IPHC Research Program:
Review of 2005 Projects and Proposals for 2006

IPHC 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 2005. The second section presents the staff research proposals for 2006. Information is provided on when each project was initiated, the anticipated completion date, the annual 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 $2.649 million (as of 2005) 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) **Funded Research:** Necessary research projects of high priority that can only be conducted with revenues generated by survey fishing in 2005, and/or carry-over from 2004;

2) **Contract and Grants:** Agreements with other parties to conduct specific research. In this case, contracts and grants are shown for projects where the IPHC staff is the principle investigator; and

3) **Research conducted with no additional funding:** Necessary research projects of high priority that can be conducted within the IPHC budget.

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; and

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 2005

Research conducted by the IPHC staff during 2005 covered a variety of subjects (coast-wide PIT tagging scanning project, archival tags, collection of tissue and otolith samples) which contribute to improving the stock assessment or our understanding of the biology of the fish. 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 these projects are outlined below.

Funded Research in 2005

The staff completed several projects during 2005, but most of the work was on long-term projects which will continue past 2005. The dockside detection program by IPHC Scan Samplers continued in 2005. This past year marked the second full season (and third overall) of scanning by samplers in eight Alaskan and four B.C. ports. Additionally, IPHC received state and tribal assistance in scanning efforts in nine west coast ports. Through 7 November, over 30 million pounds (45% of total landings, or 1.22 million fish) have been scanned. The number of recovered tags totals 454 from the 2003 primary experiment, 289 from the 2004 releases, and 198 from the September 2003 double tag experiment (2,662 PIT tags released). The latter project was conducted to confirm the PIT tag shedding rates observed during earlier holding experiments in Seward.

The otolith elemental project (project 620) continued in 2005 with additional chemical analysis of juvenile (age-2) halibut obtained from the NMFS trawl survey during 2003. Analyses prior to 2005 suggested that halibut retain distinct elemental signatures within their otoliths and that these OEFs may be distinct enough to distinguish nursery origins at regional scales and serve as naturally occurring tags. The 2004 statistical discrimination model suggested that otolith elemental signatures can be used to successfully distinguish and classify individuals within general geographic regions (southeast Bering versus west-Central Gulf), with 75-80% accuracy. Work continued this year with laboratory analyses intended to add more sites to the existing statistical discrimination model as well as to add stable isotope data (δ13C and δ18O). In spring of 2005, carbon and oxygen isotope data were received and added to the model, increasing classification accuracy by region to 80-90% as well as increasing the model's spatial resolution. Lab work has been completed on all age-2 fish and data analysis is ongoing. Additional collection of age-1 and -2 halibut from Fanshaw Bay (southeast Alaska) was also conducted in early summer. These samples are intended for a separate analysis of temporal stability that must be understood in order to establish future sampling designs.

Studies on the genetic population structure moved forward with tissue samples collected during the 2005 setline survey. Approximately 1,900 samples were collected from 20 sites; these largely mimicked collections made in 2003, when ~1,500 tissue samples were collected from 18 sites. The samples were collected to address whether discontinuities in population structure exist across the geographic range, as well as to examine temporal stability in genetic population structure. Laboratory analysis of samples collected on spawning grounds during winter of 2004 is also under way, but results are not yet available.

During the 2004 summer setline survey, 25 PAT tags were deployed in the Aleutian Islands: 12 at Atka and 13 at Attu (project 622). These tags were programmed to release from the fish and report their location and data during mid-February 2005. Eleven tags successfully transmitted from the Attu releases and five from the Atka releases. All tags popped up in relatively close proximity to tagging location and light-based longitude estimates provided no additional evidence to suggest that any of the fish had left the Aleutian Islands during time at liberty. We have received a report that one of the missing Atka tags has been recaptured by a longliner, still attached to the fish even though it should have released nearly eight months ago. The fish was recovered just northwest of Atka at Kasatochi Island. A detailed report including analysis of temperature and depth data is in preparation.

In an attempt to better understand seasonal movement of halibut, 48 adult halibut were tagged with PAT tags during the 2005 IPHC summer setline survey in the Gulf of Alaska. A total of 24 adult halibut were tagged along a transect line in the eastern Gulf and 24 along another transect in the western Gulf. Four tags were recovered by the targeted fishery prior to the end of the 2005 season, one of which was reprogrammed and redeployed during August. All tags are programmed to release and transmit their data 365 days following release, during the summer of 2006.

Project 636, which is re-evaluating gonad maturity classification criteria and examining the stages and development of gonadal (ovary) tissue, began in 2003 with preliminary histological work on female gonads. A sampling design and collection protocol for the 2004 surveys were developed. In 2004, during winter and summer surveys, 240 female gonads from three different regions, in each stage of development, were collected. The microscope station was set up in February 2005 and in March 2005 gonads in the four maturity classifications, as determined on the survey vessel, were photographed. NMFS personnel assisted in assessing the slide preparation quality, so we are now proceeding with preparing the remainder of the collection for analysis. Otoliths from the gonad sample collection have been aged.

Project 638, investigating whether species richness and evenness (i.e., species diversity) is correlated with bottom temperature and depth, got underway in 2004. Historical data from several survey regions in British Columbia and Alaska were examined and data from a directed field experiment were analyzed. Survey vessels in selected regions deployed temperature and depth recorders on each skate of gear in 2004. In addition, electronic monitoring equipment was installed on one vessel to record a sequential tally of all catch for each station (hook by hook data). A video analyst reviewed the video data, determining the numbers and species encountered. On the remaining vessels, Archipelago Marine Research (AMR) field staff recorded hook by hook data in-season. Analysis began in 2005 and will examine the spatial distribution and relative abundance of species relative to the temperature and depth profiles.

Since 2002, the IPHC has been working collaboratively with the Alaska Department of Environmental Conservation (ADEC) to collect halibut tissue samples to be analyzed for heavy metal and organic pollutant loading (Project 642). The principal results from the 2002 collection led the Alaska Division of Public Health in 2003 to conclude that the concentrations of heavy metals in Alaskan Pacific halibut are not a public health concern. In 2004 the first results regarding organic pollutants (PCB's, pesticides) were released demonstrating that halibut had the

lowest concentrations of the five species (including salmon and sablefish) examined. The IPHC and ADEC are continuing to qualify the data with physical parameters (age, size, and weight) and additional analyses will be done on the samples. ADEC and EPA planned on going ahead with this study regardless of IPHC input. Our involvement in the project has allowed us to provide input on study design, sampling protocols in the field, etc., which will make the resultant information much more representative. Sampling continued in 2005 with a targeted collection of 60 samples (30 from fish weighing between 20 – 40 lbs. and 30 from fish weighing between 40 – 100 lbs.) from each of three regions (Seward, Unalaska, and Attu) during the setline survey. Results will be published as they become available. ADEC has expressed interest in further assessments of contaminant occurrence in halibut in 2006.

As in past years, IPHC placed staff on the 2005 NMFS Bering Sea and Gulf of Alaska trawl surveys (Project 604) to collect fishery-independent data for stock assessment. Trawl data are particularly useful because they include large numbers of juveniles (ages 3-7 yr) that do not appear in large numbers in the setline survey. Otoliths have been collected on the NMFS surveys since 1996 and provide relevant age information. These data are expanded to estimates of relative abundance and age/size composition by IPHC area.

Use of the water column profiler on selected assessment survey vessels continued in 2005 (Project 610). The Seabird SBE-19 profiler records depth, salinity, and temperature, and this year a dissolved oxygen sensor (SBE 43) was added to the existing unit. This work began in 2001, and has been conducted on board seven survey vessels fishing selected areas since the beginning of the project. The work is in collaboration with the Pacific Marine Environmental Lab (PMEL).

Finally, IPHC hired one intern (Project 618) in 2005. Mr. Erin Lowery (University of Washington, Seattle, WA) worked May-August on a project examining ambi-coloration of halibut, which also gave him an opportunity to spend time on a survey vessel collecting data. He presented his results to the staff, and will also be presenting his results at the 2006 Western Groundfish Conference in Newport, OR.

2005 Contract Research

For three years, IPHC provided DFO with Area 2B fishing event (skates hauled and lost) and bycatch species (catch and discards) information that were recorded in the harvesters' logbooks (Project 376). The IPHC port samplers interviewed skippers and edited information on the bycatch of other species during halibut logbook interview. These data were provided electronically to DFO by DFO statistical area and with unique vessel identifier to maintain the confidentiality of the vessels. The goal of the program was to provide DFO with additional information for bycatch accounting of other species. Since 2003, data were provided with additional landing weight information to allow DFO the opportunity to verify the logbook-recorded bycatch landing information with validated landed weight information. In 2005, DFO managers decided to discontinue the project of having IPHC interviewing and entering bycatch species information as they intend to use observer coverage and cameras to validate logbook information. The joint logbook program was discontinued in July 2005.

IPHC and NMFS Auke Bay Lab (ABL) have a sablefish data collection program (Project 628). The program was reviewed and modified in 2003/2004 to meet the IPHC confidentiality policy and to encompass all vessels rather than just vessels greater than 60 feet. Under a Statement of Work (SOW), NMFS contracted with IPHC to collect and review information on sablefish catches during the port sampler's interview, which collects halibut logbook information. Sablefish data are entered by IPHC staff, edited, and an electronic summary provided to the NMFS ABL scientists. Vessels are assigned a unique code in the summarized data to preserve confidentiality. The SOW was renewed for 2005.

Staff continued a study in 2005 with the Central Bering Sea Fishermen's Association (CBSFA) examining the effects of oceanographic conditions on halibut catches and CPUE (Project 629). The objective of the project is to see if temporal trends in CPUE can be isolated and correlated with changing water temperature. In 2002, with the cooperation of local fishers and funding from the CBSFA, a pilot study was initiated to determine the feasibility of deploying temperature loggers on commercial gear in order to monitor the temperatures experienced by the fleet and correlate temperature and catch. In 2003, with financial assistance from the North Pacific Research Board, the study was expanded. Data were obtained from a total of 114 apparent longline sets conducted during 2002, 266 apparent sets in 2003, and 351 sets in 2004. Loggers were deployed throughout the 2005 commercial season, but data have not been retrieved from the units. The 2002-04 data clearly demonstrate annual seasonal warming trends, short-term temperature variability, and interannual variability in daily maximum temperatures. Highest bottom temperatures generally occur in early September and maximum daily bottom temperatures appear to have been greatest in 2003, with 2002 and 2004 being similar to one another. Analyses of CPUE in relation to temperature are ongoing.

2005 Research Publications

IPHC staff noted in **Bold** type.

Ames, Robert T. 2005. The efficacy of electronic monitoring systems: A case study on the applicability of video technology for longline fisheries management. Int. Pac. Halibut Comm., Tech. Rep. 80, 64 p.

Ames, R. 2005. The efficacy of electronic monitoring systems: A case study on the applicability of video technology for longline fisheries management. Unpublished master's thesis, Royal Roads University, Victoria, British Columbia, Canada.

Ames, R.T., **Williams, G.H.**, and Fitzgerald, S.M. 2005. Using digital video monitoring systems in fisheries: Application for monitoring compliance of seabird avoidance devices and seabird mortality in Pacific halibut longline fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-152, 93 p.

Clark, W.G. 2004. Nonparametric estimates of age misclassification from paired readings. Can. J. Fish. Aquat. Sci. 61:1881-1889.

Hauser, L., Spies, I., and **Loher, T.** In review. Microsatellite screening in Pacific halibut (*Hippoglossus stenolepis*) and a preliminary examination of population structure based on observed DNA variation. Int. Pac. Halibut Comm. Sci. Rep.

Leaman, B.M. and **Williams, G.H.** 2005. Collaborative Pacific halibut bycatch control by Canada and the United States. Mar. Fish. Rev. 66(2): 31-37.

Lehodey, P., Alheit, J., Barange, M., Baumgartner, T., Beaugrand, G., Drinkwater, K., Fromentin, J-M., **Hare, S.R.**, Ottersen, G., Perry, R.I., Roy, C., van der Lingen, C.D., and Werner, F. In Press. Climate variability, fish and fisheries. J. Climate XX: XXX-XXX.

Loher, T., and Armstrong, D.A. 2005. Historical changes in the abundance and distribution of adult female red king crabs (*Parlithodes camtschaticus*) in Bristol Bay (Alaska), and potential relationship with bottom temperature. Fisheries Oceanography 14(4):292-306.

Loher, T., and Seitz, A. In press. Seasonal migration and environmental conditions experienced by Pacific halibut (*Hippoglossus stenolepis*), elucidated from Pop-up Archival Transmitting (PAT) tags. Marine Ecology Progress Series.

Loher, T., and Seitz, A. In review. Seasonal migration and environmental conditions experienced by Pacific halibut in the Gulf of Alaska, elucidated from Pop-up Archival Transmitting (PAT) tags. Int. Pac. Halibut Comm. Sci. Rep.

Marzban, C., Mantua, N.J., and **Hare, S.R**. 2005. Retrospective study of climate impact on Alaska Stella sea lion: A report. University of Washington, Dept. of Statistics. Technical Report No. 485. Available at http://www.stat.washington.edu/www/research/reports/, 74 pp.

Trites, A.W., Miller, A.J., Maschner, H.D.G., Alexander, M.A., Bograd, S.J., Calder, J.A., Capotondi, A., Coyle, K.O., Di Lorenzo, E., Finney, B.P., Gregr, E.J., Grosch, C.E., **Hare**, **S.R.**, Hunt, G.L., Jahncke, J., Kachel, N.B., Kim, H., Ladd, C., Mantua, N.J., Marzban, C., Maslowski, W., Mendelssohn, R., Neilson, D.J., Okkonen, S.R., Overland, J.E., Reedy-Maschner, K.L., Royer, T.C., Schwing, F.B., Wang, J.X.L., and Winship, A.J. *In Press*. Bottom-up forcing and the decline of Steller sea lions in Alaska: Assessing the ocean climate hypothesis. Fish Oceanogr. XX: XX-XX.

Wilderbuer, T., **Leaman, B.**, Zhang, C., Fargo, J., and Paul, L. 2005. Pacific flatfish fisheries. pp. 272-288 *In* Gibson, R.N. (Ed.) Flatfishes: Biology and Exploitation. Blackwell Science Ltd. London. 391 p.

Section II: Research Proposed for 2006

Projects proposed for 2006 consist of a continuation of several projects currently underway and five new projects. Continuing projects include:

1. Project 413 - PIT tag recovery efforts will continue in 2005 with the scan sampling program. The staff is planning on placing a sampler in Adak (Area 4B) to enhance opportunities for recoveries from that area. No other changes are planned for port coverage or duration of sampling. Planning for this activity is based on a March 1 – November 15 season.

2. Project 620 – Sample analysis will continue in FY2006 in the otolith elemental fingerprinting (OEF) study. Laboratory analysis of accumulated samples will continue during FY 2006, including those collected in 2005 from southeast Alaska. Determination of index sites may begin in FY 2007.

3. Project 621 - The study of the population genetic structure will continue in 2006. Sample testing is being conducted by Drs. Lorenz Hauser and Edgardo Diaz-Ferguson (UW Marine Molecular Biology Laboratory). Additional samples were collected in 2005. The FY2006 budget will allow for a 2-year Post-Doc to complete the 2004 winter samples and work on the 2005 summer collections.

4. Project 622 - This set of PAT releases occurred in the summer of 2004 from several assessment survey vessels in the Aleutians (Area 4B). Tags popped up in mid-February, 2005, essentially completing the project. FY2006 funding is for the satellite transmission fees from the pop-ups.

5. Project 638 - The species richness study will conclude in 2006, with completion of analysis and Master's thesis by the principle investigator.

6. Project 636 - The gonad staging/histology project will continue in 2006 with analysis of the 2004 samples and microscopy work. No additional sampling is scheduled.

7. Staff will also continue with other long-standing projects in 2006. These include the collaborative work on contaminants with ADEC (#642), participation by IPHC staff on the NMFS trawl surveys (#604), data collections with water column profilers on the assessment surveys (#610), and the undergraduate internship program (#618). The otolith marginal increment analysis (#626) is expected to be completed in 2006. Finally, the investigation of sleeper shark population structure and development of an aging technique (#630) will focus on lab work and genetic testing of samples.

Five new projects are proposed for 2006 and briefly described below:

1. Project 644.11 – A proof-of-concept project which looks at the use of electronic monitoring (EM) video cameras on a trawl catcher/processor in the Bering Sea trawl fisheries as a means

of eliminating presorting of halibut. The project is being funded with a portion of the restitution funds provided to IPHC from the F/V Unimak court case.

2. Project 646 – Summer PAT releases off Oregon and Washington for a scheduled winter pop-up, to identify the Area 2A contribution to the winter spawning stock in Area 2B.

3. Project 647 – Expanded use of water column profilers and dissolved oxygen equipment on the assessment surveys.

4. Project 648 – Examining the behavior of rockfish and halibut around traps/pots. This is in response to the request by the Research Advisory Board to examine traps for catching halibut which have minimal bycatch of rockfish. The field effort would utilize the newly emerging Didson sonar technology.

5. Project 650 – Development of techniques for implanting archival tags in halibut. Two varieties of internal archival tag will be examined in a lab setting: standard temperature-depth recorders (TDRs), and archival tags equipped with a light-stalk that record ambient irradiance and can be used to geo-locate fish during time-at-liberty, as is done with PAT tag data. The study's primary objective is to practice and perfect the surgical techniques required to implant these tags in fish during an actual field study.

Projects conducted under contract to other agencies or through research grants will be continued in 2006. IPHC port sampling activities in Alaska will continue being augmented by a grant from NMFS (Project 375), and IPHC port samplers in Alaska will collect sablefish logbook data for the NMFS Auke Bay lab (Project 628). A new grant from the Pacific States Marine Fisheries Commission and in conjunction with the Washington Department of Fish and Wildlife will provide for an expanded number of stations on the assessment survey of Area 2A (Project 649). The additional stations will provide information desired by state and federal agencies for better assessment of certain rockfish species in the area.

Funded Research

Project 413: Pit tagging study: Third year of tag recovery and scanning

Cost**:** $ 440,941
Start Date: 2003
Anticipated ending: 2008
Personnel: Forsberg, Blood, Williams, Clark, Ranta, scan samplers

Scanning for PIT tags will continue in 2006. IPHC will hire samplers for Alaskan ports, while contracting with AMR for the Canadian ports and continuing to seek state and tribal assistance in Area 2A. Sampler duties include scanning commercial deliveries for PIT tags, and conducting regular tests of detection and piece (fish) counts to measure accuracy of sample data. Project costs are expected to increase moderately in FY2006, primarily due to (a) salary increases for returning samplers and staffing of Adak for 1 month, (b) equipment repair costs previously covered by warranty, (c) an anticipated minor increase in contract with AMR for sampling BC, (d) the reward program, and (e) purchase of additional scanning equipment to replace worn out equipment.

Project 604: NMFS trawl survey: At-sea data collection and data base management

Cost: $ 19,446
Start Date: 1996
Anticipated ending: Continuing
Personnel: Sadorus, Ranta, Clark

A series of NMFS trawl survey data on halibut, parallel to our setline data, is 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 yr) that do not appear in large numbers in the setline survey. Otoliths have been collected on the NMFS surveys since 1996 and provide relevant age information. These 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. Project cost is comprised of personnel and travel. In 2006, the staff is proposing placing one staff on the survey of the Bering Sea.

Project 610: Water column profiler project (annual)

Cost: $ 1,000
Start date: 2000
Anticipated ending: Continuing
Personnel: Sadorus, Hare, Stabeno (NMFS PMEL)

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. The profiler has been used on selected survey trips each season since. Project cost is directed towards annual maintenance of the one profiler owned by IPHC.

Project 618: Undergraduate Internship

Cost: $ 15,179 (One intern)
Start Date: 2002
Anticipated duration: Continuing
Personnel: Sadorus, Ames, other staff support as needed

One undergraduate 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.

Project 620: Analysis of spatial recruitment dynamics in Pacific halibut using otolith elemental fingerprints (OEF): Phase 2

Cost: $ 48,248
Start Date: 2002
Anticipated Ending: Continuing
Personnel: Loher, Wischniowski, temporary staff

Results to-date using age-2 halibut from western Alaska suggest that otolith elemental signatures can be used to successfully distinguish and classify individuals within general geographic regions (Bering vs. Kodiak vs. Cook Inlet), with 80-90% accuracy. Last year's model was improved considerably by adding oxygen and carbon isotope ratios to the existing trace element data, and additional statistical analyses are under way that will incorporate additional sites. This will complete Phase I of the project, which was simply a proof of concept. Results-to-date will be presented at the International Flatfish Symposium later this month. The second phase of the project will seek to establish appropriate protocols and sampling sites so that a coastwide nursery "otolith element map" can be developed. This will involve analyses of temporal stability in signatures within and among age-classes, and determination of appropriate sample sizes required per site. The field sampling required for these analyses has been completed and laboratory analysis of the accumulated samples is expected to be completed during FY 2006, pending final funding decisions. Determination of index sites may begin in FY 2007.

Project 621: Genetic population structure of Pacific halibut assessed via nuclear microsatellite diversity

Cost: $ 99,166
Start: 2002
Anticipated Ending: 2007
Personnel: Loher, L. Hauser and E. Diaz-Ferguson (UW-MMBL), other staff as needed

Tissue collections were made during winter charters in 2004, at spawning locations near Queen Charlotte Island, Portlock Bank, and Pribilof Canyon. Male and female halibut were sampled at all sites, resulting in sample sizes of 157-200 mature fish per site. These collections were made to address the question of whether or not the Bering Sea is reproductively isolated from the Gulf. Samples are presently being analyzed by Drs. Dr. Lorenz Hauser and Edgardo Diaz-Ferguson (UW - Marine Molecular Biology Laboratory), screening for allele frequencies in a suite of nuclear microsatellites that were isolated in Pacific halibut in 2003 and some others that became available more recently. Their analyses are about 60% complete and will be completed this winter. A preliminary population analysis was conducted with summer samples collected in 2002, comparing Adak and St. Paul Island to Newport, Oregon. The results were intriguing, suggesting potential reproductive isolation in the Aleutians. These results have been submitted as an IPHC internal report and results-to-date will be presented at the International Flatfish Symposium. Given that sample sizes were low and results of the initial summer-base population analysis were tenuous, ~1,900 tissue samples were collected from 20 sites during the 2005 assessment survey, to be analyzed in 2006. A budget increase in FY2006 will allow for a 2-year Post-Doc to complete the winter samples and work on the 2005 summer collections.

Project 622: Pop-up archival tags (PATs) to study halibut movements

Cost: $5,600
Start: 2002
Anticipated Ending: 2006
Personnel: Loher

Electronic pop-up, satellite-transmitting archival tags (PATs) can record ambient temperature, depth, and light level (used to estimate longitude under certain conditions) 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 environmental data to the satellite. The result is a record of the fish's final location, along with important environmental and behavioral data throughout the fish's time at liberty.

During the 2004 summer setline survey, 12 PATs were deployed at each of two Aleutian Islands: Atka and Attu. These tags were programmed to release from the fish and report their location and data during mid-February 2005. Costs for 2006 are for the expected invoice for satellite transmission fees.

Project 626: Otolith marginal increment analysis

Cost: $ 500

Star Date: 1999
Anticipated ending: 2006
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. Timing of annulus formation is critical to assigning accurate age and prevents smearing of strong year classes over weak ones. Collected otoliths will be used to note the timing of deposition of annual growth rings. The variability in this timing by area and sex will also be examined. Data collection occurred in 1999-2001, with otolith processing and development of the cross-sectioning methodology underway, continuing into 2006. Project costs consist of lab supplies.

Project 636: Analysis of gonad staging on IPHC setline surveys (Histology)

Cost: $ 31,075
Start: 2004
Anticipated Ending: 2007
Personnel: Geernaert, Leaman (other staff as needed)

The IPHC Stock Assessment surveys assess maturity of halibut based on visual criteria established in the early 1990's and modified in 1995. These survey data combined with the age data are important components in the stock assessment model. Four maturity stages are presently assigned to female halibut; immature (F1), maturing (F2), spawning (F3) and resting (F4). Once a female halibut has spawned, the gonad transitions to a resting phase, back to maturing, and then to spawning again. Our criteria for classification also assume that the immature (F1) stage is only seen with immature fish but we are seeing anomalies during the survey that could question this assumption. Mature females are seen as small as legal size (82 cm) but, area-wide, there have been several large 100+ cm females whose gonadal characteristics classify them as immature (never spawned). The SSA survey data also suggest that fish in the southern latitudes (Area 2B) mature earlier and possibly spawn earlier that fish in the northern latitudes (Area 3A and west). The timing and duration of these events are not clearly understood. We would like to re-evaluate our classification criteria and examine the stages and gonadal tissue development more closely.

In 2003 preliminary histological work on the female gonads was initiated. We developed a sampling design and collection protocols for the 2004 surveys. In 2004, during winter and summer surveys, female gonads from three different regions, in each stage of development, were collected. Three different histological subsamples have been prepared and we are presently standardizing the sample sites on the gonad for the final slide preparation. We have collected nearly 240 gonad pairs and will be analyzing multiple sites from each sample in 2006.

Project 638: Associating environmental variables with species richness and evenness: A case study

Cost: $ 2,000

Start: 2004
Anticipated ending: 2006
Personnel: Ames, Leaman, other staff as needed

The study will investigate whether species richness and evenness (i.e., species diversity) is correlated with bottom temperature and depth. Historical data from the stock assessment survey (SSA) and data from a directed field experiment will be analyzed. The SSA charter regions investigated include Goose Island, St. James, and Charlotte in British Columbia as well as 4A Edge, 4D Edge, and Attu in Alaska. During the 2004 SSA, vessels were chosen to deploy temperature and depth recorders on each skate of gear. In addition, electronic monitoring equipment was installed on one vessel to record a sequential tally of all catch for each station (hook by hook data). A video analyst determined the numbers and species encountered. On the remaining vessels, Archipelago Marine Research (AMR) field staff recorded hook by hook data in season. The final analysis will examine the spatial distribution and relative abundance of species relative to the temperature and depth profiles. Project costs in 2006 are for analytical software and other supplies.

Project 640: Summer PAT tagging: Areas 2B, 2C, and 3B releases

Cost: $ 14,800
Start Date: 2005
Anticipated ending: 2006
Personnel: Loher, sea samplers

This study is intended to investigate the preliminary observation that adult (presumably female) halibut tagged in the Gulf of Alaska at southeasterly and southwesterly locations (Areas 2B, 2C, and 3B) may have shorter residence times on their summer feeding grounds than fish found in Area 3A. In particular, Gulf PSAT data from 2002 suggest that southerly fish may begin their fall migration as early as September, as evidenced by an increase in depths visited, which may indicate movement away from their summer feeding locations to the shelf-break. We have no information regarding timing of the spring return-migration from the shelf-break back to shallower coastal waters.

In 2005, 26 fish in Areas 2B, 2C and 3B were tagged during the summer setline survey. Focusing primarily upon the eastern Gulf, 18 tags deployed at three general locations (lower Queen Charlotte Sound, northern Queen Charlottes, and western Baranof-Chichagof Islands). Four fish were tagged at each of two locations in Area 3B (Semidi and Sanak Islands). Tags are programmed to pop-up during the last week of May, 2006. Project costs for 2006 consist of the satellite time for transmission relay.

Project 642: Assessment of mercury and contaminants in Pacific halibut

Cost: $ 200
Start Date: 2002
Anticipated ending: Continuing
Personnel: Dykstra, Alaska Department of Environmental Conservation (ADEC)

For the last few years, health officials and media have raised the profile of pollutant contamination in fish (methyl mercury, PCB's, pesticides). Since 2002, the IPHC has been working collaboratively with the Alaska Department of Environmental Conservation (ADEC) to collect halibut tissue samples to be analyzed for heavy metal and organic pollutant loading. In 2003 the principal results from the 2002 collection led the Alaska Division of Public Health to conclude that the concentrations of heavy metals in Alaskan Pacific halibut are not a public health concern. In 2004 the first results regarding organic pollutants (PCB's, pesticides) were released demonstrating that halibut had the lowest concentrations of the five species (including salmon and sablefish) examined. The IPHC and ADEC are continuing to qualify the data with physical parameters (age, size, and weight) and additional analyses will be done on the samples.

Sampling continued in 2005 with a targeted collection of 60 samples (30 from fish weighing between 20–40 lbs. and 30 from fish weighing between 40–100 lbs.) from each of three regions (Seward, Unalaska, and Attu) during the setline survey. Results will be published as they become available. ADEC has expressed interest in further assessments of contaminant occurrence in halibut in 2006.

Project 644.11: Electronic monitoring of a factory trawler

Cost: $ 55,000
Start Date: 2005
Anticipated ending: 2006
Personnel: Williams, Leaman, NMFS Observer Program staff,

In fall 2005, a cooperative research project involving IPHC, NMFS Alaska Fisheries Science Center (AFSC), the Marine Conservation Alliance Foundation (MCAF), and Cascade Fishing, Inc. took place on the catcher processor *F/V Seafisher.* The two-fold project was testing an automated catch sampling system and to evaluate the use of video for monitoring fish handling and discard operations. The video system utilized nine cameras mounted on deck and in the live tank, sorting, and processing areas. Sea samplers collected data on sorting and discard events and this information will be compared to an analysis of the video data to determine the usefulness and applicability of video for monitoring discard. The video data was collected under normal fishing conditions.

IPHC contracted with Archipelago Marine Research (AMR) of Victoria, BC. AMR was tasked with camera placement on the vessel, system monitoring during the project, and the subsequent video analysis. Evaluation of video for monitoring potential sites of presorting and discard will provide a basis for future research and understanding the potential scientific and compliance monitoring applications of video technology. The cruise began in Dutch Harbor on October 12, 2005 and took 14 days to complete. The first 12 days of the research was dedicated to the evaluation of the automated catch sampling technology and conducting the catch sampling and census comparison portion of the research while the vessel is targeting yellowfin sole in Areas 509, 513 or 514. The video monitoring portion of the research (approximately 2 days) was conducted while the vessel was targeting arrowtooth flounder in Areas 517 or 519 and occurred

under conditions that approximate as closely as possible normal fishing operations and work pace.

Project 646: PAT tags – summer 2006 releases in Area 2A

Cost: $ 67,500
Start Date: 2006
Anticipated ending: 2008
Personnel: Blood, Loher, Williams

The purpose of this study is to track seasonal movements of halibut that are summer residents of Area 2A as they migrate to and from their summer residency to winter spawning grounds. There is some evidence derived from external tagging experiments that the population from Area 2A is highly migratory and contributes to spawning aggregates in central Area 2B and southern Area 2C. There is little to no known spawning that occurs in Area 2A, so all recruitment is dependent upon outside sources. This is unique to all other halibut regulatory areas and may warrant a different harvesting strategy for Area 2A.

Project 647: Expanded water column profiler/dissolved oxygen program

Cost: $ 221,989
Start Date: 2006 (2007?)
Anticipated ending: Continuing
Personnel: Sadorus, Hare, Leaman, Dykstra, Ames, Soderlund

The goal of this project is to implement a program to measure oceanic properties in the waters over the Alaskan, B.C., and the U.S. West Coast continental shelf on an ongoing basis. The IPHC operates a survey that covers this area. Water column profilers (for measuring temperature, salinity, and dissolved oxygen) will be deployed from the IPHC survey vessels. These data will provide an annual snapshot of near shore oceanic conditions and provide valuable observational data for modeling and biological studies on recruitment and growth variability.

To better understand the factors driving fluctuations in growth and recruitment of fish populations, increasing attention is being paid to climatic and oceanic conditions. Primary and secondary productivity are directly driven by variations in water temperature, salinity, oxygen, mixing, and light penetration, among other factors. Most of this production takes place in the mixed layer, between 20 and 100 meters deep. Spring and early summer are peak periods of production. Waters over the continental shelf are, naturally, most important to the groundfish species that constitute much of the fish production of the northeast Pacific. Observations of ocean conditions are important both to understand variability in time and space as well as to provide necessary data for modeling productivity. Satellites sample the ocean surface and free drifting arrays of mid-ocean profilers (Davis 1991, Feder 2000) provide data on mid-latitude ocean conditions. Moorings provide continuous hydrographic and current data but at fixed points. However, there is a great lack of observational data for most of the near shore northeast Pacific.

Recently, the IPHC staff has sought proposals on how the survey sampling program could be used for other scientific investigations without affecting the core survey activities. One obvious project is the collection of oceanographic data. IPHC already records bottom temperature at one quarter to one third of the survey stations using a Water Data Recorder (WaDaR), however the potential exists to sample the entire water column. Such data would provide a critical component for long-term observations, and compliment existing data and data collection. If collected, these data would be the only shelf-wide measurements of water properties, and would be critical to the identification and understanding of climate impact.

Project 648: Trap/pot experiments

Cost: $ 84,974
Start Date: 2006
Anticipated ending: 2008
Personnel: Kaimmer, Williams, other staff as needed

The purpose of the study is to investigate pot designs that minimize the catch of rockfish and interaction with marine mammals. Although hook & line is the specified gear for the legal capture and retention of Pacific halibut, there is interest in the possibility of using traps under certain circumstances. In British Columbia and southeastern Alaska, there is a growing problem with the catch and mortality of rockfish which are a restricted bycatch to many halibut fishers. In southcentral Alaska and the Aleutians, there is a problem with predation of longline captured halibut by marine mammals. Either of these problems might be addressed by using traps to catch halibut.

This study attempts to directly address a primary concern and request expressed by the Research Advisory Board (RAB). The 2003 RAB meeting identified research on alternate gear as a priority item, with an emphasis on gear modifications directed at minimizing interactions with other species. The Commission staff had proposed spending $50K in conjunction with the NMFS laboratory in Newport, OR, and initial discussions were held with NMFS staff and a preliminary project design outlined. However, funding cuts at the Commission forced cancellation of this work. NMFS staff did proceed with some aspects of this work in conjunction with other projects. At the 2004 RAB meeting, the incidental capture of or interaction with non-target species during halibut fishing was identified as the single greatest concern to the industry, with rockfish listed as one of the species groups of concern. The issue of gear modifications to avoid capture and interactions was raised again as a productive area of research. The Board restated its desire to have staff conduct research on gear to avoid interactions of halibut fishing with marine mammals, and to develop fishing gear that might reduce retention of non-target species.

Project 649: Additional survey stations in Area 2A (PSMFC/NMFS)

Cost: $ 51,864
Revenue: $ 50,238 (plus fish sales)
Start Date: 2006
Anticipated ending: Continuing
Personnel: Leaman, Dykstra, Ames, Soderlund, Washington Department of Fish and Wildlife

The project would expand on the assessment survey of Area 2A conducted by IPHC. Stations will be added to the existing survey to conduct surveys in rockfish habitats and areas that are not usually accessible to the coastwide trawl surveys conducted by the National Marine Fishery Service. The additional stations would be designated by WDFW/NMFS to enable comparisons with the manned submersible survey of non-trawlable habitat that has been conducted off the northern Washington coast. Species composition at each station can be estimated through systematic subsampling or, at additional cost, through digital video recording of all hauling. All rockfish samples would be processed subsequently by state agencies, for incorporation into stock assessments. This project would be undertaken on a cost-shared basis with the IPHC and WDFW. All data processing of fishing station, catch, and environmental data would be conducted by IPHC and made available to state and federal agencies. Information on the rockfish catch characteristics will be reported by WDFW. A summary report of survey and sampling activities would be produced and submitted jointly by the IPHC and the WDFW.

Project 650: Archival tags –development of methods & technique

Cost: $ 46,494
Start Date: 2006
Anticipated ending: 2008
Personnel: Loher

In this study, a relatively small (~12) number of halibut will be tagged with two varieties of internal archival tag: standard temperature-depth recorders (TDRs), and archival tags equipped with a light-stalk that record ambient irradiance and can be used to geo-locate fish during time-at-liberty, as is done with PAT tag data. The study's primary objective is to practice and perfect the surgical techniques required to implant these tags. Standard internal TDRs are inserted into the gut cavity in what is theoretically a simple process. A hole is cut in the belly, the tag is slipped into the hole, and a suture or two is used to entirely close the hole. Implantation of the MK-9 may be a little trickier. The body of the tag is inserted into the fish in the same way as a normal TDR but the light-stalk remains external. It is unknown how sensitive the implantation procedure is and whether the stalk can slide back into the gut cavity if implanted improperly. Testing is expected to be conducted at a local facility capable of holding halibut for a short (i.e., 12 weeks) period of time.

Other 2006 Research – Contracts and Grants

Project 375: AK port sampling grant (NMFS)

Cost: Staff salaries
Revenue: $ 114,014
Start Date: 2002
Anticipated ending: Continuing
Personnel: Gilroy, Larsen, Hutton

The commercial fishery port sampling program hires samplers to collect otoliths, halibut lengths, fishing logbook information and landed weight data. The U.S. program includes staffing eight Alaskan ports and Bellingham, Washington. The samplers act as the liaison between the fishing industry and the Commission staff in Seattle. The Commission is responsible for the overall assessment and management of the halibut fishery and the data collected are necessary for stock assessment. The U.S. Government adopted the Individual Fishing Quota (IFQ) allocation program in 1995. This grant provides funds to the IPHC for the incremental cost to the Commission sampling program due to the IFQ program. The grant is generated from the NMFS IFQ Fee Collection Program.

Project 628: AK catcher vessel logbook and sablefish data collection (NMFS)

Cost: Staff salaries
Revenue: $ 35,000
Start Date: 1999
Anticipated ending: Continuing
Personnel: Hutton, Gilroy, Taheri, port samplers

IPHC and NMFS Auke Bay Lab (ABL) have a sablefish data collection program. The program was reviewed and modified in 2003/2004 to meet the IPHC confidentiality policy and to encompass all vessels rather than just vessels greater than 60 feet. Under a Statement of Work, NMFS contracted IPHC staff to interview the IFQ fishers to review and collect the sablefish information in addition to the halibut information. Data are entered by IPHC staff with an electronic summary provided to the NMFS ABL scientists. In the summarized data, the vessels are assigned a unique code to preserve confidentiality.

Project 649: Additional survey stations in Area 2A (PSMFC/NMFS)

Cost: $ 51,864
Revenue: $ 50,238 (plus fish sales)
Start Date: 2006
Anticipated ending: Continuing
Personnel: Leaman, Dykstra, Ames, Soderlund, Washington Department of Fish and Wildlife

The project would expand on the assessment survey of Area 2A conducted by IPHC. Stations will be added to the existing survey to conduct surveys in rockfish habitats and areas that are not

usually accessible to the coastwide trawl surveys conducted by the National Marine Fishery Service. The additional stations would be designated by WDFW/NMFS to enable comparisons with the manned submersible survey of non-trawlable habitat that has been conducted off the northern Washington coast. Species composition at each station can be estimated through systematic subsampling or, at additional cost, through digital video recording of all hauling. All rockfish samples would be processed subsequently by state agencies, for incorporation into stock assessments. This project would be undertaken on a cost-shared basis with the IPHC and WDFW. All data processing of fishing station, catch, and environmental data would be conducted by IPHC and made available to state and federal agencies. Information on the rockfish catch characteristics will be reported by WDFW. A summary report of survey and sampling activities would be produced and submitted jointly by the IPHC and the WDFW.

Research Conducted With No Additional Funding

1. Seabird occurrence project

Cost: Staff salaries
Start Date: 2002
Anticipated ending: Continuing
Personnel: Ames, Geernaert, Washington State Sea Grant

During the 2004 stock assessment surveys, sea samplers counted the number of seabirds in the vicinity of the vessels following gear retrieval. This is the third year the seabird occurrence data were collected on IPHC surveys. 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 has developed a database to store seabird occurrence data from the IPHC stock assessment surveys, as well as the NMFS and ADF&G sablefish surveys. The data are currently being analyzed. IPHC, in coordination with Washington Sea Grant, will be writing a joint paper on the results for the 2002-2004 data. The collection project is ongoing.

2. Seabird data repository (Project 643)

Cost: Staff salaries
Start Date: FY 2005
Anticipated ending: Continuing
Personnel: Ames, Geernaert

This project encompasses the storage by IPHC of various types of seabird data collected on agency surveys, including the seabird occurrence project conducted on the assessment surveys. Although IPHC has been collecting these data on its assessment survey since 2002, other agencies are just beginning the same procedure. IPHC's head-start with these types of data led other programs to seek the efficiencies provided by IPHC in data management for optimal use by analysts and managers. A grant from Washington Sea Grant funded this activity in previous years.

3. Estimates of bycatch on the setline surveys in Area 2B

Cost: Staff Salaries
Start Date: 2003
Anticipated ending: Continuing
Personnel: Dykstra, Survey Team, and DFO personnel

Rockfish bycatch in the halibut fishery can be a constraint in conducting halibut fishing in some areas. In 2005, IPHC worked with DFO to allow a third biologist on IPHC survey vessels to sample rockfish and sablefish bycatch. The program was funded by industry (Canadian Sablefish Association and Pacific Halibut Management Authority). Data collected included hook by hook

information, otoliths, maturities, and lengths for rockfish and sablefish. This activity will be continued in 2006.

4. Amphipod distribution and predation on survey halibut

Cost: Staff Salaries
Start Date: 2004
Anticipated ending: 2006
Personnel: Leaman, Ames, Soderlund

The project intends to document the occurrence and virulence of attacks by predatory amphipods on halibut caught on IPHC surveys and, by inference, the commercial fishery. The commercial industry suffers annual losses of product due to amphipod predation and must adjust its fishing locations and practices in response to predation. Harvester discussions indicate that predation sites are both known and ephemeral, and the virulence may vary interannually at a given site. The specific identity of the amphipods has not been established and it is probable that more than one species is involved. Harvesters are interested in both documentation of predation areas for avoidance, as well as gaining an understanding of the dynamics of the species at given sites, i.e., are there cycles of abundance that respond to other factors. Data were collected on all stations during the 2004 stock assessment survey as part of standard protocol, recording incidence of sand flea predation, and the extent and virulence of the predation. Analysis is expected to occur in the spring, 2005.

5. Sleeper shark investigations (Project 630)

Cost: Staff salaries
Start Date: 2003
Anticipated ending: 2005
Personnel: Wischniowski, Williams

During 2003, the Pacific sleeper shark (*Somniosus pacificus*) age determination program collected enough samples to begin the pilot study. Historical ageing studies on this species have been plagued by the lack of visible microstructure within the centra of the vertebrae. An attempt will be made to expose any growth increments by way of an etching and staining experiment. All materials and structures required for this experiment have been collected, or purchased. Lab work began in winter of 2004.

The objective of the second component of this research into Pacific sleeper sharks is to determine if these sharks come from a homogenetic population. The population dynamics of sleeper sharks within the northeast Pacific is not well documented. Preliminary tagging studies have indicated that at least some sleeper sharks display a resident behaviour, and likely have relatively small home ranges. To test this assumption tissue samples were collected from live sharks by way of biopsy darting during the 2004 Stock Assessment Survey. A simple test of homogeneity will compare samples collected from regions of high occurrence to peripheral regions of lesser occurrence. All tissue samples for this project have been collected, and no

further are need for this experiment. This portion of the research proposal will specifically target the analysis aspect of the study.

Mitochondrial DNA polymorphisms will be used as the initial genetic marker system to investigate population differentiation among the three sampling locations. We will initially attempt amplification using primers located within the proline tRNA and 12S rRNA regions of the mitochondria. These primers have been used to examine population genetic structure across a similar geographic range in blacktip sharks and yielded sufficient information to differentiate among nurseries of this species. Statistical analysis will be by way of χ^2 and AMOVA probabilities of haplotype homogeneity across sampling sites. As the name suggests, Analysis of Molecular Variance (AMOVA) is a method for studying molecular variation within a species.

6. Review of port sampling, 1994 to present

Cost: Staff salaries
Start Date: 2002 (Deferred in 2004)
Anticipated ending: 2006
Personnel: Hutton, Kong

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.

7. Electronic reporting project for commercial landings in Alaska

Cost: Covered under Catch Statistics budget (7131, 7132)
Start Date: 2002
Anticipated ending: 2006
Personnel: Gilroy, Hutton, Kong, Tesfatsion, Tran

Since 2002, IPHC, ADF&G, and NMFS staffs have worked with contractors hired by Pacific States Marine Fisheries Commission (PSMFC) to analyze and work towards developing a cooperative interagency electronic fishery reporting system for commercial landing records in Alaska. In 2005, the project included designing and testing a web based Interagency Electronic Reporting System (IERS) with the repository database in the State Office Building in Juneau. The appropriate data from IERS will be sent to the multiple agencies. Starting in August 2005, IERS was operational 24/7 and mandatory for recording landings from Bering Sea and Aleutian Island (BSAI) rationalized crab fisheries. In January 2006, the system will be available and optional for statewide groundfish, IFQ/CDQ halibut and sablefish, and BSAI shellfish. For halibut, the system reduces duplicative reporting resulting from the current requirements of completing ADF&G fish tickets and NMFS RAM quota share reports. The application (eLandings) will record data for all requirements, print fish tickets and connect with the NMFS quota share database. The application allows processors to import or export data into their own

databases so double entry will not be necessary. In 2007, the system will incorporate salmon and herring landings.

8. The 2005 stock assessment

Personnel: Clark, Hare

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.

9. Development of IPHC harvest policy

Personnel: Hare, Clark

Staff quota recommendations are calculated by applying a judiciously chosen harvest rate to an estimate of present exploitable biomass. The constant 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. In 2003 the staff proposed a conditional constant catch policy under which total removals would be capped at a chosen ceiling level at high biomass levels, while a constant harvest rate policy would continue to be employed at low and intermediate stock levels. The Commission did not adopt the proposed policy at the 2004 annual meeting, and a staff/industry workshop on harvest policy alternatives in September 2004 showed general satisfaction with the present policy, as mediated in practice by the judgment exercised by the Director in developing staff recommendations and by the Commission in finally setting catch limits. In 2004, an explicit lower limit on spawning biomass and a threshold below which the harvest rate will be reduced—were added to the constant harvest rate policy. As a result the target constant harvest rate for the core IPHC areas (2B, 2C, and 3A) was lowered to 22.5% from 25%. The staff will continue to evaluate the constant harvest rate policy. In particular, we will recalculate the optimum harvest rate itself in light of our present understanding of stock dynamics and new information on commercial length-specific selectivity coming from the PIT tag experiment.

10. Development of a formal medium-term recruitment forecast

Personnel: Hare, Clark

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. This project is under development and should result in recruitment forecasts in 2006.

11. Estimation of halibut abundance from mark-recapture data

Personnel: Clark, Leaman

The IPHC has conducted many tagging programs since the 1920s. 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 staff marked the catch of three skates at each survey station coastwide in 2003 and in Areas 2B and 3A in 2004. Preliminary analysis of the 2004 recoveries showed good agreement with the stock assessment in Areas 2B and 2C, but farther west the mark-recapture estimates were much higher than the assessment estimates. The 2005 recoveries will be added to the analysis this year.

12. Density-dependent and independent control of halibut growth and recruitment

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. Understanding, and properly modeling, stock dynamics are critical to the simulations done in support of the constant harvest rate policy.