IPHC Research Program:
Review of 2002 Projects and Proposals for 2003

The following was compiled from the International Pacific Halibut Commission Report of Assessment and Research Activities, 2002 (IPHC Research Program: Review of 2002 Projects and Proposals for 2003). January 21, 2003

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 2002. The second section presents the staff research proposals for 2003. 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.

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.

REVIEW OF RESEARCH CONDUCTED IN 2002

Research conducted by the IPHC staff during 2002 covered a myriad of subjects, from preparation work for the 2003 PIT tagging project, archival tags, collection of tissue and otolith samples, 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.

IPHC Staff Research

The staff completed several projects during 2002, but most of the work was on projects that will continue into 2003 and beyond. Staff efforts in the PIT tagging project in 2002 were focused on establishing baseline information on tagging location, shedding, and mortality rates, setting the stage for the comprehensive project planned for 2003.

Programs for undergraduate internships, water column profilers and sample collection for trophic status studies on the assessment surveys were completed in 2002. At-sea research looking at spatial recruitment dynamics from otolith elemental composition (i.e., fingerprinting) also took place. Samples were collected in September outside of Sitka. Samples from other regions around the North Pacific were also obtained. The post-doctoral fellowship continued into 2002, until the position was converted to full-time status. Only one NMFS trawl survey was staffed in 2002, but we expect to resume staffing of two vessels in 2003.

Summary of 2002 Research Projects and Status

I. FUNDED THROUGH APPROPRIATIONS

Project Title	Status

Biological Research and Fisheries Management Program

1) Monitoring changes and discrepancies in application of aging criteria using computerized otolith images ..... Deferred
2) Otolith break-and-burn percentage agreement ..... Completed
3) Changes in assigned ages over time due to changes in application of criteria and equipment ..... Dropped
4) Otolith exchange with eastern Canadian branch of DFO ..... Deferred
5) Incidence of crystallized otoliths from the SSA surveys ..... Continuing
6) Sport halibut fishery review ..... Continuing
7) Prior hook injury (PHI) study on setline surveys ..... Continuing
8) Hook-size/bait-size comparison ..... Deferred
9) Documentation of historical special setline experiments ..... Deferred
10) Analysis of 1998-1999 special setline experiments ..... Deferred
11) Time stratified sampling by observers for halibut viability and length ..... Deferred

Fishery Statistics and Regulations Program

1) The effects of changing gear in the halibut fishery following IQs ..... Continuing
2) Impacts of extending the commercial fishery season ..... Completed
3) IPHC statistical area documentation ..... Continuing
4) Review of port sampling, 1994 to present ..... Deferred
5) Verification of the commercial catch database, 1974 to present ..... Deferred
6) Development of an interagency Electronic Fishery Information Collection and Management Program in Alaska ..... Continuing
7) Preliminary assessment of mercury incidence in Pacific halibut ..... Continuing
8) Examination of the hook by hook information from the stock assessment surveys ..... Complete

Stock Assessment Program

1) The 2002 stock assessment ..... Completed
2) Addition of NMFS trawl survey data to the stock assessment ..... Completed
3) Development of a medium-term harvest policy ..... Continuing
4) Development of a formal medium-term recruitment forecast ..... Continuing
5) Misclassification of ages ..... Deferred
6) Estimation of halibut abundance from mark-recapture data ..... Continuing
7) Recruitment variability and the spatial distribution of juvenile halibut in the eastern North Pacific ..... Deferred
8) Geostatistics/GIS methods for halibut spatial/temporal distribution ..... Continuing
9) Density-dependent and independent control of halibut growth and recruitment ..... Continuing
10) Discard mortality rates and bycatch length frequency estimates ..... Completed
11) Halibut bycatch mortality and length composition, 1974-2000 ..... Completed

II. FUNDED THROUGH SUPPLEMENTAL REVENUES

Project Number	Project Title	Status
Biological Research and Fisheries Management Program		
410	Chalky halibut research	Continuing
411	PIT tagging study – Tag selection & retention experiment	Continuing
414	Bait quality studies	Dropped
607	Graduate student	Continuing
608	Update halibut viability video used in NMFS observer training	Deferred
609	Post-doctoral fellowship	Completed
618	Undergraduate internships	Completed
620	Analysis of spatial recruitment dynamics using otolith elemental fingerprints (phase 1)	Completed
621	Genetic population structure assessed via mitochondrial DNA and nuclear microsatellite diversity (phase 1)	Continuing
622	Pop-up, satellite-transmitting archival tags (PSTATS) to study halibut movements	Continuing
624	Halibut age validation utilizing ^{14}C radiocarbon	Continuing
626	Otolith marginal increment analysis	Continuing
Fishery Statistics and Regulations Program		
623	GIS applications to Pacific halibut	Completed
Stock Assessment Program		
602	Spatial and ontogenetic variability in the trophic status of Pacific halibut	Completed
610	Expansion of the water column profiler project	Continuing
604	NMFS trawl survey: at-sea data collection and data base management	Continuing

III. CONTRACTS AND EXTERNAL FUNDING

Project Acct. #	Project Title	Status
627	Project to pilot test the use of video for assessing compliance and effectiveness of seabird avoidance devices and monitoring seabird mortality in halibut longline fisheries	Continuing
617	NMFS catcher vessel logbook and sablefish data collection	Continuing
801	Retrospective studies of climate impacts on Alaska Steller sea lions	Continuing
632	Area 2B logbook program and bycatch	Continuing

RESEARCH PROPOSED FOR 2003

The IPHC staff has identified 19 research projects for 2003 which require funding from outside Commission appropriations. Many are continuing projects, having been initiated in 2002 or earlier. We propose to continue these projects in 2003. Five projects are new to the list. All projects requiring funding in 2003 are summarized in the table on the next page. Also shown are two contract projects that provide revenue, with no costs other than staff salaries. The table also shows Line Numbers (e.g., S.2) for reference to the detailed descriptions found 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. Projects that met these goals are in 2002 are shown below. In addition, projects proposed for 2003 may further add to this focus.

Projects Conducted in 2002

S.6 – *Analysis of spatial recruitment dynamics using otolith elemental fingerprints (Phase 1).*
S.7 – *Genetic population structure assessed via mitochondrial DNA and nuclear microsatellite diversity (Phase 1).*
S.8 – *Pop-up, satellite-transmitting archival tags (PSTATS) to study halibut movements.*
S.16 – *Spatial and ontogenetic variability in the trophic status of Pacific halibut.*
A.23 – *Expansion of the water column profiler.*

Projects Planned for 2003

S.2 – *PIT tagging study*
S.6 – *Analysis of spatial recruitment dynamics using otolith elemental fingerprints (Phase 1).*
S.7 – *Genetic population structure assessed via mitochondrial DNA and nuclear microsatellite diversity (Phase 1)*
A.23 – *Expansion of the water column profiler.*

Summary List of Proposed 2003 Research

I. FUNDED THROUGH APPROPRIATIONS

II. FUNDED THROUGH SUPPLEMENTAL REVENUES

II. CONTRACTS AND EXTERNALLY FUNDED

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: 2004
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 exchange with eastern Canadian branch of DFO

Status: Continuing
Cost: Staff salaries
Start Date: 2000
Anticipated ending: 2003
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 2002, but is anticipated in 2003.

A.3 Incidence of crystallized otoliths from the 1998-99 setline surveys

Status: Continuing
Cost: Staff salaries
Start Date: 2000

Anticipated ending: 2003
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 crystal**l**ized 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 2002 due to a change in staff responsibilities.

A.4 Incidence of "double ring" pattern in halibut otoliths

Status: New
Cost: Staff salaries
Start Date: 2003
Anticipated ending: 2003
Personnel: Tobin, Forsberg

A double ring pattern is fairly common in halibut otoliths. "Double ring" refers to a pattern in which two rings are closer together than either ring to the previous or following ring. Sometimes readers count the two rings as separate annuli, sometimes one as an annulus and one as a check, depending on the sharpness of the rings, regularity of the rest of the otolith pattern, and where on the otolith the double ring occurs. Presence of double rings and their location within the otolith will be recorded for otoliths in 2003 and occurrence by area and/or year class will be analyzed.

A.5 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 1973 report, which recognized the development of the sport fishery. 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.6 Prior hook injury (PHI) study on setline assessment surveys

Status: Continuing
Cost: Staff salaries
Start Date: 1997

Anticipated ending: Ongoing
Personnel: Williams, Kaimmer

Data on the presence and severity of prior hook injuries on halibut caught on the 2003 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.7 Hook-size/bait-size comparison

Status: Deferred
Cost: Staff salaries
Start Date: 2000
Anticipated ending: 2003
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 2003, but it may piggyback on other cruises.

A.8 Documentation of historical special setline experiments

Status: Continuing
Cost: Staff salaries
Start Date: 2001
Anticipated ending: 2003
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.9 Analysis of 1998-1999 special setline experiments

Status: Continuing
Cost: Staff salaries
Start Date: 2001
Anticipated ending: 2003
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.10 Time stratified sampling by observers for halibut viability and length

Status: Deferred from 1999
Cost: Staff salaries
Start Date: 1999
Anticipated ending: 2003
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.11 The effects of changing gear in the halibut fishery following IQs

Status: Continuing
Cost: Staff salaries
Start Date: 2001
Anticipated ending: 2003
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.

A.12 IPHC statistical area documentation

Status: continuing
Cost: Staff salaries
Start Date: 1999
Anticipated ending: 2003
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. A technical report draft of the documentation of historical and current statistical area definitions will be completed in 2003.

A.13 Review of port sampling, 1994 to present

Status: Deferred in 2002
Cost: Staff salaries
Start Date: 2002
Anticipated ending: 2004
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 2002 was deferred due to turnover with the Alaska port samplers.

A.14 Verification of the commercial catch database, 1974 to present

Status: Deferred in 2002
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 2002 due to other commitments.

A.15 Development of an interagency Electronic Fishery Information Collection and Management Program in Alaska

Status: Phase 1 – Complete
Phase 2 - New
Cost: Staff salaries, possibly travel costs if they are not included in grant ($1,500)
Start Date: 2002
Anticipated ending: Ongoing
Personnel: Gilroy, Vienneau

Phase 1: IPHC staff were 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. Two reports were completed and presented to the agencies, including a needs analysis and a technology assessment and recommendations.

Phase 2: The goal is to have a memorandum of understanding signed by the Directors of the agencies to ensure the individual agency's interests are protected and that the agencies are committed to work toward a cooperative electronic fishery information system. A new contractor will be hired to work with the agencies to resolve data collection issues, and to design and implement a technology demonstrator or prototype.

A.16 Preliminary assessment of mercury incidence in Pacific halibut

Status: Continuing
Cost: Staff salaries and possibly costs of assays
Start Date: 2002
Anticipated ending: On going
Personnel: Dykstra, Alaska Dept. of Environmental Conservation

Recent reports from health officials and media have raised the profile of mercury contamination in fish. In 2002, the Alaska Dept. of Environmental Conservation (ADEC), in conjunction with the U.S. Environmental Protection Agency (EPA), launched an environmental contamination study looking into levels of organochlorine pesticides, dioxins, furans, polybrominated diphenyl ethers, PCB congeners, methyl mercury and heavy metals (arsenic, selenium, lead, cadmium, nickel, and chromium) within 13 Alaskan fish species, including halibut. The Commission staff collected 8 samples from 8 locations within Alaska for the ADEC study during the 2002 setline surveys. An additional 50 flesh samples were provided for methyl mercury analysis. These samples are currently being analyzed, and the results have not yet been finalized or released.

ADEC has expressed interest in further assessments of methyl mercury occurrences in halibut in 2003.

Preliminary investigations under the Freedom of Information Act found that only 8 samples were analyzed by the Canadian Food Inspection Agency (CFIA) between August, 1990 and March, 2002. The CFIA has approached the PHMA to do a more intensive assessment of the occurrence of methyl mercury in halibut. The PHMA has asked the IPHC to provide some input on their experimental design, and possibly aid in scientifically-based collection of samples for the CFIA. The staff is looking into this for the 2003 field season and will be reviewing IPHC historical records and reports on mercury and the halibut fishery.

A.17 Seabird occurrence on the surveys

Status: New
Start Date: 2002
Cost: Staff salaries
Anticipated ending: Ongoing
Personnel: VanWormer, Geernaert, WA Sea Grant

During the 2002 stock assessment surveys, sea samplers performed a count of the seabirds in the vicinity of the vessels after hauling. Sampling after the haul addresses the question of where and when certain seabird species occur. Ultimately these data might be used to identify appropriate seabird deterrent requirements in certain geographic locations, especially for the halibut fleet. IPHC will develop and maintain a data base with the seabird information. Data were collected in 2002 and will be analyzed in 2003.

Stock Assessment Program

A.18 The 2003 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.19 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.20 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.21 Misclassification of ages

Status: Ongoing
Cost: Staff salaries
Start Date: 2000
Anticipated ending: 2003
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.22 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.23 Expansion of the water column profiler project

Project Account No.: 610
Status: Continuing
Cost: Staff salaries, outside funding for additional hardware
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.

A.24 Recruitment variability and the spatial distribution of juvenile halibut in the eastern North Pacific

Status: Continuing
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.25 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.26 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.27 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.

SUPPLEMENTAL PROJECTS

Biological Research and Fishery Management Program

S.1 Chalky halibut research

Project Account No.: 410
Status: New
Cost: $ 43,649, partially offset by $23,050 contributed by HANA
Start Date: 2003
Anticipated ending: 2003
Personnel: Williams, Leaman, Kaimmer

During 2002, the Commission put out an RFP for additional work on the chalk condition, based on provisional approval by the Commission to spend $30,000 on such work as long as matching funds were provided by industry. HANA has raised roughly $23,000 during 2002, enabling IPHC to contract with the University of Alaska Fairbanks' research facility in Kodiak. The contract was awarded in October, with project concluding in March/April, 2003.

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: Continuing
Cost: Project 411 - $ 146,706
Project 412 - $ 266,805
Project 413 - $ 436,072
Anticipated ending: 2005
Personnel: Williams, Kaimmer, Geernaert, Chen, Clark, Loher, Leaman, Blood, Forsberg, Sadorus, Dykstra, Van Wormer, Ranta, sea samplers, scan samplers.

IPHC will be undertaking a large-scale marking experiment using PIT (Passive Integrated Transponder) tags in 2003. In 2002, additional pilot work evaluated the appropriate tag 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, several experiments were conducted to evaluate detection capability under normal offloading conditions.

In 2002, two cruises are planned to further test and refine the on-deck tagging protocols and data collection systems. We are also planning on a tagging cruise in the spring of 2003 where halibut

will be double-tagged with PIT tags and wire tags to quantify PIT tag loss over 1-2 years of liberty.

The tagging effort in 2003 will utilize the stock assessment survey vessel and samplers for tagging and releases. Approximately 40-45,000 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 ($3.50 per tag), equipment, and personnel.

S.3 Graduate student

Project Account No.: 607
Status: New
Cost: $22,840
Start Date: 2003
Anticipated ending: 2004
Personnel: Leaman, Clark

We propose to fund a graduate student in FY 2003 to assist staff in project analyses. The specific assignment will look at the potential for using video monitoring systems for enumerating the hook by hook catch on the stock assessment surveys vessels. Video was gathered in 2002 during the NMFS seabird video project, so the student will be analyzing the data and reporting on the potential of such systems to gather data.

S.4 Undergraduate internships

Project Account No.: 618
Status: Continuing
Cost: $23,500 for two interns
Start Date: 2003
Anticipated duration: May-August, 2003
Personnel: Sadorus, Van Wormer, Chen, Vienneau, other staff support as needed

Two undergraduates will be selected through the intern/co-op programs at regional universities and colleges 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.5 Update halibut viability video used in NMFS observer training

Project Account No.: 608
Status: New (carryover from 2001)
Cost: $500
Anticipated ending: 2003

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.6 Analysis of spatial recruitment dynamics in Pacific halibut using otolith elemental fingerprints: Phase 2

Project Account No.: 620
Status: New
Cost: $77,000
Start Date: 2002
Anticipated Ending: Ongoing
Personnel: Loher, Wischniowski, temporary staff

Sampling in 2003 will focus on the eastern Gulf and on determining how substantially the elemental fingerprints in a given location change over the course of the summer. With respect to the eastern Gulf, we will have few samples from 2002 and therefore can say little about signature variance in that region, especially whether unique signatures are found within the inside waters relative to the outer coast. With respect to time, it will be important to understand how much the signatures are expected to change from the beginning of the summer field season through the fall, so that future sampling can be conducted within an appropriate "window" during which the signatures are likely to remain stable.

S.7 Genetic population structure of Pacific halibut assessed via mitochondrial DNA and nuclear microsatellite diversity: Phase 1

Project Account No.: 621
Status: New
Cost: $141,293
Start: 2002
Anticipated Ending: 2003
Personnel: Loher, temporary staff

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 3 locations in northern B.C., the central Gulf of Alaska, 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.8 Pop-up, satellite-transmitting archival tags (PSTAT) to study halibut movements

Project Account No.: 622
Status: New
Cost: $7,000
Start: 2002
Anticipated Ending: Ongoing
Personnel: Loher, Kaimmer, Geerneart, sea samplers

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 tagged 12 adult halibut with PSTATS during the 2002 summer setline 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, tagged 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. In 2003 we expect that several of these tags will be recovered, thus the funds are for tag rewards and the satellite time that is used to transmit data once the tags pops to the surface.

S.9 Halibut age validation proposal utilizing ^{14}C radiocarbon

Project Account No.: 624
Status: Deferred from 2002
Cost: $20,365
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 thermonuclear 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. 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.10 Otolith marginal increment analysis

Project No.: 626
Status: Continuing
Cost: $ 900
Anticipated ending: 2003
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.

S.11 Comparing laser ablation vs. solution-based mass spectroscopy

Project No.: 628
Status: New
Cost: $ 15,510
Anticipated ending: 2003
Personnel: Loher, Wischniowski

The basic goal of the nursery otolith elemental fingerprint (OEF) project is to attempt to use the elemental signatures in halibut otoliths to identify the nursery origins of fish captured within the fishery. The project will require numerous phases, one of those being to correlate OEFs within the otolith core of adult fish to the OEF signatures determined during coast-wide mapping to elucidate the nursery origin of those fish. During this process, we will use two different elemental analysis techniques: isotope dilution inductively coupled plasma mass spectrometry (ID-ICPMS) on the juvenile otolith samples and laser ablation (LA-ICPMS) on the adults. The drawback to this 2-phase analysis process (i.e., ID-ICPMS of juveniles and LA-ICPMS of adults) is that the apparent concentration of elements may differ between the two instruments even if the concentrations are actually identical. We can statistically correct for such differences during data analysis, but we must first understand the differences between the instruments. In order to do so we will conduct a separate study that compares ID-ICPMS and LA-ICPMS results from pairs of otoliths removed from individual fish. For example, we will bisect otoliths from a number of fish, subject one half of each "pair" to ID-ICPMS and the other half to LA-ICPMS, examine the apparent differences in the concentration of each constituent element between paired samples, and determine what statistical adjustments are needed to unify results.

S.12 Analysis of onshore-offshore movement patterns of Pacific halibut along the southeast Bering Sea shelf edge

Project No.: 629
Status: New
Cost: $ 6,000
Anticipated ending: 2003
Personnel: Loher

This project was listed in the 2002 Annual Meeting Bluebook, as "Research Under Consideration for 2002/2003", and was not funded directly by IPHC. However, the Central Bering Sea Fisherman's Association was able to provide the necessary funding so that the study could be conducted during 2002. A total of 10 Water Data Recorders (WaDaRs) were purchased in late May and distributed to the local fleet by the IPHC port sampler. Fishers began deploying those instruments in early July, attached to their fishing gear during normal fishing operations. Half of the instruments were retrieved from the fleet in at the end of August so that the data would not be lost, while the remaining instruments were redistributed to those fishermen who still hold IFQ and who are most likely to fish throughout the fall. The temperature data from the instruments has not yet been downloaded; analysis of the data in comparison to CPUE and mean fish size is expected to begin during October, at which time the fleet will likely end their season and the remaining WaDaRs will be retrieved.

S.13 Sleeper shark aging study

Project No.: 630
Status: New
Cost: $ 200
Anticipated ending: 2003
Personnel: Wischniowski

The availability of sleeper shark (*Somniosus pacificus*) biological samples from the IPHC's general surveys will allow biologists to initiate an age determination study on the species. Currently, there is no age structure for sleeper sharks. The age and growth lab would like the opportunity to investigate an age determination on sleeper sharks. Vertebra samples would be required, and could be collected opportunistically from any bycatch mortalities on the survey. Age determination costs are monies spent on lab supplies, such as microscope slides, stains and dyes.

S.14 Delta sub diving in Southeast Alaska for halibut habitat identification

Project No.: 631
Status: New
Cost: $ 18,077
Anticipated ending: 2003

Personnel: Loher

The Alaska Department of Fish and Game (ADF&G) has offered IPHC two days of time during their June, 2003 use of the 2-person submarine R/V Delta. We plan on examining Shelikof Bay (outside of Sitka) to identify habitat preferences of juvenile halibut. The influence of tidal cycle on these preferences may be a factor, as well as spatial and temporal variances. If agreeable with the sub operators, we will run line transects with the sub while taking video of the area around the sub for subsequent viewing.

S.15 Seabird video analysis

Project No.: 627
Status: Continuing
Cost: $ 14,750
Anticipated ending: 2003
Personnel: Ames, Williams, Leaman, Dykstra

This project entails the final stages of the analysis and write-up of the report for to the NMFS Domestic Observer Program on the contract for evaluating a video monitoring system to monitor compliance with seabird avoidance device requirements and the potential for monitoring seabird bycatch. The requested funds are for costs associated with video equipment lease from Archipelago Marine Research in Victoria, B.C, and contracted personnel. The project will be completed by the end of March, 2003.

Stock Assessment Program

S.16 Spatial and ontogenetic variability in the trophic status of Pacific halibut

Project Account No.: 602
Status: Continuing
Cost: $15,000 and staff salaries
Start Date: 1999
Anticipated ending: Continuing
Personnel: Hare, Kline

This project attempts 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. 2002 was the fourth year of sample collection; analysis of these data will begin to allow us to estimate interannual variability in trophic level. No collections are expected in 2003, in order to process the backlog of samples collected thus far.

S.17 NMFS trawl survey: at-sea data collection and data base management

Project Account No.: 604
Status: Ongoing
Cost: $32,207 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.

CONTRACT AND EXTERNALLY FUNDED PROJECTS

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

Project Account No.: 801
Status: Continuing
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.: 617
Status: Ongoing
Revenue: $7,000 (to be reviewed)
Start Date: 1998
Anticipated ending: 2004
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 in order 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. IPHC and NMFS are reviewing the logistics of collecting data from vessels under 60 feet and whether there will be an additional cost.

C.3 Area 2B logbook program and bycatch

Project Account No.: 632
Status: Continuing
Start Date: 2002
Revenues: In 2002, bycatch revenues from the 2002 setline surveys in Area 2B. In 2003, to be determined
Anticipated ending: Ongoing
Personnel: Geernaert, Gilroy, Leickly, Taheri

IPHC expanded the B.C. port sampler's tasks to include interviewing skippers and editing information on the bycatch of other species during halibut fishing. These data were entered into the IPHC log data base tables. The latitude/longitude location was converted using a Geographical Information System (GIS) to DFO statistical areas and vessels were assigned a unique identifier to maintain the confidentiality of the vessels. IPHC will provide DFO with fishing event (skates hauled and lost) for the bycatch species (catch and discards) that are recorded in the logbook. The data provided has a skipper's signature, acknowledging that IPHC will provide the information to DFO.