of the UW Dept. of Statistics. One month of Hare's salary is covered by this NOAA funded study.

C.2 NMFS catcher vessel logbook and sablefish data collection

Project Account No.: 628

Status: Ongoing

Revenue: \$7,000

Start Date: 1998

Anticipated ending: 2003

Personnel: Hutton, Port samplers

IPHC and NMFS have a joint IFQ catcher vessel logbook program for vessels 60 ft and greater. NMFS contracted IPHC staff to interview the IFQ fishers to review and collect the sablefish information in addition to the halibut information. Copies of the log sheets are sent to the NMFS scientists at the lab in Auke Bay, Alaska.

SECTION III: RESEARCH UNDER CONSIDERATION FOR 2002/2003

The IPHC staff has been discussing several research projects that will expand our understanding of halibut life history and site affinity by juveniles and adults, but cannot be conducted in 2002 due to the number of projects we are expecting. Data collections for the first two projects would occur during the spawning season, probably November 2002 through February 2003, and would involve longline and trawl vessel charters. The third project would take place during the summer months in Area 4C to examine fish movements into and out of the area. The staff will continue to refine these proposals for next year, but we wanted to present some of our ideas at this time.

I. PIT tag sampling to elucidate seasonal migration patterns of adult Pacific halibut

Status: New

Cost: \$6,000 (if piggybacked with other ship operations)

Start Date: 2003

Anticipated Ending: 2004

Personnel: Loher, Geernaert, Kaimmer, temporary staff

While a certain amount of breeding likely occurs throughout the range of Pacific halibut, a number of potentially important spawning grounds have been located between Cape St. James, BC, and the southeast Bering Sea shelf break south of the Pribilof Islands. We do not know to what extent spawning grounds are populated by fish from local feeding areas, the distance individual fish migrate to return to their spawning grounds, or whether fish remain faithful to a single ground throughout life or visit many grounds over time. The answers to these questions will be important as we seek to understand how localized fishing pressure impacts both local and distant spawning populations, attempt to more accurately define the reproductive units that comprise the population, and determine whether management should be refined to reflect subtleties of spatial population structure. Our ongoing PIT tag project provides an opportunity to monitor spawning grounds and answer some of these questions. A large number of fish will be marked at known locations throughout the summer of 2002, and roughly 80% of the marked fish are expected to return to their spawning grounds the following winter. During this project, we will conduct winter fishing charters on 6 important spawning grounds across the range of the population. Fish will be scanned to identify tagged individuals before returning them to the population. Given the complete spatial coverage of the initial tagging effort and the application of tags in proportion to local abundance, we will be able to determine migration pathways and attractive distances for each nursery in a non-biased manner. Additionally, up to 250 previously untagged fish from each spawning ground will be marked to provide information on the reverse migration (i.e., from winter spawning grounds to summer feeding areas). The ongoing PIT tag project will provide portside sampling to retrieve these tag data. Application of pop-up satellite transmitting archival tags (PSTATs) would also be valuable in addressing migratory questions, and repeating the proposed project in subsequent years could address hypotheses regarding spawning site fidelity. Listed costs do not include a PSTAT component or multi-year sampling.

II. Group-level breeding site fidelity of Pacific halibut assessed using otolith elemental fingerprints

Status: New

Cost: \$40,000 (if piggybacked with other ship operations)

Start Date: 2003

Anticipated Ending: 2004

Personnel: Loher, Wischniowski, temporary staff

The establishment of regulatory and statistical areas in fishery management relies heavily upon the concept of the “unit stock”; i.e., that the fish found in each regulatory area represent a functionally discrete breeding population whose dynamics are not substantially influenced by events that occur in neighboring regions. Defining stock components is sometimes a difficult task, often approached through genetic analyses. However, while it is clear that groups of fish that are genetically different from one another represent separate stocks, the converse is not necessarily true. Spatially-structured populations often contain regional units whose population dynamics operate in relative isolation, and which might lend themselves to regional management strategies, but which may demonstrate little genetic divergence from neighboring regions. In particular, a very small amount of genetic exchange may be sufficient to maintain homogeneity between two regions (e.g., a few individuals every hundred years), especially at loci that display low mutation rates. Genetic population structure is typically established by isolation mechanisms that are measured in the thousands to tens of thousands of years, whereas the population dynamics most important to fisheries are observed across year-classes, and are described on interannual and decadal time-scales. Species that home to discrete breeding grounds throughout their lifetime may be vulnerable to local depletion and warrant a management strategy that recognizes changes in stock structure within each breeding area. During this project we will collect otoliths from fish captured on 6 different breeding grounds and analyze their chemical composition to determine if otoliths collected on different spawning grounds possess unique, identifiable signatures that suggest long-term breeding site fidelity. Analyses will be conducted separately on males and females of similar age to determine whether they differ, suggesting sex-specific movement patterns over their lifetimes, or possess similar elemental fingerprints that suggest complementary life histories.

III. Analysis of onshore-offshore movement patterns of Pacific halibut along the southeast Bering Sea shelf-edge

Status: New

Cost: \$9,000

Start Date: 2002

Anticipated Ending: 2004

Personnel: Loher, St. Paul Port Sampler, Local Fisher Collaboration

During the early 1980's, the IPHC established a unique management area within the Bering Sea encompassing the Pribilof Islands (Area 4C). The establishment of this area was driven largely by economic considerations, namely a desire to provide local communities with a source of income at the termination of the fur seal harvest. Quotas in Area 4C are set in proportion to surrounding areas,

assuming that the entire Bering Sea represents a mixed population. However, local fishers have recently experienced reduced CPUE, which may constitute local depletion. If this is true, then it follows that the region's fish must be faithful to the Pribilof shallows and may not mix substantially with fish elsewhere in the southeast Bering Sea. This would have implications for present assumptions of population mixing, and suggest that Area 4C is more than simply an economically derived management area. Alternatively, changes in CPUE may simply reflect changes in movement patterns of fish near the islands. The local fishery is seasonal; fish typically move into the waters around the islands in late June, and depart at the onset of winter. It is believed that these migrations are governed by temperature patterns, and regional ocean conditions can vary considerably from year-to-year. Lower CPUE might represent reduced residence time within the shallows due to colder bottom conditions, or use of different migratory pathways to move from the shelf-edge to the shallows and back. This sort of interannual variability in movement patterns could also have ramifications for interpreting abundance throughout the entire southeast Bering Sea, not simply in the Pribilof region. Unlike the Gulf of Alaska, IPHC's southeast Bering Sea setline stations cover very little of the shelf, being focused entirely along the shelf-break. Fish spawn along the shelf-break in the winter, but many disperse into shallow shelf waters during the summer, effectively eluding the survey. The proportion of fish available to the survey each year will depend upon the timing of movements relative to the survey. During the course of this project, catch data from the 4C fishery will be analyzed to attempt to isolate temporal trends in size-specific migratory timing in the region. With the cooperation of local fishers, depth- and temperature-recording instruments will be placed on longline gear to determine whether movements can be associated with particular temperature regimes and to look for spatial patterns that might represent migration corridors. This project will be expanded in future years in an attempt to understand large-scale patterns of onshore-offshore movement in the species.

