Report of the Technical Subcommittee of the Canada-United States Groundfish Committee

Forty Seventh Annual Meeting of the TSC

May 2-3, 2006

Inn at Otter Crest

Otter Rock, Oregon

Appointed by the Second Conference on Coordination of Fisheries Regulations between Canada and the United States

Compiled by the Pacific States Marine Fisheries Commission

History of TSC meeting locations, hosts, and chairpersons.

YEAR	DATES	LOCATION	HOST	CHAIR
1969	June 17-19	Seattle, WA	Kauffman	Forrester
1970	July 22-24	San Francisco, CA	Jow	Forrester
1971	Late June	Vancouver, BC	Forrester	Meehan
1972	June 28-30	Newport, OR	Meehan	Meehan
1973	June 20-22	Seattle, WA	Dark	Humphreys
1974	June 19-21	Millbrae, CA	Jow	Forrester
1975	June 25-27	Vancouver, BC	Forrester	DiDonato
1976	June 23-25	Newport, OR	Robinson	DiDonato
1977	June 15-16	Seattle, WA	Dark	Leaman
1978	June 14-15	Menlo Park, CA	Jow	Westrheim
1979	June 20-21	Parksville, BC	Beamish	Dark
1980	June 18-20	Petersburg, AK	Rigby	Dark
1981	June 10-11	Bend, OR	Demory	Cass
1982	June 9-10	Port Ludlow, WA	Pederson	Cass
1983	June 15-17	Palo Alto, CA	Jow	Rigby
1984	June 20-22	British Columbia	Westrheim	Rigby
1985	June 25-27	Juneau, AK	Morrison	Westrheim
1986	June 19-19	Ashland, OR	Demory	Westrheim
1987	June 9-11	Seattle, WA	Jagielo	Demory
1988	June 7-9	Carmel, CA	Henry	Demory
1989	June 6-9	Ladysmith, BC	Saunders	Jagielo
1990	June 5-7	Sitka, AK	Bracken	Jagielo
1991	June 4-6	Newport, OR	Barss	Wilkins
1992	May 5-7	Seattle, WA	Jagielo	Wilkins
1993	May 5-7	Point Lobos, CA	Thomas	Saunders
1994	May 3-5	Nanaimo, BC	Saunders	Saunders
1995	May 2-3	Seattle, WA	O'Connell	Bracken
1996	May 7-9	Newport, OR	Barss	O'Connell
1997	May 6-8	Tiburon, CA	Thomas	Barss
1998	May 5-7	Olympia, WA	Jagielo	Barss
1999	May 4-6	Seattle, WA	Methot	Barnes
2000	May 9-10	Nanaimo, BC	Saunders	Barnes
2001	May 8-10	Newport, OR	Schmitt	Schmitt
2002	May 7-8	Point Lobos, CA	Barnes	Methot
2003	May 6-7	Sitka, AK	O'Connell	Jagielo
2004	May 4-5	Coupeville, WA	Wilkins	Jagielo
2005	May 3-4	Parksville, BC	Stanley	Stanley
2006	May 2-3	Otter Rock, OR	Parker	Stanley

REPORT OF THE TECHNICAL SUBCOMMITTEE OF THE CANADA-UNITED STATES GROUNDFISH COMMITTEE

Table of Contents

A. Overview and Terms of Reference

During the Conference on Coordination of Fisheries Regulations Between Canada and the United States (April 1959, Vancouver B.C.), the Ad Hoc Committee on Trawl Fishery Regulations recommended that the governments of Canada and the United States establish a continuing group made up of administrative and technical representatives of Oregon, Washington and Canada to review trawl regulations, to exchange information of status of bottom fish stocks, and to continue, enhance and coordinate bottom fish research programs. The Technical Sub-committee (TSC) was then created by the Committee on Trawl Fishery Regulations (now the Canada-U.S. Groundfish Committee) at the trawl committee meeting held in Seattle, Washington, on November 4, 1959. The TSC first met in Portland, Oregon, on January 19-20, 1960. Dr. K.S. Ketchen (Canada) served as Chairman. Member agencies at the time were the Fisheries Research Board of Canada (now the Department of Fisheries and Oceans), Washington Department of Fisheries (now the Washington Department of Fish and Wildlife), Fish Commission of Oregon (now the Oregon Department of Fish and Wildlife), and the California Department of Fish and Game. In 1972, two more agencies became members – the Alaska Department of Fish and Game and the U.S. Bureau of Commercial Fisheries (now the National Marine Fisheries Service).

The TSC has met at least annually since 1960 and submitted a processed report of each meeting to its Parent Committee.

These terms of reference did not apply to Pacific halibut, whose research and management are the responsibility of the International Pacific Halibut Commission:

1. Exchange information on the status of groundfish stocks of mutual concern and coordinate, whenever possible, desirable programs of research.
2. Recommend the continuance and further development of research programs having potential value as scientific basis for future management of the groundfish fishery.
3. Review the scientific and technical aspects of existing or proposed management strategies and their component regulations relevant to conservation of stocks or other scientific aspects of groundfish conservation and management of mutual interest.
4. Transmit approved recommendations and appropriate documentation to appropriate sectors of Canadian and U.S. governments and encourage implementation of the recommendations.

The TSC has exhibited considerable flexibility in reacting to the diverse problems of the dynamic groundfish fishery off western Canada and the United States. It has coordinated coastwide fishery statistics and research projects; created working groups to deal in depth with specific problems; scheduled workshops at which appropriate specialists met to jointly deal with specific problems and exchange data and information; and provided an on-going forum for exchange of data, procedures, and regulations. The TSC has identified problems associated with the utilization and management of groundfish resources of importance to both countries; often well in advance of public or agency awareness. The concerns expressed in 1962 by the TSC

over the development of foreign fisheries and recommendations for stock assessments were significant. TSC-coordinated Canada-U.S. research on Pacific Ocean perch provided the basis for negotiation of bilateral fishing agreements between the United States and Japan and the USSR. Furthermore, the continually updated information provided the basis for quotas imposed in 1977 by Canada and the United States when they both promulgated their 200-mile zones of extended jurisdiction.

B. Executive Summary

The TSC met May 2-3, 2006 in Otter Rock, Oregon. The meeting was hosted by the Newport labs of the Oregon Department of Fish and Wildlife and the Northwest Fisheries Science Center. As is done each year, participants review previous year (2005) research achievements and projected current year (2006) research for each agency.

The TSC again noted the ongoing work of the Committee of Age Reading Experts (**CARE**) (http://care.psmfc.org/index.htm). These activities are conducted under the auspices of the TSC. CARE and TSC noted that the spring 2006 CARE meeting greatly benefited from the new addition of the Ageing Group at Moss Landing Marine Laboratory in the person of Dr. Greg Cailliet.

At the 2005 TSC meeting, it was suggested that CARE consider a rotational scheduling of species specific ageing workshops in order to assure comparability of methods among labs. Further discussion indicated that the impetus for such workshops should probably come from the principal investigators for the species and be held on an as-needed basis. Nevertheless, the TSC noted that sometimes there is a lack of communication between age reading experts and assessment staff regarding between-lab variation in ageing techniques. TSC encouraged CARE members, by letter, to communicate such concerns to users of the data.

The TSC noted that plans for the **Sablefish Symposium** have been changed.
The working group has decided that rather than one comprehensive symposium, they would support several smaller focused workshops. This would make more efficient use of the limited resources. For instance, CARE is considering a sablefish otolith reading workshop and the Alaska Fishery Science Center is considering an "escape ring" workshop. Stephen Phillips noted that PSMFC might be able to provide some funding in support of these sablefish workshops.

TSC also noted that organization is under way for the **2008 Western Groundfish Conference**. It is scheduled for Feb 4-8, 2008 at the Santa Cruz Coast Hotel in Santa Cruz, CA.

The **Trawl Survey Working Group**, created under the auspices of the TSC, met for the fourth consecutive year and plans to continue to meet each February in Seattle. This Working Group has been successful in transferring technology and design features among the various survey groups operating in U.S. and Canadian waters.

The **GIS Working Group,** proposed at the 2005 meeting, held a two-day GIS workshop in Richmond, B.C. in March 2006. Participants came from ADFG (Sitka), WDFW (Montesano and Mill Creek) and the NMFS (NWFSC and SWFSC) and DFO (PBS). The first day of the workshop was devoted to agency presentations and the second day to demonstrations of the

software and GIS tools developed and used by agencies to manipulate, analyze and display habitat data. A wide range of topics were discussed, including how to:

- code and manage visual habitat data,
- collect and filter/smooth submersible navigation data,
- measure area swept using a 3-beam system,
- develop habitat proxies from fisher records and bathymetric analyses,
- interpret habitat from acoustic data,
- use new data collection technologies,
- adapt GIS tools for 3-D visualization and linear referencing.

Participants also saw demonstrations of custom software applications for:

- integration of data streams into a GIS,
- video review and data capture,
- the use of habitat data to stratify fishing and visual surveys
- the use of habitat data to expand fish densities to abundance and biomass.

Participants felt it was valuable to bring together GIS-habitat "users" to discuss their experiences (and frustrations) in working with habitat data and conducting various analyses. The Working Group is in the planning stages of a more comprehensive workshop for the winter of 2006/2007.

TSC members were informed by Mark Wilkins that the supervisors at each agency have been contacted to assess the level of interest in a TSC-Sponsored **Data Acquisition Workshop**. The intent is to showcase and discuss recent technological tools and procedures for acquiring data and integrating databases in the marine environment as they relate to fisheries and oceanographic research. Positive responses were received from many agency supervisors and a list of candidates for the steering committee has been assembled. They will now identify a date and venue for the workshop.

A key new development at the 2006 TSC meeting was the endorsement of planning for a **Workshop on Acoustic Telemetry** techniques and analysis for Pacific coastal marine species. The objective of the workshop would be to bring together researchers from California through Alaska to discuss approaches and techniques for conducting acoustic telemetry experiments with the unique environments and species present in the NE Pacific Ocean. Topics could include capture and tagging, active-tracking, passive tracking array configuration, data collection, and database management. Steve Parker of the ODFW offered to poll various agencies, academic programs, and organizations with active telemetry projects on the west coast to gauge interest, develop a steering committee, workshop scope, timeline, and venue.

Following the May 2006 meeting, the TSC Chair passed to Alaska Department of Fish and Game. Ms Cleo Brylinsky will be Chair for the 2-year term from 2006/2007-2007/2008. The

next meeting is planned for April 24-25 in Santa Cruz, CA, hosted by the SWFSC-Santa Cruz lab. The TSC thanked Rick Stanley for serving as Chair for the previous two years.

The success of the TSC is related directly to the commitment and participation of member agencies. All of the member agencies are thanked for the contribution of reports and the expertise of their staffs. The TSC also thanked PSMFC and Stephen Phillips for the ongoing funding support for the TSC and its efforts to foster communication and cooperation among the groundfish research agencies on the West Coast. TSC also notes the commitment of financial support from the IPHC for holding the WG meetings.

C. Minutes of the Technical Subcommittee

Forty-Seventh Annual Meeting of the TSC
May 2-3, 2006
Inn at Otter Crest
Otter Rock, Oregon

I. Call to Order – Rick Stanley, Chair, called meeting to order at 8:30am, May 2.

II. Appointment of Secretary – Alena Pribyl and Polly Rankin

III. Introductions – Attendees introduced themselves:

Cleo Brylinsky	- Alaska Department of Fish and Game, Sitka
Dave Clausen	- Alaska Fisheries Science Center, Auke Bay
Tracee Geernaert	- International Pacific Halibut Commission, Seattle
Tom Jagielo	- Washington Department of Fish and Wildlife, Montesano
Patrick MacDonald	- Pacific States Marine Fish Commission, Newport
Steve Parker	- Oregon Department of Fish and Wildlife, Newport
Stephen Phillips	- Pacific States Marine Fish Commission, Portland
Mike Schirripa	- Northwest Fisheries Science Center, Newport
Rick Stanley	- Fisheries and Oceans Canada, Nanaimo
Mark Wilkins	- Alaska Fisheries Science Center, Seattle

Jane DiCosimo of the North Pacific Fishery Management Council and John Field of the Southwest Fisheries Science Center participated by conference call on May 3, from 10:00 a.m. to 11:00 a.m.

IV. Approval of 2005 Report

The 2005 report was approved. The TSC thanks Bess Wong and Susan Anderson, and PSMFC for putting the report together. The report was distributed in a timely manner.

V. Approval of 2006 Agenda

TSC added a conference call from 10:00 am to 11:00 am on Wednesday, May 3, for those who could not attend.

VI. Working Group Reports

Committee of Age Reading Experts (CARE)

P. McDonald, CARE Chair, summarized the 2006 bi-annual CARE workshop. All agencies were in attendance. They examined the structures of 15 species of fish during the workshop.

The idea of doing yelloweye and darkblotched rockfish for future workshops was brought forward. The minutes were approved and will be put on the TSC website.

Lingcod and Dover sole will be added to the ageing manual. Raw data from double readings will be on the website so people can analyze these results as they wish. The 2008 CARE meeting will be held in Nanaimo, rather than the usual Seattle location, to coincide with the Pacific Biological Station's 100th Anniversary.

R. Stanley asked whether the various agencies are including age readers' comments (in addition to the estimate of age) in their databases. P. McDonald responded that some notes are now being coded and input. S. Parker and C. Brylinsky commented that their agencies just put the basic information in the databases.

CARE reported that Dr. Greg Cailliet from the Moss Landing Marine Laboratory attended for the first time in 2006, and his contribution was much appreciated. Among other things, his input led to the initiation of a skate discussion group. TSC recommended that the Chair send a letter of appreciation to Dr. Cailliet. M. Wilkins mentioned that their NMFS taxonomists will soon be publishing a guide to North American skates.

It was suggested at the 2005 TSC meeting that CARE should hold annual workshops that rotated among the common species of interest. During the year and at the 2006 meeting, TSC discussed this request and noted some inter-lab issues concerning the proposal. At the same time, it was noted that CARE has planned two such workshops – one for sablefish and another for petrale sole. These workshops were what the original request was intended to provide. It was suggested that the spirit of the request was being addressed and that no formal need for rotating workshops was necessary. Instead, the TSC commended CARE for planning the upcoming CARE ageing workshops and reiterated their support for future workshops.

T. Jagielo commented on how valuable the CARE organization is. M. Wilkins thanked S. Phillips and the PSMFC for their support of CARE. TSC recommended that the annual TSC letter to supervisors should highlight the benefits of CARE, but that it recommend there be increased liaison between stock assessors and age reading staff.

Trawl Survey Working Group Report

The Trawl Survey Working Group met February 21, 2006 in the Montlake Lab in Seattle. It was attended by NMFS staff from the AFSC (Mark Wilkins, Ken Weinberg and Bob Lauth); NWFSC (Guy Fleischer Aimee Keller, Vanessa Tuttle, Victor Simon, John Wallace, and Ian Stewart); and DFO (Greg Workman and Rick Stanley). All sides summarized current and future plans for the large scale trawl surveys. R. Stanley noted that DFO is building a survey simulator to explore the cost-benefit of alternative survey designs (e.g., annual vs. bi-ennial) as well as attempting to quantify how well a survey "works" given hypothetical power test scenarios.

K. Weinberg (AFSC) summarized their trawl catchability studies. M. Wilkins noted that they have a working group looking at how to improve trawl survey methodology. They are looking at the effects of different trawl setting routines. M. Schirripa noted that NWFSC is planning a fall workshop that will focus on how best to analyze the Washington-California survey data. R.

Stanley noted that the annual meeting is beneficial to DFO and they plan to continue to attend each year.

Sablefish Working Group Report

M. Schirripa noted that since the establishment of the Sablefish Symposium steering committee, little interest has been expressed in the symposium. Furthermore, based on the most recent Western Groundfish Conference held in Newport in 2006, he suggested that there is only a limited amount of research currently being conducted on sablefish. Consequently, the working group decided that rather than one comprehensive symposium, several smaller focused workshops would make more efficient use of the limited resources. For instance, CARE is considering sablefish ageing workshop and the Alaska Fishery Science Center is considering an "escape ring" workshop. It seems best to take advantage of these efforts. S. Phillips noted that PSMFC might be able to provide limited funding in support of these sablefish workshops.

GIS Working Group (see notes)

L. Yamanaka reported that a two-day GIS workshop was held in Richmond, B.C. with participation from the ADFG (Sitka), WDFW (Montesano and Mill Creek) and the NMFS (NWFSC and SWFSC) and DFO (PBS). The first day of the workshop was devoted to agency presentations and the second day to demonstrations of software and GIS tools that had been developed and used by agencies to manipulate, analyze and display habitat data. A wide range of topics was discussed during the workshop, including:

- Methods in use to:
  - code and manage visual habitat data,
  - collect and filter/smooth submersible navigation data
  - measure area swept – 3 beam system
  - develop habitat proxies from fisher records and bathymetric analyses
  - interpret habitat from acoustic data;
- New data collection technologies
- GIS tools for 3-D visualization and linear referencing
- Custom software for;
  - video review and data capture,
  - raster operations classification library tool
  - integration of various data streams into a GIS and interpolate between data points,
- Scaling habitat data collection and the scale used for analyses
- Using habitat data to stratify fishing and visual surveys
- Using habitat data to expand fish densities to an abundance and biomass.

Participants felt it was valuable to bring together habitat "users" to discuss their experiences (and frustrations) in working with habitat data and conducting various analyses. All agreed that the workshop was beneficial and identified the following themes to focus on for a more comprehensive workshop.

- GIS tools
- Survey methods, comparability coastwide
- Stock assessment methods

A proposed steering committee, subject to approval by supervisors, was struck with agency members at the workshop. Agencies not represented were asked to recommend a member to the committee. The steering committee will plan the logistics for a comprehensive workshop around these basic themes to take place in the winter of 06/07. L. Yamanaka recommended that she be contacted regarding membership on the committee. Agencies and members on the GIS/habitat workshop steering committee with proposed members include: ADFG-C. Brylinsky; DFO-L. Yamanaka/Lisa Lacko; WDFW-Wayne Palsson/Robert Pacunski; NWFSC- Elizabeth Clarke/Waldo Wakefield/Curt Whitmire; and SWFSC-Mary Yoklavich/Diana Watters.

Remaining Agencies that are requested to designate a member to the committee:

- Oregon Department of Fish and Game
- International Pacific Halibut Commission
- Alaska Fisheries Science Center
- California Department of Fish and Game

J. DiCosimo requested that NPFMC also be included in the distribution list regarding the meeting. She suggested Cathy Coon (cathy.coon@noaa.gov) and John Olson (john.olson@noaa.gov) be the contacts.

C. Brylinsky seconded Lynne's comments and stated that it was a good workshop and benefited from being small and informal. She suggested the larger workshop consider inviting someone who makes their living using GIS tools, in order for the group to "bounce" their needs off more high-powered GIS experts and obtain more ideas on how to create more tools. The TSC thanked Lynne for organizing the workshop and PSMFC for providing coffee and snacks.

Data Acquisition Working Group

M. Wilkins reported that supervisors at each agency have been contacted to assess the level of interest in a "data acquisition" workshop. The intent would be to showcase and discuss recent technological tools and procedures for acquiring data and integrating databases in the marine environment as they relate to fisheries and oceanographic research. They were also asked to provide a contact from their agency that might participate on the workshop steering committee. Mark received positive responses from many agency supervisors and has assembled a list of candidates for the steering committee. He will hold an initial phone meeting of the steering group within the next two weeks to identify a date and venue for the workshop.

VII. Other Topics

IDFA Funding

S. Phillips noted that Interjurisdictional Fisheries Act Funds are used to support TSC activities, as well as to augment existing (e.g. database) and special PSMFC projects.

Age Validation

R. Stanley noted that a paper on validation of spiny dogfish ageing (S. Campana) was soon to be published as well as 2nd validation paper on canary rockfish by Allen Andrews at Moss Landing. M. Schirripa commented on the work by Bryan Black which related growth increments in long-

lived rockfish to oceanographic conditions by using dendrochronology. M. Wilkins noted that Craig Kastelle had finalized radiometric validation of walleye pollock; and Charles Hutchinson was finalizing his work on shortraker rockfish. C. Kastelle was also completing a paper on bomb radiation validation of GOA POP. There is a page on the AFSC website on age and growth that is worth examining. P. McDonald noted that Jody Neill of ADFG was working on bomb calibration of shortspine rockfish.

Marine Reserves

R. Stanley commented that DFO had extended the boundaries of the sponge-reef reserves following discussions with trawl fishermen. DFO had also recently hosted a Habitat stock assessment meeting with the discussion focused on papers about 1) trawl bycatch of coral, and 2) identification and taxonomy of corals. The meeting also included environmentalists and trawlers. The meeting proved useful for showing the complexity of the situation and that the solution was not simple. A working group will be formed to look at possible solutions.

S. Parker reported that last summer, the Ocean Policy Advisory Committee (OPAC) was reformed in response to a recommendation from the Oregon Governor's office to give consideration to making the entire coast of Oregon a marine sanctuary. OPAC was charged with providing a summary paper on this concept to the Governor. OPAC is currently in an information gathering phase. Discussion issues include:

- What does a national marine (or state) sanctuary mean?
- Who is in control?
- Should it be limited to state waters?

To date, they have had two meetings.

T. Jagielo noted that the PFMC had discussions on essential fish habitat (EFH). S. Parker commented that PFMC recommended that EFH include depths to 3500 f, but NMFS suggested going only to 700 fathoms. NMFS rejected oil drilling platforms as EFH. T. Jagielo noted that most of the state waters of Washington were already designated as a marine sanctuary.

Genetics and Stock Structure

T. Geernaert reported that the IPHC is conducting otolith elemental work and population genetics on halibut. The genetic work uses fin clips and the elemental chemical work uses otoliths. The data are currently being analyzed. The strontium component looks promising.

Western Groundfish Conference 2008 Update

No update on the WGC was received at the meeting, but TSC was subsequently informed that WGC 2008 is scheduled for February 4-8, 2008, at the Santa Cruz Coast Hotel in Santa Cruz, California.

Letter to Supervisors

TSC endorsed continuing with the letter to the supervisors. The overall response was positive with no negative comments. The letter should also be sent to the PFMC supervisor (Don MacIsaac). TSC could also use the letter to flag issues (i.e., different ageing techniques).

5th International Observers Conference

The 5th International Observers Conference will be held in Victoria, May 15, 2007. It is a bi-ennual meeting which addresses fisheries observer programs, emerging fisheries monitoring technologies, and other approaches for fishery dependent data collection. Howard McElderry is the chair of the conference. The website is http://www.fisheriesobserverconference.com/.

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

Agency Overviews

ADFG

C. Brylinsky commented that Tory O'Connell will be retiring at the end of May from ADFG. Tory intends to apply for seasonal work. Given Tory's long-standing support for TSC, the TSC recommended that the Chair send a thank you note [note: this was done after the meeting].

AFSC

M. Wilkins noted that the AFSC-RACE Division is facing numerous retirements. Among these, the Division Director, Gary Stauffer retired, replaced by Russ Nelson. The Observer Program has attained the status of its own division headed by Bill Karp. D. Clausen (AFSC-Auke Bay) noted they have a new director, Phil Mundy. The lab will be moving to the new facility at Lena Point by the end of the year.

DFO

R. Stanley noted that DFO was going to reduce the staffing of the stock assessment groups across the nation by 30% over the next 3 years. However, the lack of capacity is mitigated somewhat by faculty at Simon Fraser University and the University of British Columbia who are taking an increasing interest in groundfish research.

NWFSC

M. Schirripa reported that the FRAM Division of NWFSC (Montlake) is in trailers in parking lot. The trailer-style buildings were condemned. About 20 people have been displaced and are dispersed throughout the Montlake building.

WDFW

T. Jagielo reported there had been no major changes in the groundfish division at WDFW.

ODFW

S. Parker commented on reorganization in ODFW. They have hired a new data services person. Bill Barrs retired but has been brought back for part-time age reading. They are doing more nearshore rockfish ageing. They have hired Josie Thompson to fill Bob Mikus's position in ageing. They completed a near shore management plan.

Multispecies Studies

NWFSC
M. Schirripa reported that the Stock Synthesis model has been revised as SS2. It will be the model of choice for U.S. groundfish assessments on the west coast. Michael will be testing the performance of SS2 on simulated data. SS2 is available on the NOAA website (search under NOAA stock assessment toolbox).

SWFSC
J. Field noted that the SWFSC and NWFSC are working to develop juvenile indices for rockfish and hake as well as conducting a detailed examination of the spatial variability in the results. They welcome other collaborators. He noted that a workshop that was being organized jointly by the Southwest and Northwest Science Centers on the use of juvenile indices in stock assessments. [Note: this meeting was held September 13-15, 2006].

ODFW
S. Parker reported that ODFW is building a large database for the maturity data on various groundfish species, but mostly nearshore rockfish. They are continuing to study barotrauma effects, including: 1) physiological damage caused by barotrauma in different species of rockfish, and 2) long-term survivability of rockfish after recompression. ODFG has put Didson acoustic devices on trawl. They are obtaining good information on how fish interact with the footrope and how halibut behave in a selective flatfish trawl. They can identify any species that has a unique outline.

IPHC
T. Geernaert reported that the IPHC is examining escapement of sablefish and halibut from traps. They are conducting recompression effects on rockfish using a video camera mounted on a cage.

By Species

Nearshore Rockfish

AFSC
D. Clausen reported that the Auke Bay lab is beginning to study maternal age effect on survival of quillback.

ODFW
S. Parker reported that they are using telemetry to study movements and home range of black rockfish. The paper will be out soon. There is also a paper in prep on vertical movements of black rockfish. These studies will expand to cover canary, yelloweye, and china rockfish in the future. They are also continuing the work with the cage cam to study survival after recompression. They are looking to link behavioral assays to estimating mortality. They are also looking at gear selectivity by testing different tackle on different rods and seeing what the catch rate of different species is. The height of the lure off bottom appears to affect catch composition.

Shelf and slope rockfish, and thornyheads

ADFG
C. Brylinsky reported that this year they did not open the directed commercial fishery for yelloweye. The commercial halibut fishery received 84% of the quota for bycatch. The sport fishery was allocated the remaining 16%. Funds for yelloweye rockfish stock assessments are now only available on a three-year rotation, instead of having the money every year.

AFSC
D. Clausen reported that there was a small experimental fishery for silvergray rockfish in Alaska. They used modified dinglebar and shrimp flies. They were also conducting catchability studies on slope rockfish in the trawl surveys. They found evidence of herding in POP.

NWFSC
M. Schirripa noted that assessments were completed on cabezon, POP, darkblotched, blackgill and canary, yellowtail and yelloweye rockfish, and longspine and shortspine rockfish (assessments available on NOAA website). T. Jagielo reported that the assessment on yelloweye was controversial, but the conclusion still indicated that the population was depleted and overfished.

ODFW
S. Parker reported on an experiment which involved a cage cam and attached transmitter on 6 yelloweye rockfish. They used a lack of vertical movement to indicate mortality. At the 21-day mark, 3 of 6 were definitely still alive, 1 was dead, and 2 fish had left the area. At 120 days, it was the same picture. They observed that 5 of 6 fish made large vertical movements soon after release (40-50m). Vertical movements and survival rates differed from what was expected. This year, they will tag 12 yelloweye in a new array off the Siletz River.

Sablefish

ADFG
C. Brylinsky reported that they are not PIT-tagging sablefish anymore. They only use external tags (secondary tail clip). ADFG would like see more collaboration among agencies on the sharing of tag information.

AFSC
D. Clausen noted that the AFSC is looking in more detail at the effects of competition for hooks in sablefish longline survey. In the past, they have assumed that sablefish out-competed all other fish caught. Dana Hanselman will replace Mike Sigler in sablefish assessments

NWFSC
M. Schirripa reported that he is working with simulation techniques to study the extent to which sablefish population variation is correlated to the sea level index. Any relationships will then be incorporated into SS2 for further study. NWFSC is also conducted a sablefish mortality assessment. They used a combination of lab observations and sea surface temp to estimate

discard mortality. The new sablefish assessment is available online. NWFSC also has a grad student looking at sablefish predation on shortspine thornyheads.

Flatfish

AFSC
M. Wilkins noted that they have two new people working on flatfish. They are looking at juvenile flatfish habitat distribution around Kodiak Island. They will also be doing work on arrowtooth flounder.

DFO
R. Stanley commented that the trawl industry had found new markets for arrowtooth flounder in China. DFO implemented an interim increase in the coastwide quota.

IPHC
T. Geernaert reported that the stock assessment survey of halibut in the Bering Sea and will be adding 100 more stations. They will be putting out more satellite tags next year as well and are considering using archival tags.

NWFSC:
M. Schirripa reported that English, Dover, and Petrale sole stock assessments were conducted last year. They also conducted a brief study on the use of interopercles for ageing. They are probably moving to break-and-burn ageing for all flatfish.

Lingcod

***ADFG*C**
Brylinsky noted that the Board of Fisheries raised the quota for lingcod. They have not conducted any lingcod surveys for a few years. They have a retired ADFG biologist tagging lingcod whenever he catches them.

WDFW
T. Jagielo was lead author on an assessment in 2005. The stock is now considered to be re-built on a coastwide basis although the population in the south is still depleted. The PMFC is managing it as a coastwide resource.

Dogfish and Skates

AFSCM. Wilkins commented that they are now collecting dogfish spines and vertebrae from skates during Alaska surveys.

NWFSC
M. Schirripa reported that NMFS is doing longnose skate assessment for the first time this year. They will use ages derived from vertebrae as provided from Josie Thompson, formally a supported grad student, now with ODFW.

WDFW
Theresa Tsou and Farron Wallace will be doing the dogfish assessment for the first time this year. They are not sure how to proceed with ageing.

Pacific Mackerel and Sardines

ADFG
C. Brylinsky reported that some sardines are showing up in SE Alaska. One fisherman asked for permit to harvest. ADFG estimated that Alaska has ~1% of coastwide sardine biomass, so it was decided that fishermen could take 1% of the estimated Alaska biomass.

Other Species

AFSC
D. Clausen reported that the NPFMC has asked AFSC to prepare draft assessments on grenadier, sculpins, octopus, forage fish, squid, and sharks. M. Wilkins noted that they are beginning to collect otoliths and ovaries from sculpin species. The meso-pelagic survey will be starting up this year.

Other Related Studies

AFSC
D. Clausen commented that AFSC has started a Habitat and Ecological Processes Program (HEPR). Mike Sigler will be in charge, with equal status to a division manager. His duty station will physically be at the Auke Bay Lab, although HEPR will be autonomous from the Lab. M. Wilkins commented that the two big picture projects for HEPR will be: 1) loss of sea ice in the Bering Sea ,and 2) EFH – Other studies of the AFSC will include sampling efficiency of survey trawl gear and the collection of acoustic data during surveys using ES60 sounders. For the Bering Sea work, they are comparing trawl catch with acoustic density data. They will be testing whether estimated acoustic density sampling is the same at 3 knots as at 6 knots. They will be using archival tags that measure light intensity on trawls and relating vertical distribution of pollock to catch rate.

Other Items

Telemetry
S. Parker noted the coastwide interest in telemetry, but individual investigations are tending to work in isolation. He suggested that it would be a good idea to organize a workshop to discuss techniques, moorings, and data management. D. Clausen noted the increasing involvement of AFSC in this technology for sharks and the POST array. TSC members noted that there are confidentiality issues associated with tag IDs and not all investigators are willing to share information. There are also issues related to tag transmission interference decoding, which are proprietary but not patented. Users are not always interested in providing data to other groups using different tags on a host array. S. Parker offered to organize a steering committee this winter. TSC endorsed the idea and will recommend it to the Parent Committee.

Fisheries Management
R. Stanley commented that the groundfish fishery in B.C. is implementing a new integrated strategy. DFO specified that all catch, including discards of all species, must be recorded. All fishermen, including small-scale hook-and-line, will now have either an observer or a camera. However, because of the expense to review all the video, they will review a random sample of 10% of the video against the fisher logbook to se if it matches. Unloadings are already 100% monitored. There will be 100% retention of all rockfish. Interestingly, the industry needs drove the demand for precision so that each fisher knows the other cannot cheat. Vessels effectively cannot leave port without the quota to catch all the possible bycatch they may encounter. Quota will be traded on a restricted basis.

Comments on the format of TSC meeting
There was a general discussion on whether the membership of TSC should be expanded to include, for example, university staff. Or, could TSC consider a more informal approach wherein the host agency could invite students or professors as observer?. Some commented that one of the TSC's strengths is the frank discussion about strengths and weaknesses of each agency's programs. These comments could easily be misunderstood by individuals less familiar with the context. It was decided that there would be no official expansion of membership, but the host agency could invite some observers if the Chair and other agencies approved.

TSC re-affirmed that agencies (particularly the host agency) could invite staff to the meetings. There was a brief discussion as to whether TSC needed to meet every year. The consensus was that annual meetings are required. There was also general agreement that the conference call was successful, but TSC felt the meeting required actual attendance to be successful. Therefore, participation by conference call should only be used as a last resort by participants.

IX. Progress on 2005 Recommendations

TSC to Parent Committee

Following discussions since the previous 2005 meeting and at the 2006 meeting, there was a consensus that CARE not be directed to schedule routine ageing workshops that systematically work through the various species. Although, CARE and TSC noted the potential for problems where, for example, different agencies used different techniques, it was felt that the impetus for workshops should really come from the principal investigators or stock assessment staff for these species. TSC did however, encourage CARE representatives to communicate their concerns to such staff (see below).

***Action**: If accepted by the Parent Committee, the letter to CARE will encourage CARE representatives to forward their concerns regarding standardization of techniques to the principal investigators of the species.*

From TSC to itself

Regarding a Field Data Acquisition Workshop, M. Wilkins reported that the nominees for the steering committee have been forwarded to him by the steering group, and will be in contact by

phone to discuss agenda and date. He thanked the IPHC for the offer of financial and logistic support. TSC thanks Mark for initiating this workshop.

Regarding the GIS workshop, TSC thanks Lynne Yamanaka for organizing the preliminary workshop. TSC looks forward to the larger-scale workshop under consideration for the winter of 2006/2007.

X. 2006 Recommendations

TSC to Parent Committee

TSC recommends that the parent committee support the planning of a workshop on acoustic telemetry techniques and analysis for Pacific coastal marine species. The objective of the workshop is to bring together researchers from California to Alaska to discuss approaches and techniques for conducting acoustic telemetry experiments with the unique environments and species present in the NE Pacific Ocean. Topics could include capture and tagging, active-tracking, passive tracking array configuration, data collection, and database management.

Action: If approved by the parent committee, S. Parker will poll various agencies, academic programs, and organizations with active telemetry projects on the west coast to gauge interest, develop a steering committee, workshop scope, timeline, and venue.

TSC to CARE

TSC had no specific recommendations or action items for CARE other than to encourage ageing staff to communicate their concerns over the standardization (or at least calibration) of ageing methods among agencies. The Chair of TSC was directed to send a letter to CARE commending them on their achievements. The Chair was also directed to forward a letter of appreciation to Dr. Cailliet and MLML for joining CARE.

From TSC to itself

TSC passed the Chair and Baton to ADFG, represented by Cleo Brylinsky, thanked Rick Stanley for his chairmanship for the 2004-2005 and 2005-2006 years.

The next TSC meeting will be held in California, in the vicinity of the Santa Cruz lab. John Field and the SWFSC at Santa Cruz offered to host the meeting. The proposed date is April 24-25, 2007.

TSC approved the continued use of a conference call during the meeting for those agencies unable to attend, but suggested that representatives only use this option as a last resort.

TSC thanks NMFS-NWFSC-Newport, in particular Mike Schirripa and Steve Parker, for hosting the meeting. Alena Pribyl and Polly Rankin did an excellent job of taking the minutes. Their efforts were much appreciated by the Chair. As usual, TSC appreciates the support of the Pacific

States Marine Fish Commission and Stephen Phillips for providing the funding for the meeting room and the condiments.

The meeting was adjourned at 12:00 p.m. on May 6, 2006.

D. PARENT COMMITTEE MINUTES

Minutes of the 47th Annual Meeting of the Canada-US Groundfish Committee (aka "Parent Committee")

Call to Order

Chair Mr. Stephen Phillips, PSMFC, representing the U.S. (for Randy Fisher, PSMFC), and Rick Stanley, DFO Canada, representing Canada (for Diana Trager, DFO), called the meeting to order at 11:00, Wednesday, May 3, 2006. Also in attendance were: Tom Jagielo (WDFW); Mark Wilkins (NMFS, AFSC Seattle); Cleo Brylinsky (ADFG); Dave Clausen (NMFS, AFSC, Auke Bay Lab); and Steve Parker (ODFW).

Rick Stanley was appointed secretary for the meeting.

The agenda, following the format of previous meetings, was approved.

Adoption of minutes. The minutes of the May 2005 Parent Committee meeting were adopted as presented.

Progress on 2005 Recommendations

CARE
In 2005, the TSC recommended to the Parent Committee that CARE consider annual ageing workshops on different species of concern on a rotational basis, modeled after the current annual Dover sole workshop held in Eureka, California. The objective of this recommendation is to disperse the "hands on" workshop effort over a wider range of species and to maintain inter-lab calibration on ages that are shared for stock assessments. It was estimated that a maximum of six scientists could be accommodated for an ageing lab exchange for two to three days. The Parent Committee concurred, and directed the TSC (Tom Jagielo) to carry this forward to the PFMC and NPFMC SSC to obtain a list of candidate species for this process. Rick Stanley will do the same with respect to PSARC. Michael Schirripa will present the recommendation to the CARE committee.

Following discussions since the previous 2005 meeting and at the 2006 meeting, there was consensus that CARE not be directed to schedule routine ageing workshops that systematically work through the various species. Although, CARE and TSC noted the potential for problems where, for example, different agencies used different techniques, it was felt that the impetus for workshops should really come from the principle investigators or stock assessment staff for these species. TSC did, however, encourage CARE representatives to communicate their concerns to such staff (see below).

***Action*:** See 2006 Parent Committee Recommendations.

2006 Parent Committee Recommendations

Acoustic Telemetry Workshop
TSC recommended that the Parent Committee support the planning of a workshop on acoustic telemetry techniques and analysis for Pacific coastal marine species. The objective of the workshop is to bring together researchers from California through Alaska to discuss approaches and techniques for conducting acoustic telemetry experiments with the unique environments and species present in the NE Pacific Ocean. Topics could include capture and tagging, active-tracking, passive tracking array configuration, data collection, and database management.

Action: The Parent Committee agreed. Steve Parker will poll various agencies, academic programs, and organizations with active telemetry projects on the West Coast to gauge interest, develop a steering committee, workshop scope, timeline, and venue.

CARE
Following discussions since the previous 2005 meeting and at the 2006 meeting, there was consensus that CARE not be directed to schedule routine ageing workshops that systematically work through the various species. Although, CARE and TSC noted the potential for problems where, for example, different agencies used different techniques, it was felt that the impetus for workshops should really come from the principle investigators or stock assessment staff for these species. TSC did, however, encourage CARE representatives to communicate their concerns to such staff (see below).

Action: The Parent Committee directed the chair of the TSC to write a letter to CARE to encourage CARE representatives to forward their concerns regarding standardization of techniques to the principal investigators of the species.

Meeting Location
John Field and the SWFSC at Santa Cruz offered to host the 2007 meeting. The proposed date is April 24-25, 2007.

Other Business

The Parent Committee thanked Steve Parker and Michael Schirripa for hosting the meeting.

The Parent Committee thanked Rick Stanley, who acted as chair of this year's meeting, and **Alena Pribyl and Polly Rankin** for recording the minutes.

E. Agency Reports

Report of the Technical Subcommittee of the Canada-United States Groundfish Committee

Agency Reports

Agency Reports:

1. ALASKA FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

2. COMMITTEE OF AGE READING EXPERTS (CARE)

3. INTERNATIONAL PACIFIC HALIBUT COMMISSION (IPHC)

4. NORTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

5. SOUTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

6. STATE OF ALASKA – ALASKA DEPARTMENT OF FISH AND GAME

7. STATE OF OREGON – OREGON DEPARTMENT OF FISH AND WILDLIFE

8. STATE OF WASHINGTON – WASHINGTON DEPARTMENT OF FISH AND GAME

Alaska Fisheries Science Center

of the

National Marine Fisheries Service

2006 Agency Report
to the
Technical Subcommittee
of the
Canada-US Groundfish Committee

May 2006

Compiled by
Mark Wilkins, Tom Wilderbuer, and David Clausen

VIII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, AND MANAGEMENT IN 2005

A. Agency Overview

Essentially all groundfish research at the Alaska Fisheries Science Center (AFSC) is conducted within the Resource Assessment and Conservation Engineering (RACE) Division, the Resource Ecology and Fisheries Management (REFM) Division, and the Auke Bay Laboratory (ABL). The RACE and REFM Divisions are divided along regional or disciplinary lines into a number of tasks and subtasks. In 2005 a new Division was formed from the North Pacific Observer Program within the REFM Division; this Division has been named the Fisheries Monitoring and Analysis (FMA) Division and is under the leadership of Director Dr. Bill Karp. A review of pertinent work by these groups during the past year is presented below. A list of publications pertinent to groundfish and groundfish issues is included in Appendix I. Yearly lists of publications and reports produced by AFSC scientists are also available on the AFSC website at http://www.afsc.noaa.gov/Publications/yearlylists.htm , where you will also find a link to the searchable AFSC Publications Database. Lists or organization charts of groundfish staff of these four units are included as Appendices II - V.

Race Division

In 2005, the primary activity of the Resource Assessment and Conservation Engineering (RACE) Division continued to be fishery-independent stock assessment surveys of important groundfish species of the northeast Pacific Ocean and Bering Sea. Regularly scheduled bottom trawl surveys in Alaskan waters include an annual survey of the crab and groundfish resources of the eastern Bering Sea shelf and biennial surveys of the Gulf of Alaska (odd years) and the Aleutian Islands and the upper continental slope of the eastern Bering Sea (even years).

Two major bottom trawl surveys of groundfish resources were conducted during the summer of 2005 by RACE Groundfish Assessment Program (GAP) scientists on the eastern Bering Sea shelf and upper slope and on the shelf and slope of the Gulf of Alaska. RACE scientists of the Habitat Research Team (HRT) also continued Groundfish habitat-related research.

RACE scientists of the Habitat Research Team (HRT) continue research on essential habitats of groundfish. Currently, a major focus is on incorporating seabed variables into habitat models. The team is gearing up for large-scale field experiments beginning summer 2006 to evaluate the efficacy of new and existing sonar technology for acquiring seabed data, and such data in explaining species-habitat relationships. Effort is greatly enhanced by the recent addition of Mark Amend and LTJG (NOAA Corps) Jay Lomnicky, bringing expertise in habitat research and acoustic mapping.

The Midwater Assessment and Conservation Engineering (MACE) Program conducted winter echo integration-trawl (EIT) surveys of midwater pollock abundance in the Shumagin-Sanak area in February and around Bogoslof Island in March. MACE scientists also continued research on development of salmon excluder devices for pollock fisheries.

The AFSC's new research vessel, the NOAA ship *Oscar Dyson*, underwent several months of sea trials and was commissioned in its new homeport in Kodiak last May. Several issues have prevented its full deployment in support of AFSC's research programs. Inter-vessel calibrations are being planned and implemented between the *Dyson* and the *Miller Freeman*.

It was another year of retirement for several RACE scientists. Most notably, Director Gary Stauffer retired at the end of the year after leading the Division for 20 years. Former Deputy Director Russ Nelson was selected to replace Gary as Director. Terry Sample retired at the end of August and Eric Brown left in the beginning of October. Terry and Eric had been with the RACE Division since 1975. Dan Twohig retired from the MACE Program in November after 40 years of federal service, all but 3 of those with NMFS or its predecessor agency. Finally, Bob Otto, Director of the Kodiak Shellfish Assessment Program since 1984, retired after 32 years of federal service. Bob Lauth was selected as the team leader of the Eastern Bering Sea Team following Gary Walters's retirement. Brian Knoth joined the GAP. He's stationed in Kodiak and joins the Gulf of Alaska/Aleutians team.

For more information on overall RACE Division programs, contact Division Director Russell Nelson at (206)526-4170.

REFM Division

The research and activities of the Resource Ecology and Fisheries Management Division (REFM) are designed to respond to the needs of the National Marine Fisheries Service regarding the conservation and management of fishery resources within the US 200-mile Exclusive Economic Zone (EEZ) of the northeast Pacific Ocean and Bering Sea. Specifically, REFM's activities are organized under the following Programs: Age and Growth Studies, Socioeconomic Assessments, Resource Ecology and Ecosystem Management, and Status of Stocks and Multispecies Assessment. Scientists at AFSC assist in preparation of stock assessment documents for groundfish in the two management regions of Alaska (Bering Sea/Aleutian Islands and Gulf of Alaska, conduct research to improve the precision of these assessments, and provide management support through membership in regional groundfish management teams.

For more information on overall REFM Division programs, contact Division Director Dr. Pat Livingston at (206)526-4173.

FMA Division

In 2005, the North Pacific Groundfish Observer Program (NPGOP) was given recognition for its vital role at the Alaska Fisheries Science Center (AFSC), through the formation of the new Fisheries Monitoring and Analysis (FMA) Division with the Observer Program as its foundation. Since its beginning in 1973 with the first observer deployments to foreign vessels fishing in the Bering Sea and Aleutian Islands, the Program has grown into the largest fisheries observer program in the United States. In 1990, the Program began placing observers aboard domestic vessels and now deploys approximately 400 observers each year, who spend roughly 36,000 days at sea collecting data for use in all aspects of marine scientific research and resource

management at the AFSC. In July 2005, a milestone was reached when the 10,000th North Pacific domestic groundfish observer cruise was completed. The FMA Division will continue to evolve along with the North Pacific fisheries to meet the fishery dependent information needs of the AFSC and NMFS. The FMA Division, with the Observer Program at its core, can be expected to continue to be an integral part of the management system for groundfish in the North Pacific.

During 2005, no foreign vessels were allowed to catch or process fish in the U.S. EEZ off the coast of Alaska. The FMA Division trained and deployed 706 observers to 304 vessels and 24 shore plants in Alaska. These observers spent 36,914 days collecting data in 2005. The Division is responsible for defining the sampling duties and data collection methods used by observers, training of the observers prior to deployment, debriefing of observers upon their return, and editing and managing the resulting data. The catch data are provided to the Alaska Regional Office to assist in management decisions regarding the catches of groundfish and prohibited species. Data are also collected regarding the operations of the groundfish fishery.

For more information on overall FMA Division programs, contact Division Director Dr. Bill Karp at (206)526-4194.

Auke Bay Laboratory

The Auke Bay Laboratory (ABL), located in Juneau, Alaska, is a division of the NMFS Alaska Fisheries Science Center (AFSC). One major change at ABL in 2005 was the selection of a new laboratory director, Dr. Phil Mundy. ABL's Groundfish Assessment Program is primarily involved with research and assessment of sablefish and rockfish in Alaska and with the study of fishing effects on the benthic habitat. Presently, the program is staffed by 14 scientists, including 13 permanent employees and 1 term employee. One member of the program staff left in 2005 – Mike Sigler accepted a position as head of the AFSC's newly created Habitat and Ecological Processes Research Program (HEPR). This position is physically based at the ABL facility, but is not considered part of ABL. Four employees in other ABL programs have also been involved with research on groundfish in recent years.

In 2005, field and laboratory research, ABL's Groundfish Program, in cooperation with the AFSC's RACE Division, conducted the annual NMFS sablefish longline survey in Alaska. Other field and laboratory work by ABL included: 1) a habitat study of juvenile and adult rockfish in the Gulf of Alaska based on *in situ* observations from a manned submersible; 2) research on the catchability of rockfish in the standard net used in AFSC biennial trawl surveys in the Gulf of Alaska; 3) continued juvenile sablefish studies, including routine tagging of juveniles and electronic archival tagging of a subset of these fish; 4) a genetics study to determine species identification and stock structure of young-of-the-year rockfish from offshore waters of the Gulf of Alaska and eastern Bering Sea; 5) a tagging study of Pacific sleeper sharks in southeastern Alaska; 6) research on spiny dogfish near Yakutat, Alaska, to collect information on movements and biology; 7) epipelagic trawling in offshore waters of southeastern Alaska to sample young-of-the-year rockfish and sablefish; and 8) a study of the reproductive biology of giant grenadier.

Ongoing analytic activities involved management of ABL's sablefish tag database, analysis of sablefish logbook and observer data to determine fishery catch rates, and preparation of seven annual status of stocks documents for Alaska groundfish: sablefish, Pacific Ocean perch, northern rockfish, rougheye rockfish, shortraker rockfish and "other slope rockfish", pelagic shelf rockfish, and Bering Sea/Aleutian Islands sharks. Other major analytic activities during the past year were: 1) an analysis of localized depletion in Gulf of Alaska rockfish trawl fisheries; and 2) a habitat evaluation of major fishing grounds in the Gulf of Alaska based on a comparative analysis of multibeam sonar surveys and catch data.

Construction continued at Lena Point., north of Auke Bay, on a new facility that will house the Auke Bay Laboratory. Current plans are for this facility to be completed by the end of 2006, at which time most Laboratory employees will move to the new location.

For more information on overall Auke Bay Laboratory programs, contact Laboratory Director Phil Mundy at (907) 789-6001.

B. Multispecies Studies

Research

Diel Sampling of Epipelagic Ichthyofauna in Offshore Waters of the Eastern Gulf of Alaska

During the period August 10 to August 20, 2005, the Auke Bay Laboratory (ABL) conducted research directed at diel sampling of epipelagic ichthyofauna in offshore waters of the Eastern Gulf of Alaska. The general objective of this cruise was to evaluate procedures for establishing a trawl indexing survey for young-of-the-year (YOY) rockfish, sablefish, and salmon in offshore waters of southeastern Alaska. This research was done under a new annual partnership agreement between ABL and the Alaska Department of Fish and Game vessel Medeia. Three programs within ABL collaborated on this study: Groundfish, Marine Salmon Interactions, and Ocean Carrying Capacity.

Sampling was successfully completed by the Medeia at all priority stations, and cruise study objectives were met due to favorable weather conditions. The cruise consisted of day and night surface trawl sampling with a Nordic 264 rope trawl at nine stations; one of these stations was sampled each day. The stations were located up to 75 km offshore southeastern Alaska along three transects: Cape Edward, Cross Sound, and Icy Point. Catches totaled nearly 40,000 fish representing 22 species in 55 hauls. Catch in numbers for the target species of the study were as follows: YOY rockfish, 11; YOY sablefish, 70; and salmon, 587. Catches of YOY rockfish were less than anticipated, which may be an indication of patchy distribution or of poor survival this year for YOY rockfish off southeastern Alaska. Oceanographic data were collected coincident with the vessel track and trawl hauls to investigate the relationship between oceanographic conditions and the distribution/abundance of fish caught in the trawl. These data included continuous measurements by a thermosalinograph of surface temperature and salinity, and conductivity-temperature-depth (CTD) casts to depths of 200 m at 31 hauls. Information from this study will provide a conceptual framework of diel interactions among species and enable us to better understand marine ecosystem dynamics.

Several interesting or unusual non-target species were captured during the cruise, including Pacific pomfret (Brama japonica), Pacific sardine (Sardinops sagax), blue shark (Prionace glauca), and Humboldt squid (Dosidicus gigas). Occurrence of these species may be related to above average surface temperature that were observed this year in the Eastern Gulf of Alaska. Although occasional Pacific pomfret are sometimes observed during the summer in the Gulf of Alaska, Pacific pomfret in the cruise was the most abundant fish species caught in terms of weight. Pacific sardine have become much more abundant in recent years in waters off the U.S. West Coast and British Columbia, and they appear to have expanded their range into southeastern Alaska in the last few years. Pacific sardines were caught in nearly one third of the trawl hauls, indicating the widespread occurrence of this species in the area that was sampled. A total of six blue sharks were caught in the cruise, which suggests that blue sharks may have been unusually abundant in the study area. Finally, a total of 29 Humboldt squid was caught, including one haul that captured 20 individuals. This large squid normally does not range north of Baja California Mexico, and until last year had never been found north of Newport OR. In 2004, it suddenly appeared off Washington state, British Columbia, and southeastern Alaska as far north as Sitka. The Humboldt squid that were caught in this cruise are the most northerly specimens that have been collected.

For more information, contact Dave Clausen at (907) 789-6049.

Bering Sea Crab/Groundfish Bottom Trawl Survey – RACE

No report by press time. For further information, contact Bob Lauth, (206) 526-4121.

Gulf of Alaska Biennial Groundfish Bottom Trawl Survey - RACE

The fourth in the series of biennial bottom trawl surveys of Gulf of Alaska (GOA) groundfish resources was conducted from 18 May through 6 August 2005. Prior to establishing a biennial schedule in 1999, groundfish resources in the GOA had been surveyed by the RACE Division triennially beginning in 1984. The GOA triennial surveys covered the continental shelf (out to 500-m depth), but only included portions of the continental slope in 1984 (to 825 m) and 1987 (to 750 m). The GOA survey has been repeated on a biennial schedule since 1999. The biennial surveys were designed to cover the continental shelf and slope between the Islands of the Four Mountains (long. 170°W) and Dixon Entrance (U.S.-Canada border in Southeast Alaska) out to the 1,000 m depth contour.

While the 1999 survey succeeded in sampling the entire area, the 2001 survey area was reduced because the Division's survey responsibilities were stretched across three major areas that year under limited funding. Consequently, the 2001 survey area did not include the area east of long. 147°W, nor did it extend deeper than 500 m. The 2003 survey covered the entire geographic range, but vessels were only capable of sampling to depths of 700 m. This year the survey covered the entire geographic and depth extent of the survey area.

Sampling was conducted aboard three chartered commercial trawlers which worked for a total of 225 days between 18 May and 6 August. Sampling began near the Islands of Four Mountains and progressed eastward on the continental shelf and slope to the U.S.-Canada border in Southeast Alaska. Originally, 777 stations were allocated among 54 depth and geographic strata

and were preselected randomly from a grid of potential sites overlaying the survey area. If rugged bottom or heavy commercial fishing prevented sampling a station, a nearby alternate station was selected. By early July it became apparent that the vessels were significantly ahead of schedule. Another 109 stations were allocated to strata east of long. 154°W and most of these were also completed by the end of the survey. Of the 905 attempted standard survey tows, 839 were successfully completed, ranging in depth from 22 to 882 m.

Estimates of abundance and size composition were incorporated into stock assessment updates for 2005. Over the entire survey area, the most abundant species in 2005 were, in order, arrowtooth flounder, Pacific ocean perch, giant grenadier, Pacific halibut, walleye pollock, northern rockfish, and Pacific cod.

We can compare the 2005 abundance estimates with the 2003 results in all areas and in all depths except the deepest (700 – 1,000 m) depth stratum. Since 2003, increases in the estimated abundance were seen for Pacific ocean perch, by 68% to 766,400 t; northern rockfish, by over 400% to 359,000 t; giant grenadier, by 48% to 587,000 t; and Pacific cod, by 4% to 308,000 t. Reduced biomass estimates were seen for arrowtooth flounder, by 33% to 1,900,000 t; halibut, by 11% to 565,000 t; and pollock, by 11% to 378,000 t.

For further information, please contact Mark Wilkins, (206) 526-4104.

Groundfish Systematics Program - RACE

James Orr, Duane Stevenson, and Elaina Jorgensen are continuing work on the taxonomy and systematics of several families of fishes, most recently skates, snailfishes, rockfishes, and eelpouts, and cephalopods.

Orr and Stevenson with Jerry Hoff and John McEachran (Texas A&M University) are preparing the description of a new species of skate from the Aleutian Islands, as well as participating in a study with Ingrid Spies and Mike Canino in their genetic analysis of skates of Alaska.

Orr's research on snailfishes has expanded with descriptions of four new species of *Allocareproctus* with Morgan Busby, two new species of *Careproctus* with Katherine Maslenikov of the University of Washington Fish Collection, and several new species of *Paraliparis* with Zachary Baldwin, an undergraduate intern from the University of Washington.

Orr's work with Sharon Hawkins of Auke Bay Laboratory on the recognition, identification, and nomenclature of species of the rougheye rockfish complex is continuing. Stevenson's description (with M. E. Anderson) of the new species *Bothrocara nyx* has now been published, and Stevenson and Orr's description of a new species of eelpout of *Lycodes* is in press. Stevenson's most recent research is focused on the systematics of eelpouts, including a revision of the genus *Bothrocara* (with Anderson and G. Shinohara), during which he has recognized the presence of at least three additional species in the eastern Bering Sea. He is also conducting an examination of morphological variation in *Lycodes diapterus* from across its entire range in the North Pacific in an effort to better understand its taxonomy.

Both Orr and Stevenson have recently published notes on the distribution of fishes in the Bering Sea, including two species of deep sea skates, *Bathyraja abyssicola* and *Amblyraja badia*, the slickhead *Roulenia attrita* (with Chris Kenaley, University of Washington), as well as the snailfish *Paraliparis paucidens* and the deep-sea cuskeel *Bassozetus zenkevitchi* (with Beth Sinclair and Bill Walker of the National Marine Mammal Laboratory).

Cephalopod taxonomic research is being conducted by Elaina Jorgensen. She is preparing guides to the both the adults and early life history stages of cephalopods of the North Pacific and, with Louise Allcock of Queen's University Belfast, is working on the redescription of a small, very common octopus found on the Bering Sea slope.

For further information, contact Dr. Jay Orr, (206) 526-6318.

Recruitment Processes

No report by press time. For further information, contact Dr. Jeff Napp, (206) 526-4148.

Fisheries Behavioral Ecology Program - RACE

The Fisheries Behavioral Ecology Program conducts experimental research designed to understand the role that behavior plays in regulating distribution, abundance growth, and survival of fish species and their interactions with fishing methods and gear. The goal of the Program is to provide the critical information needed to improve survey techniques, to improve predictions of population abundance and survival, and to conserve populations of economically significant marine resource species and their habitats. Research conducted during 2005 continued under long-term research themes related to bycatch stress and basic studies in fish ecology relevant to the performance of fishing gear, definition of essential habitat, and recruitment processes.

Experimental Bycatch Studies – Bycatch studies in the Fisheries Behavioral Ecology Program fall into two main categories: 1) the fate of fish which are discarded after their arrival on the deck, and 2) the fate of fish which escape trawl gear at depth through cod-end meshes. In studies related to discards, an attempt has been made to understand the key principles which control mortality; integrating analysis of injury, behavior and plasma constituents with observed mortality. Recent laboratory experiments conducted with sablefish, Pacific halibut, walleye pollock, and northern rock sole, have shown that capture and environmental stressors interact to produce physical injury, behavior impairment and immediate and delayed mortality. High incidence of mortality in smaller fish indicates that the practice of high-grading in fisheries is counter-productive for stocks and should be generally restricted.

The magnitude of reflex behavior impairment in discards and escapees was correlated with stressor intensity and was a good predictor of total and delayed mortality in captured and discarded fish. Bycatch discards are probably more susceptible to predation after release and this is an additional source of delayed mortality that is not normally measured in field studies. Few methods are available for predicting delayed mortality in the field. Present research has developed rapid field methods for quantifying delayed mortality in fishing experiments based on measures of fish reflex behavior impairment that can be employed on fishing vessels.

Performance of Fishing Gear – Capture of fish with baited fishing gear (e.g., longlines and traps) for both prosecution of a fishery and stock assessment depends upon feeding motivation, movement patterns, and sensory capabilities in the target species as well as the design of hooks, fish pots, and other gear. The Program has published several papers showing that environmental variables affect the catchability of fishery species on baited gear. A recently completed study shows that catch rates of Pacific halibut will be affected by seawater temperature. Halibut in temperatures <4°C were relatively immobile and after a bait scent was introduced into experimental tanks, searching behavior was directly proportional to temperatures between 2 and 10°C. The rates at which baits were located and attacked also increased with temperature. When environmental variables reduce feeding motivation and locomotion, such as in cold water, population sizes based upon baited gear surveys can be greatly underestimated.

Trawls also rely upon fish behavior to facilitate fish capture, with visual signals providing fish with the directional information to stimulate and guide herding behavior. In laboratory experiments conducted in a 12 m flume, light level had a pervasive influence upon the initial behavioral reaction of flatfish to approaching trawl ground-gear. In the light flatfish were apt to herd, whereas in the dark fish were more likely to rise off of the bottom allowing the gear to pass beneath them. During the day, it has been observed that flatfish frequently escape under ground-gear or are rolled over by the footrope as they herd. If flatfish are more likely to rise off the bottom in darkness/night, more of these fish would be captured, potentially explaining the widely observed increase in flatfish catches from survey trawls in shallow (<100 m) waters at night. Additionally, these laboratory studies also suggest that as many as 40% of flatfish do not react at all to an approaching footrope in light or dark conditions. This suggests that many fish may passively pass beneath the ground-gear and are not captured with currently used trawl gear.

In 2005, field research was initiated to test these findings in waters around Kodiak. An acoustic camera (DIDSON) was mounted on a benthic sled, which was towed with otter doors and abbreviated (5 m) sections of trawl sweep (3" cookies). The DIDSON was aimed along the length of one of the sweeps, providing imagery of the seafloor and fish encountered by the sweep as it was towed along the bottom, both during the day and night. After completion of video analysis, this study will provide further insight into the role of ambient illumination in the herding behavior of flatfishes, as well as potential diel and depth related changes in the capture efficiency of both survey and commercial trawl gear.

Habitat Studies – A three-year field survey for juvenile flatfishes was completed in 2005. The surveys were conducted with a towed camera sled integrated with navigation and depth data to provide a spatially-explicit analysis of distribution and habitat association at several spatial scales, from 10's of kilometers to <1 meter. Analyses from the first year showed that physical variables explain distribution patterns at broad scale while biological variables such as shells, sponges, and other emergent biota and bedform structures are more important at fine scale. Distribution models will be validated with independent field data collected during 2006.

Manipulative laboratory and field experiments, conducted in parallel with the field surveys, were designed to examine the potential influence of predator abundance upon habitat value. While predators may remove juvenile fish directly, through predation, their activity may also indirectly influence juvenile flatfish activity, habitat preference and growth. Results of these experiments

indicate that age-0 rock sole respond to perceived predation risk over a range of temporal scales. Upon detection of predators, rock sole reduce activity and bury in the sediment. If predation risk is persistent (hours to days), they move to areas of lower perceived risk. Finally, if they are unable to move to habitats of lower risk, growth is inhibited.

Nighttime swimming behavior of northern rock sole is believed to be an important mechanism of redistribution in heterogeneous environments. This non-oriented behavior has the potential to disrupt distribution patterns established through active habitat selection during the daytime. New laboratory experiments established that nocturnal redistribution is density dependent and unaffected by the presence of epibenthic structure. Hence, structured habitats where fish congregate during the day "leak" fish into the less preferred surrounding habitats at night when densities reach certain levels.

Fish Behavior, Foraging and Growth – Examination of the spatial and temporal variation in growth rates of northern rock sole continued in 2005 with monthly sampling at three Kodiak Island nursery sites. Variation in growth rates among sites was greater in 2005 than 2004, but the rank order of growth rates was maintained across sites. This work is being extended to examine the potential differences in energetic condition of rock sole among the nursery sites. Analysis of condition factors will demonstrate the ontogenetic pattern of energy storage and may suggest even greater differences in recruitment potential among sites than indicated from growth rates alone.

Examination of stomach contents collected during 48 hours of juvenile flatfish sampling in 2004 nears completion. The data demonstrate that diets and diel feeding patterns differed among three abundant flatfish species that co-occur in Kodiak Island nursery sites. Northern rock sole, the most abundant flatfish, fed upon copepods, mysids and amphipods with feeding occurring most rapidly at dusk. English sole ate benthic infauna such as clam siphons and polychaetes throughout the day. Pacific halibut had peak feeding in the afternoon prior to dusk and fed on the most mobile prey including mysids and cumaceans. Differences in diel feeding pattern may be linked to species-specific variation in predation vulnerability associated with their cryptic behavior and depth preferences.

For further information, contact Dr. Allan Stoner, (541) 867-0165.

Age and Growth Program - REFM

The Age and Growth Program of the REFM Division serves as the Alaska Fisheries Science Center's ageing unit for groundfish species. The program consists of a biometrician, age validation researcher, IT/data specialist, and 10 age readers. Ages are usually determined from otoliths, but scales, finrays and vertebrae are sometimes used. The protocols governing age determination at the AFSC have recently been documented by (Kimura and Anderl, 2005), whose paper is now available on the Age and Growth website.

Data provided by the program are used in stock assessment modeling, which contributes to the estimation of the allowable catch of many commercially important groundfish species. These species include walleye pollock, Pacific cod, sablefish, Pacific Ocean perch, northern, rougheye,

and dusky rockfishes, Atka mackerel, yellowfin sole, rock sole, rex sole, and misc. sole and rockfish species.

Research in the Age and Growth Program in 2005 has focused on the following areas:

1. Craig Kastelle is finalizing a draft a paper on the radiometric age validation of the AFSC's walleye pollock surface/bb ageing method (Kastelle, C.R. and D. K. Kimura. 200X).
2. Jake Gregg (now with the USGS) in collaboration with Delsa Anderl has completed a paper that documents an innovative method of ageing Greenland turbot based on cutting and staining otoliths (Gregg, J.L., D.M. Anderl, and D.K. Kimura). This work was also presented at a February 2006 NAFO workshop on the ageing of Greenland halibut.
3. Craig Kastelle and Dan Kimura are also completing a manuscript documenting results on C-14 age validation of Pacific ocean perch from the Gulf of Alaska. Although some outliers exist, the bomb carbon method provides strong support of the POP ageing criteria used at the AFSC.
4. Charles Hutchinson presented results from "Using radiometric ages to develop conventional ageing methods for shortraker rockfish," a paper that was also submitted for publication in the Lowell Wakefield Rockfish Symposium Proceedings. Meeting held September 12-16, 2005.
5. Chris Gburski continues the project of ageing Alaska skates (big and longnose skates) using vertebrae. This work will be presented at the upcoming Elasmobrach Society Meeting to be held in New Orleans in July, 2006.
6. Jon short of the Age and Growth Program recently unveiled a new interactive website. This Age Reading Demonstration (ARD) website allows site visitors to place marks on otolith images, which essentially assigns an age to the otolith. ARD will then automatically mark the otolith image with marks from an experienced age reader, and compare the visitor's age with the experienced age reader's age. ARD will present otoliths from various species, and of varying levels of ageing difficulty, which will demonstrate once and for all that otoliths from different species often require completely different ageing strategies, and that otoliths from even an easy species can present difficult challenges.

For further information, contact Dr. Daniel K. Kimura (206) 526-4200.

Resource Ecology and Ecosystem Modeling - REFM

Multispecies, foodweb, and ecosystem modeling and research are ongoing. Documents, symposia and workshop presentations, and a detailed program overview are available on the World Wide Web. These can be viewed from the Alaska Fisheries Science Center (AFSC) web site at: **http://www.afsc.noaa.gov/refm/reem/Default.htm**.

Groundfish stomach sample collection and analysis – The Resource Ecology and Ecosystem Modeling Task (REEM) continued regular collection of food habits information on key fish predators in the North Pacific. Collection of groundfish stomach samples is primarily through the RACE bottom trawl and echo-integration/trawl surveys. Additional samples that

broaden our spatial and seasonal coverage are obtained through the Observer Program and through coordinated studies with other agencies. In 2005, REEM collected samples and data during bottom trawl surveys of the Gulf of Alaska and eastern Bering Sea. Observers also collected stomach samples during fishery operations from the eastern Bering Sea. In total, 2,950 stomachs were collected from the eastern Bering Sea and 463 stomachs were collected from the Gulf of Alaska. Laboratory analysis was conducted on 10,972 fish stomachs from the Bering Sea, 1,058 fish stomachs from the Gulf of Alaska and 5,635 fish stomachs from the Aleutian Islands. At-sea analysis was conducted on 1,362 fish stomachs from the Bering Sea and 1,864 fish stomachs from the Gulf of Alaska. The REEM predator-prey database was updated with 53,506 records in 2005. Complete database details can be found at http://www.afsc.noaa.gov/refm/reem/data/Default.htm.

Recent completed laboratory analyses include the 2002 Aleutian Islands and Bering Sea Slope surveys. 2004 analyses of these surveys were conducted on shipboard so these later surveys are already complete. Figure 1 shows a subset of diet data from the 2002 Bering Sea slope survey. Aleutian skates (*Bathyraja aleutica)* are a more shallowly distributed species on the slope (majority of biomass at less than 400m depth) and show a progression in diets from small zooplankton to shrimp to walleye pollock with increasing size. Black skates (*B. trachura)* are distributed below 600m, and show diets of larger sizes primarily consisting of deep-dwelling crabs. A broader comparison of skate diets throughout the Alaska regions is currently in preparation.

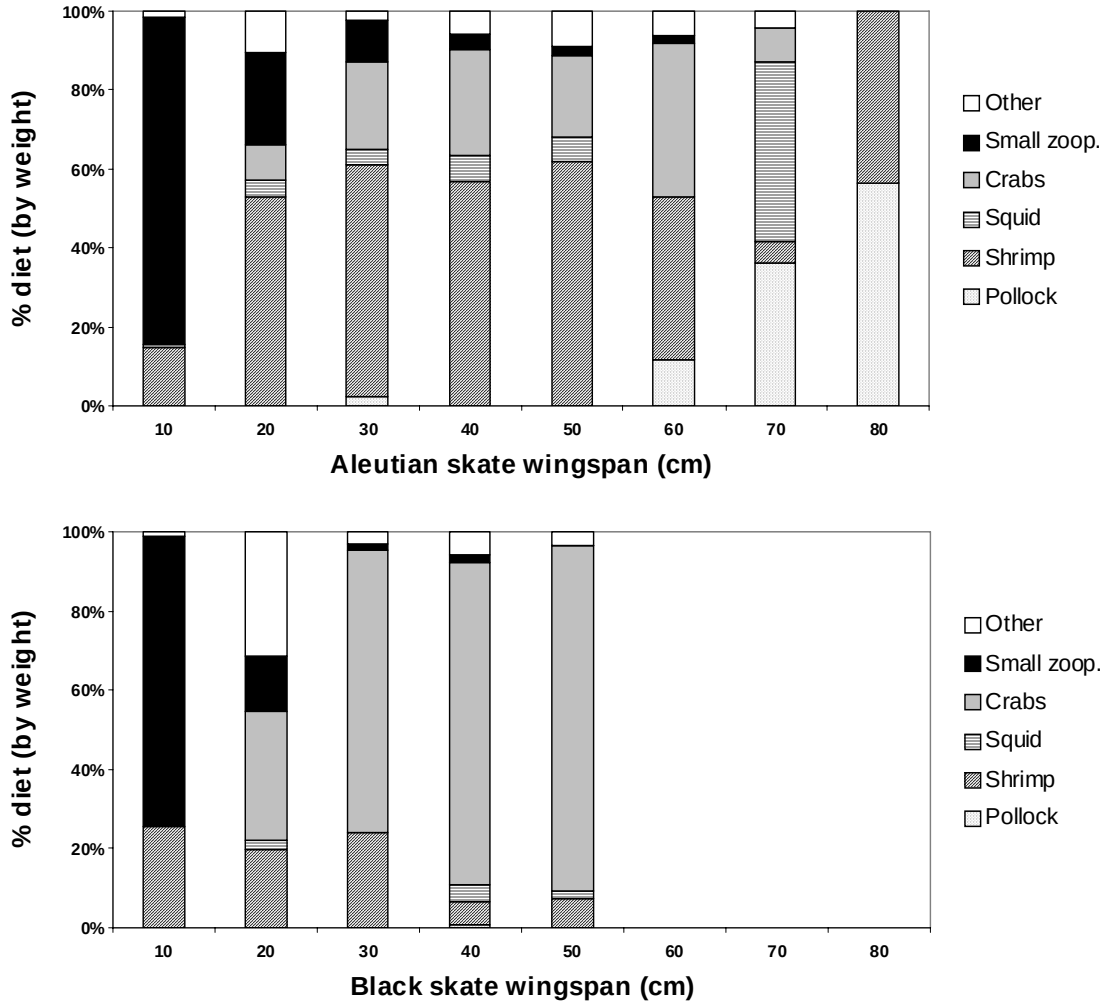

Figure 1. Diet composition (% wet weight) by wingspan of two species of skates from the 2002 Bering Sea Slope survey.

Fish Ecology – The comparative study of life-history data such as spawning season, age at maturity, and growth rate will improve multispecies modeling efforts as well as analysis of fish response to climate and fisheries. A website has been developed http://access.afsc.noaa.gov/reem/LHWeb/index.cfm which collects relevant life-history data of Alaska fishes into a searchable database.

Multispecies and Ecosystem Modeling – The NOAA five-year plan, "Towards Understanding and Predicting Earth's Environment", lists as a 3-5 year goal "developing the next generation of multi-species fisheries and food web production models." Recent model development work has been http://www.afsc.noaa.gov/refm/reem/models/MSVPA.htm and http://www.afsc.noaa.gov/refm/reem/models/MSM.htm

To aid in this development for the Alaska region, REEM personnel helped to organize and give presentations at a workshop on multispecies and ecosystem modeling, hosted by the North

Pacific Fisheries Management Council's Scientific and Statistical Committee in February 2005. At this workshop, 12 scientists from the Alaska Fisheries Science Center, the University of Washington, and the University of Alaska presented recent and upcoming work in developing assessment-quality models of species (predator/prey), technical (fishing gear) and management (management strategy) interactions for input into stock assessment and other decision-making processes within a multi-species, multi-sector fishery.

Of specific interest to the workshop attendees was the investigation of simulations in which single species models and multispecies models gave contrasting results. For example, Fig. 2 shows the results of a simulated scenario consisting of removing all fishing pressure within the eastern Bering Sea ecosystem, then predicting the biomass of target species 20 years later under conditions of average recruitment. This same scenario was run with three models: a set of single species models similar to the current stock assessment models, a multispecies virtual population analysis model (MSVPA) and an Ecosim model. While results between models was similar for top predators such as Pacific cod and Greenland turbot, walleye pollock, a key forage species, showed different results when predator/prey interactions were included. Both the multispecies and ecosystem models predicted much more modest increases in pollock biomass than did the single species model, as predation increased to compensate for the increase in food supply. It is hoped that the continued presentation of results such as these will become a useful addition to the management process.

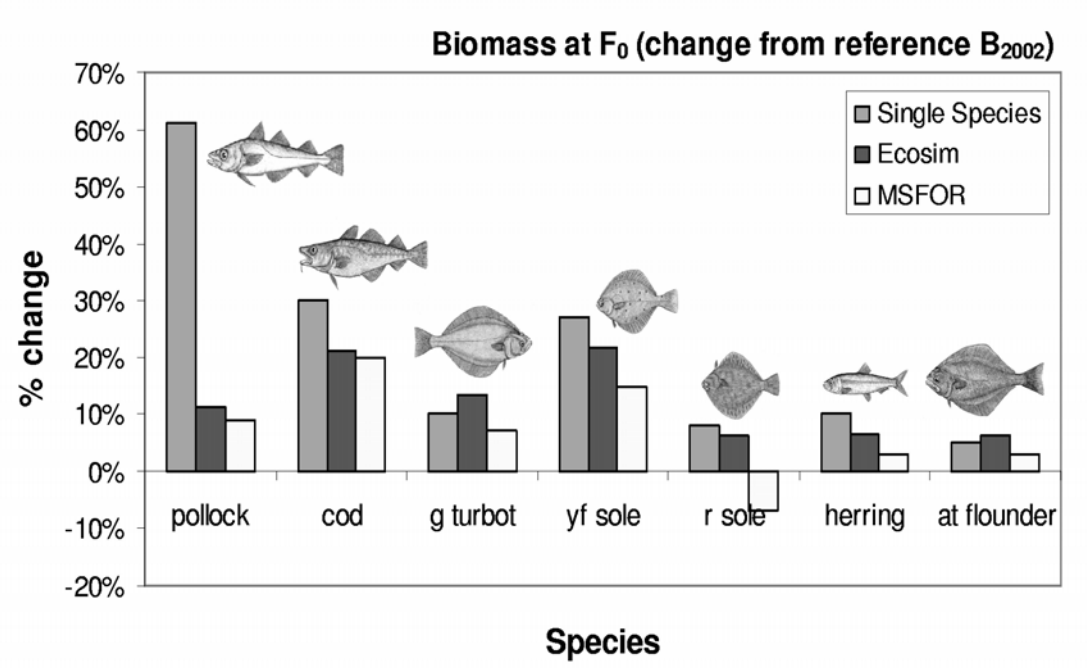

Figure 2. Simulated percent change of adult biomass for several target species in the eastern Bering Sea, after removing all fishing pressure for 20 years and assuming average recruitment over that time period, as reported by single species, multispecies (MSVPA), and ecosystem (Ecosim) models.

Examination of Ontogenetic Migration of Walleye Pollock in the Eastern Bering Sea – It is widely accepted that walleye pollock in the eastern Bering Sea (EBS) have an ontogenetic distribution where younger fish are found in the northwest region, and as they age, their

distribution gradually shifts southeasterly over the EBS shelf. This trend in average distribution does not generally appear to be represented by the ontogenetic distributions of individual year classes, and may partly result from pooling data from year classes of walleye pollock that exhibit differing ontogenetic distributions. In addition, EBS age composition estimates of walleye pollock from survey data have generally been computed using the aggregate length-age composition from areas of slower growth (in the northwest) and areas of faster growth (in the southeast). This results in a systematic bias in length-age conversion in each region that reinforces the accepted average distributional pattern.

To illustrate how this occurs, consider two hypothetical groups of fish that have identical, static age-composition and abundance, but differing rates of growth (Fig. 3a, b). Using the aggregate length-age composition of the fish from the two areas to convert the length-frequency into an age-frequency within each area would result in a systematic bias in age composition in both areas. In the area of slower growth, the numbers of young fish are overestimated and the numbers of older fish are underestimated (Fig. 3c). In the area of faster growth, the opposite bias is introduced (Fig. 3d). The resulting distribution of ages, or year classes, between the two areas departs from the original distribution of 50% of each age in each area (Fig. 4), and suggests an ontogenetic shift in distribution where young fish are more abundant in the area of slower growth and gradually migrate into the area of faster growth as they age.

Seabird – Fishery Interaction Research

The Alaska Fisheries Science Center's REEM Seabird Program is currently involved in several projects. The program is also doing some facilitation between the Washington Sea Grant Program (WSGP) and the North Pacific Groundfish Observer Program in preparation for WSGP's demersal longline integrated weight studies in July through November 2005. Seabird stationary sighting surveys were again implemented for the summer groundfish charters, but were also expanded in 2005 to include hydroacoustic surveys and cod pot research charters. This work depends on many AFSC employees who staff these cruises to take extra time to complete the surveys. Their work is critical to this effort.

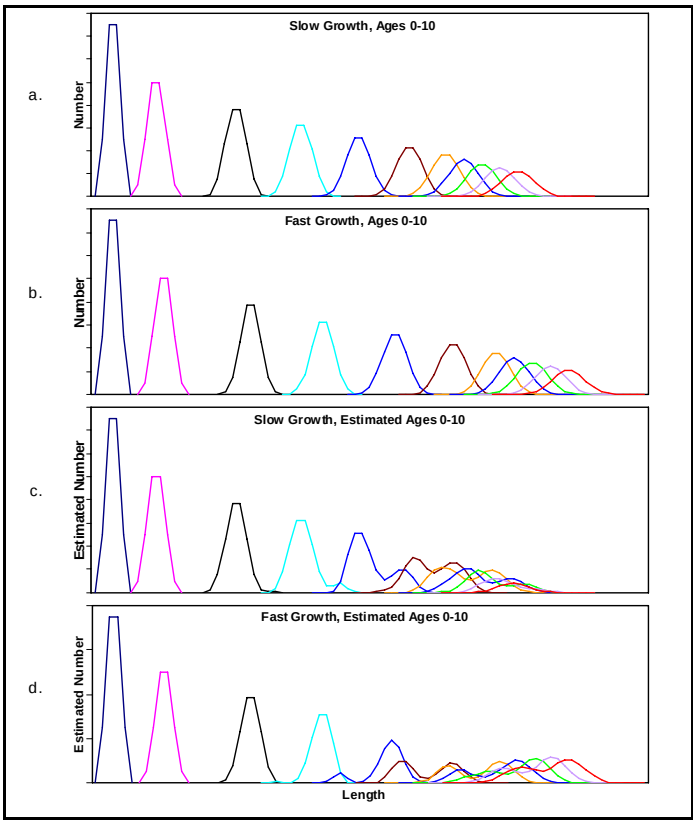

Figure 3. Hypothetical age-composition in an area of slower growth (a) and faster growth (b), and the biased estimates of age-composition in these areas (c, d) resulting from use of the aggregate length-age key.

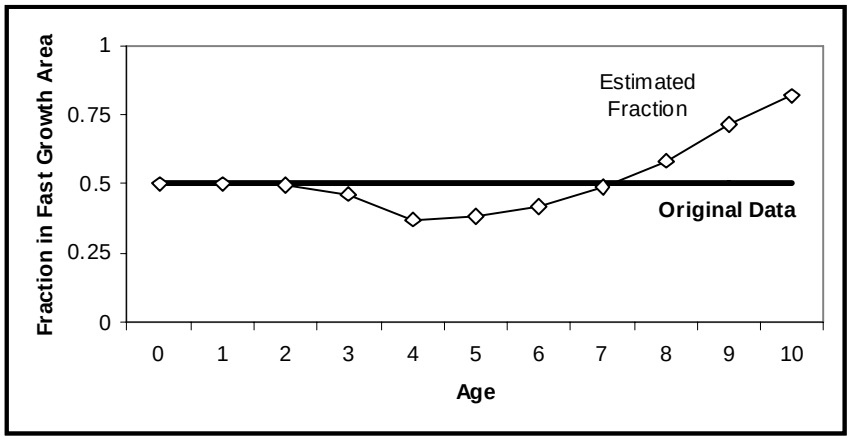

Figure 4. The estimated fraction of ages, or year classes, in the faster growth area which results from using the aggregate (combined faster and slower growth) length-age key to estimate the age composition. This illustrates the artificial shift from the slower growth area into the faster growth area that differs from the original data with equal numbers (50%) of each age in each area.

Most work currently being undertaken by the REEM Seabird Program has to do with seabird interactions with the trawl fleet. Seabirds are known to sometimes collide with the main warp cables used for towing the net or the trawl sonar third wire cable (Fig. 5) used for monitoring net

performance and catch while towing. The rates of these interactions are not known. No short-tailed albatross, an endangered species, have been documented as interacting with this gear but there is concern that this might occur. Efforts are underway to both develop deterrent devices and better characterize the interaction rates. These efforts involve close collaboration with the trawl industry, WSGP, and the University of Washington. We are coordinating with the Pollock Conservation Cooperative (PCC) and WSGP to develop seabird deterrent devices for trawl catcher processor vessels. Funds to support materials and installation have come from the NMFS National Cooperative Research Program and from the PCC. Gear was pilot tested on one vessel during January through April 2005, and will be fitted out on an additional vessel for the pollock B season, June – October 2005. With support from the USFWS Ecological Services Division and the NMFS Cooperative Research Program, funding was provided to support a research team boarding these two vessels to complete some experimental trials during late July and August. WSGP is the lead organization for that work.

In addition to developing mitigation devices, NMFS is working to better characterize the seabird bycatch on trawl vessels. An observer special project is ongoing throughout the 2005 season for all trawl observers. This information will allow us to better understand seabird interactions with trawl warp and third wire cables by fishery sector. Finally, we are working on meeting non-discretionary requirements under one of the two short-tailed albatross biological opinions to provide reports on trawl effort and the use of trawl sonar technology, and have implemented work with the University of Washington to develop a risk-assessment model for trawl fishery sectors on the likelihood of interactions with short-tailed albatross.

The impact on North Pacific seabirds of provisioning by the Alaskan groundfish fishery continues on two fronts: a quantitative analysis of fish and fish parts returned to the sea, and a stable isotope study investigating the use of fisheries discards and offal by Laysan and Black-footed Albatrosses. In consultation with fishing industry representatives, especially the At Sea Processors Association, at-sea offal discharge rates are being estimated based on product recovery rates and total retained catch estimates. An important component of this investigation is a comparison of discharge rates between at-sea and shore-based processors, with particular emphasis on the presence or absence of fish meal plants at the processing facilities.

The delta-15N value of an animal's tissue is indicative of the level at which that animal feeds in the food chain. Higher values correspond to higher trophic levels. Preliminary data from the delta-15N values of feathers clearly show that the diets of Laysan and Black-footed Albatrosses have shifted over the last 80 years, a period corresponding to the rise of large-scale commercial fisheries in the North Pacific. Historically (before 1925), the diets of Laysan and Black-footed Albatrosses during the non-breeding season differed by an average of almost two trophic levels. Currently (after 1995), the diets of Laysan and Black-footed Albatrosses collected mostly behind fishing vessels differed on average by less than one trophic level. Thus, the dietary overlap of these two-closely related but distinct species has increased with the advent of commercial fishing.

The REEM Seabird Program focused on addressing requirements in the Short-tailed Albatross biological opinion published in 2003 (Available from the Alaska Regional Office website noted below). Several observer special projects were implemented in coordination with staff in the

Fisheries Monitoring and Assessment Division so that we will be able to address BiOp non-discretionary requirements in the future. Several other BiOp requirements are being worked on, including an assessment of how important trawl sonar (3rd wire) technology is to the Alaskan fleet and analyzing trawl and 3rd wire effort among the fleet. Another requirement was met by summarizing observer checks of seabird avoidance gear on longline vessels during 2004 (see table). Observer data are also being used along with catch information from the Alaska Regional Office to provide estimates of seabird incidental takes through the 2004 fishing season. Analysis was completed by the National Marine Mammal Lab, and REEM Program staff is preparing summary tables and graphs for public distribution. This information is available at the AFSC website (see below). A large component of the freezer longliner fleet started using paired streamer lines at the start of 2002, before regulations were implemented. The average annual seabird incidental takes for demersal longline (all fisheries combined) for the years before and after paired streamer lines were being used is 15,888 from 1993 through 2001 and 4,910 from 2002 through 2004 -- a 70% reduction.

These many projects could not happen without the hard work carried out by groundfish observers deployed to commercial fishing vessels in Alaskan waters and the staff needed to support their deployments and data management activities. We are grateful for all that these dedicated people do in support of seabird monitoring and reporting.

REEM Program personnel are also coordinating with the Migratory Bird Management Division of the US Fish and Wildlife Service, Anchorage Alaska, to implement a seabird sighting survey program that takes advantage of current research, charter, and possibly fishing vessels while in transit or on station. Funds were applied for through the North Pacific Research Program that would support materials, travel costs, and data management for dedicated seabird observers on vessels of opportunity.
Alaska Regional Office: http://www.fakr.noaa.gov/protectedresources/seabirds.html
AFSC Seabirds: http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm

Table 1. Summary of seabird avoidance measures used in 2004 by demersal groundfish longline catcher-processor (CP) and catcher (CV) vessels in the Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA) Regions of Alaskan waters while NMFS-Certified groundfish observers were on board. Vessels 60 feet length overall and larger have 100% or 30% observer coverage of fishing days depending on vessel size. Observers spot-checked for avoidance gear during the set but did not monitor the entire setting process.

							Streamer Line Use for Examined Sets			
Period[1]	Region	Vessel Type	Total Sets	Sets not checked	Sets Checked	% sets checked	Paired Steamer	Single Streamers	No Streamers	% Paired or Single
	BS	CV	0	-	-	-	-	-	-	-
	BS	CP	2,885	979	1,906	66.1	1,732	96	78	95.9
	AI	CV	0	-	-	-	-	-	-	-
	AI	CP	0	-	-	-	-	-	-	-
	GOA	CV	61	9	52	85.3	14	14	24	46.2
	GOA	CP	318	51	267	84.0	263	4	0	100.0
	Subtotal		3,264	1,039	2,225	68.2	2,009	114	102	95.4
	BS	CV	79	0	79	100.0	79	0	0	100.0
	BS	CP	13,945	4,496	9,449	67.8	8,116	1,034	299	96.8
	AI	CV	38	5	33	86.8	17	16	0	100.0
	AI	CP	1,455	785	670	46.1	512	39	119	82.2
	GOA	CV	871	127	744	85.4	654	72	18	97.6
	GOA	CP	1,261	391	870	69.0	797	30	43	95.1
	Subtotal		17,649	5,804	11,845	67.1	10,175	1,191	479	96.0
Total			20,913	6,843	14,070	67.3	12.184	1,305	581	95.9

[1] New regulations requiring the use of streamer lines for vessels greater than 55 feet length overall became effective February 12, 2004. See http://www.fakr.noaa.gov/protectedresources/seabirds/regulations.htm for full text.

Ecosystem Considerations for 2005

The Ecosystem Considerations section of the Stock Assessment and Fishery Evaluation (SAFE) was updated again in 2005 and includes an ecosystem assessment, updated status and trend indices, and ecosystem-based management indices and information. This report is made available to stock assessment scientists, plan team members, the SSC, AP, NPFMC, and public in the fall of each year and the information in this report is used in scientific evaluations in stock assessments and the Environmental Assessment that are also provided to management. One of the additions and improvements to the report this year is an executive summary which highlights important and recent trends in climate, biology and fishing impacts. Also, a new website has been developed that provides access to the contributions as well as to data time series summarized in the report http://access.afsc.noaa.gov/reem/ecoweb/Index.cfm.

Notable trends include recent warm conditions in the eastern Bering Sea and a long-term warming trend in shallow waters of the Gulf of Alaska. This year, there were two apparent "red flags" in the eastern Bering Sea. First, there was a persistent decline of summer net zooplankton (e.g., large copepods such as *Calanus marshallae*), which are important prey for fish, including pollock, seabirds, and baleen whales (Napp and Shiga, 2005). If the low abundances of these prey items continue, there may be declines in consumer populations or range shifts northward to areas where these copepods might be expected to remain abundant. The second flag was less certain. Declines in annual surplus production (ASP) in the eastern Bering Sea were observed, in spite of relatively stable abundances and exploitation levels (Mueter, 2005). Excluding the most abundant groundfish species that dominate observed trends, annual surplus production trends also showed strong and significant declines in all non-pollock species from 1978 – 2004 in the Bering Sea and declines stocks, excluding pollock and arrowtooth flounder, in the GOA over this same period (Mueter, 2005). These declines may be a reflection of changes in either annual primary production, or changes in food web structure. If these declines in annual surplus production are the result of climate change and if the current climate conditions persist, future fish production in the eastern Bering Sea is expected to be lower than in previous decades. However, if the declines in surplus production are a function of density dependent factors resulting from moderate to high biomass levels, then the declines are not a "red flag" but a natural response to changes in stock size.

The number of northern fur seal pups born on the Pribilof Islands continued to decline in 2004. However, increases in Steller sea lion non-pup counts were observed in 2004 in all areas except the central GOA (slight decline) and the eastern GOA (similar counts as 2002). These time series are updated biennially and updates to these time series in 2006 will indicate whether these trends in marine mammal populations continued.

Time trends in bycatch of prohibited species are examples of ecosystem-based management indices that may provide early indications of direct human effects on ecosystem components or provide evidence of the efficacy of previous management actions. Interestingly, the bycatch of "other salmon" and herring increased markedly in 2003 and 2004. Between 2002 and 2003, herring bycatch increased by over 600% and "other salmon" bycatch more than doubled. After the dramatic increase in 2003, the herring bycatch increased again by about 42% and "other salmon" bycatch almost doubled in 2004.

Most of the herring bycatch in all years occurs in the BSAI trawl fisheries, primarily during the months of July, August and September with smaller amounts in January through March and October. The recent rise in bycatch can be partly explained by increases of herring biomass; the biomass of Kuskokwim herring, for example, is estimated to have increased by about 34% in 2003 and again by about 32% in 2004. Observer data reveals differences in the distribution of both effort (all pelagic-trawl hauls) and bycatch (hauls with herring in the species composition) over the years 2002-04. In most months of 2003 and 2004, the amount of effort and bycatch increased noticeably in the northwestern-most portions of the fleet's range compared to 2002.

Part of the 2003 increase in "other salmon" bycatch could be explained by the 33% increase in the overall catch of "other salmon" in 2003 compared to 2002. The "other salmon" bycatch nearly doubled again in 2004, despite an almost 6% reduction in the overall catch. In 1994, the

North Pacific Fisheries Management Council and NMFS established the Chum Salmon Savings Area (CSSA) in parts of the Bering Sea and at times when salmon bycatch had been highest based on historical observer data. Unfortunately, in both 2003 and 2004 the highest chum salmon bycatch rates were outside of the CSSA and after its closure. Similar problems occurred in 2003 and 2004 with Chinook salmon bycatch outside of the Chinook Salmon Savings Area—the highest bycatch rates were encountered by the pollock trawl fleet outside of the Savings Area after regulations had forced its closure. The resulting Chinook salmon bycatch was about 28% higher in 2003 and 41% higher in 2004 than the long-term average over the period 1994-2002. To address these problems, the Council is considering other means to control salmon bycatch. For more information about REEM research, please contact Kerim Aydin at (206)526-4225.

Stock Assessment

Status of Stocks and Multispecies Assessment Task - REFM

The Status of Stocks and Multispecies Assessment Task is responsible for providing stock assessments and management advice for groundfish in the North Pacific Ocean and the Bering Sea. In addition, Task members conduct research to improve the precision of these assessments, and provide technical support for the evaluation of potential impacts of proposed fishery management measures.

During the past year, stock assessment documents were prepared by the Task for the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Plan teams of the North Pacific Fishery Management Council and for the groundfish management team of the Pacific Fishery Management Council.

Assessment scientists provided analytic assistance on many current fisheries management issues. These included: 1) identification and prioritization of research activities that may lead to improved groundfish stock assessments; 2) modeling of groundfish stock structure; 3) contribution to a comprehensive report on bycatch, utilization and discards; 4) helped to develop overfishing definitions for the NPFMC, 5) provided analysis of environmental impacts of the pollock and Atka mackerel fisheries on Stellar sea lions, and 6) worked with the NMFS Alaska Region to provide a supplemental environmental impact statement for the setting of TACs.

Research activities spanned a broad range of topics. Field studies initiated by staff members included the continuing development of a demersal rockfish trawl for improved stock assessment and hydroacoustic approaches for rockfish habitat determination. Significant research contributions on: 1) the examination of climatic effects on the recruitment of North Pacific groundfish species, 2) relationship of Bering Sea oceanography to pollock recruitment, 3) modeling the Pacific whiting fishery behavior, 4) analysis of the geographic and genetic variation in Atka mackerel in the Aleutian Islands, and 5) incorporation of predation in the Gulf of Alaska pollock assessment were presented at various symposia. In addition, staff members participated on nationwide NMFS committees for specifying a precautionary approach to fisheries management; used a Leslie depletion model to analyze Atka mackerel fishery CPUE data; investigated restratifying fisheries data along biological lines as opposed to traditional INPFC areas; worked with other fishery labs in developing and implementing a new stock assessment model, and continued the international cooperative analysis of Bering Sea pollock

stocks with Russian scientists. Staff members also served on national and international steering committees of GLOBEC and PICES.

For further information, contact Dr. Anne Hollowed (206) 526-4223.

Management

Economics and Social Science Research Program - REFM

No report by press time. For further information or if you have questions about the Economic and Social Sciences Research Program, please contact Dr. Ron Felthoven (206)-526-4114.

C. By Species, By Agency

Pacific Cod

Stock Assessment

Bering Sea/Aleutians

The present assessment is a substantial revision of last year's assessment, incorporating a new maturity at length schedule and new assessment model software. The 2005 EBS shelf bottom trawl survey resulted in a biomass estimate of 604,000 t, nearly identical to the 2004 estimate (597,000) and near the minimum for the 23 year time series (534,000 t). The Aleutian Islands and EBS slope were not surveyed in 2005. The stock assessment model estimates of abundance are lower than last year's assessment. Estimated 2006 spawning biomass for the BSAI stock is 283,000 t, down about 4% from last year's estimate for 2005 and down about 2% from last year's *F40%* projection for 2006. The abundance is projected to continue to decrease during 2006-2009 because recent (2001-2004) recruitments are below average. The stock assessment model estimates of current total and spawning biomass are roughly half of the peak value for the time series which occurred in 1987.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, and that this stock therefore qualifies for management under tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 295,000 t, 0.41 and 0.50, respectively. Pacific cod qualify for management under sub-tier "b" of tier 3 because projected biomass for 2006 is about 5% below $B_{40\%}$. Fishing at an instantaneous rate of 0.39 is projected to result in a 2006 catch of 194,000 t, which is the maximum permissible ABC. The overfishing level was determined from the tier 3b formula, where fishing at a rate of 0.50 gives a 2006 value of 230,000 t, down about 13% from the 2005 estimate. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The new maturity-at-length schedule implies that Pacific cod mature earlier than the previous schedule. The new schedule is based on microscopic examination of the ovaries which detected developing eggs in small cod that the previous macroscopic methods had missed.

Gulf of Alaska
The stock assessment was updated as follows:

1) catch data for 1964-77 were incorporated, catch data for 2004 was updated, and preliminary catch data for 2005 were incorporated.
2) Size composition data from the 1977 commercial fisheries were incorporated, size composition data from the 2004 commercial fisheries were updated, and preliminary size composition data from the 2005 fishery were incorporated.
3) Size composition data from the GOA bottom trawl survey were incorporated.
4) The biomass estimate from the GOA bottom trawl survey was incorporated (the 2005 estimate of 308,102 t was an increase of 4% over the 2003 point estimate).
5) Age composition data from the 2003 GOA bottom trawl survey were incorporated.
6) Length-at-age data from the 2003 GOA bottom trawl survey were incorporated.
7) A new maturity-at-length schedule was incorporated.

New implementation software was also used in this assessment (same as in BSAI assessment). Model results indicate that the 2006 female spawning biomass is estimated at 116,575 t, up about 80% from last years estimate of 2005 female spawning biomass and above the B_{40} value of 106,779 t. This change is largely due to the new maturity schedule where the length at 50% maturity is estimated at 50 cm. Thus, Pacific cod are now in Tier 3a where the maximum permissible ABC for 2006 is 79,618 t. An ABC of this magnitude would represent an increase of 21,518 t, or 37% relative to the 2005 ABC. The assessment notes that the 2001-2003 year classes are almost certainly below average and that biomass is likely to decrease in coming years as these cohorts begin to dominate the age structure of the population. Since ABC levels are now set for two years because of the regulatory changes brought about under Amendment 48, ABC for 2006 is set at 79,618 t and at 49,466 for 2007 due to the projected future biomass reductions. The 2006 ABC harvest level corresponds to a fishing mortality rate of 0.545. The estimated 2006 overfishing level is 95,500 t for Tier 3a (59,100 t for 2007). The 2006 harvest is apportioned as follows: East 6%, Central GOA 55% and Western GOA 39%. The Pacific cod stock is not overfished and is not approaching an overfished condition.

For further information, contact Dr. Grant Thompson at (541) 737-9318.

Shelf Rockfish

Stock Assessment

Gulf of Alaska

Pelagic shelf rockfish – ABL – The pelagic shelf rockfish assemblage is comprised of four species (dusky, dark, yellowtail, and widow rockfish) that inhabit waters of the continental shelf of the Gulf of Alaska and that are thought to exhibit midwater, schooling behavior. At certain times, however, some of these fish are caught in bottom trawls. Dusky rockfish is by far the most abundant species in the group, and has been the target of an offshore bottom trawl fishery since the late 1980's. A major change in 2004 was the taxonomic separation of what was formerly one species, dusky rockfish, into two species: dusky rockfish (*Sebastes variabilis*) and

dark rockfish (*Sebastes ciliatus*). Previously, these two varieties were referred to as "light dusky rockfish" and "dark dusky rockfish", respectively, and were both classified as *S. ciliatus*. Dark rockfish share an inshore reef or kelp environment with black rockfish, and these two species are often found together. Black rockfish in Alaska were placed under state jurisdiction in 1998, and now that dark rockfish have been recognized as a distinct species, a North Pacific Fishery Management Council (NPFMC) Plan amendment has been proposed that would also transfer this latter species to state control. An environmental review analysis was prepared in February 2006 by NPFMC staff with assistance from ABL staff and was scheduled for initial review at the April NPFMC meeting. Pending the review process by the NPFMC, the analysis will be revised and released for public review following the April meeting. Final action on the amendment is scheduled for June 2006.

An age-structured model was used for the first time in 2003 to determine biomass and ABC for dusky rockfish (*S. variabilis*), the predominant species in the assemblage. This model was developed in a workshop held at the Auke Bay Laboratory in February 2001, and refined to its current configuration in 2004. In 2004 and 2005 a large quantity of new age data for dusky rockfish became available, which required some reconditioning of the model. As a result, the 2005 model has a better fit to available data and closely follows survey biomass estimates. The model estimate of current total biomass for dusky rockfish is 86,893 mt, and recommended ABC for 2006 based on an $F_{40\%}$ harvest rate (0.120) is 4,885 mt. This ABC is an increase of about 20% compared to the 2005 value of 4,056 mt. The increase in ABC is largely due to a 2.5 fold increase in survey biomass from 2003 to 2005. Exploitable biomass for the three other species in the assemblage (dark, yellowtail, and widow rockfish) is computed using their average biomass estimates for last three biennial trawl surveys in 2001, 2003, and 2005 which equal a total of 10,500 mt. Applying an F=0.75M=0.0525 rate to this value of exploitable biomass yields a recommended ABC of 551 mt. Therefore, for the pelagic shelf rockfish group as a whole, total biomass is 97,386 mt, and recommended ABC for 2006 in the Gulf of Alaska is 5,436 mt.

For more information, contact Chris Lunsford at (907) 789-6008.

Slope Rockfish

Research

Gulf of Alaska

Species Identification of Young-of-the-Year Rockfish and Population Genetic Structure of Pacific Ocean Perch Collected in Offshore Waters of the Gulf of Alaska and Bering Sea – Young-of-the-year (YOY) *Sebastes* rockfish were collected as "bycatch" during Auke Bay Laboratory (ABL) Ocean Carrying Capacity surveys of juvenile salmon in the Gulf of Alaska (GOA) in 1998, 2000–2003, and in the Bering Sea in 2002. The YOY rockfish were caught in rope trawls towed near the surface in offshore waters of both regions. These collections are significant because very little is known about the species identification, distribution, habitat, and genetic structure of YOY rockfish in Alaska.

A pilot study of species identification using morphological analysis by Dr. Arthur Kendall (retired from AFSC's RACE Division) and mitochondrial DNA (mtDNA) analysis by ABL scientists in cooperation with Dr. A. J. Gharrett of the University of Alaska Fairbanks (UAF), revealed that the majority of the rockfish are Pacific ocean perch (*S. alutus*; POP). Six other species were also identified: shortraker, rougheye, dusky, darkblotched, widow, and yellowmouth rockfish. Results from this pilot study were presented at the University of Alaska Lowell Wakefield Symposium on North Pacific Rockfishes in affiliation with the annual American Fisheries Society meeting in Anchorage, September 2005.

In 2003 and 2004, the entire collection was processed for further analysis, resulting in a total of 2,072 POP-type fish sampled for population structure using genetic methods, a subset (600) of which was examined using mtDNA analysis to confirm species identification. Species identification analysis revealed that 95% of the fish were POP and 5% were other rockfish species. With funding from the North Pacific Research Board, Dr. Gharrett and graduate student Lisa Kamin began population structure analysis of the POP in 2005, using a suite of microsatellite DNA markers to determine the extent of genetic divergence between year-classes and between geographic locations. Charles Hutchinson (AFSC REFM Division) examined several otoliths across the size range of POP in the collection and determined the fish to be less than one year old, confirming their young-of-the-year status.

In 2004 and 2005, the species identification analysis for >400 fish was completed using genetic and morphological methods. A total of 12 species were identified. We anticipate two reports from this research: 1) species description at this life history stage using morphological features, and 2) a comparison of geographic distribution around the Gulf of Alaska within and between years.

For more information, contact Chris Kondzela at (907) 789-6084.

Habitat of Juvenile Rockfish in Offshore Waters of the Gulf of Alaska – During the summer of 2005, the Auke Bay Laboratory used the submersible *Delta* to explore habitat of juvenile rockfish in the Gulf of Alaska on Albatross Bank southwest of Kodiak Island and off Cape Ommaney and the Hazy Islands in southeast Alaska. Most of the dive sites were in areas that had been previously mapped and habitat-typed using high resolution multibeam sonar. Most juvenile rockfish were on shelf habitats at depths between 50 and 150 meters. On the shelf, juvenile rockfish were observed on several habitats, particularly high relief granite rock exposures and highly-fractured glaciated rock. Within these habitat types, larger juveniles (presumably aged 1-3 years) were often associated with cobble and boulder fields. In some cases, juveniles were observed taking cover in the interstices of closely packed cobbles. Young-of the-year rockfish were often in large schools hovering 1-10 m above the bottom and were rarely observed using cover. In low relief habitat (cobble pavement and hummocky habitats), most juveniles were solitary and used sponges and rocks for cover. Adult yelloweye rockfish and lingcod were observed preying on juvenile rockfish. Except for juvenile rosethorn, yelloweye, and redbanded rockfish, it was not possible to identify juveniles to the species level. Detection curves are being developed to quantify densities of juvenile rockfish in different habitat types. Future research includes development of methods to collect juvenile rockfish to identify species-specific habitat relationships.

For more information, contact Jon Heifetz at (907) 789-6054 or Kalei Shotwell at (907) 789-6056.

Juvenile Rockfish Distribution and Habitat – Chris Rooper continued to analyze sidescan and multibeam sonar and video data collected at the Islands of Four Mountains rockfish habitat study sites. A method for characterizing and mapping seafloor habitat using these data was developed and described in a manuscript that is currently undergoing internal review. He has also continued analysis of juvenile rockfish distribution and habitat use in the study area. A web site documenting the progress and results of this project has been launched on the AFSC web site at http://www.afsc.noaa.gov/race/groundfish/habitat/POP/pop_intro.htm.

For more information, please contact Chris Rooper, (206) 526-4689.

Adult Rockfish Benthic Habitat Associations in the Gulf of Alaska – Many species of commercially valuable rockfish (*Sebastes* spp.) inhabit waters on the outer continental shelf and upper slope in the Gulf of Alaska typically between depths of 100-500 m. The benthic habitat requirements and spatial distribution of these rockfish species are relatively unknown. Information regarding benthic habitat use would improve current stock assessments and provide baseline information for an ecosystem approach to management. Several study areas in the Gulf of Alaska have recently been mapped with high resolution multibeam bathymetry and backscatter to generate detailed benthic habitat maps. Large populations of rockfish have been surveyed and fished within these mapped areas.

The objectives of this study were to delineate habitat on two resolutions of classification, generate density estimates for rockfish using these methods, and identify useful predictors of rockfish distribution for use in stock assessments. We used a modified deep-water marine benthic habitat scheme for habitat classification. The larger scale used multibeam imagery for determining benthic habitat, while the smaller scale used direct observations of seafloor features from submersible video. In summer 2005, forty dive transects were completed on three mapped sites (Albatross Bank, Cape Ommaney, and Hazy Islands) in the Gulf of Alaska using the *Delta* two-person occupied submersible. We observed schooling behavior in dusky rockfish typically in the water column and Pacific ocean perch in very large schools over soft bottom. Numerous gravid females were found in cobbles and small boulder fields. Solitary individuals such as shortraker, rougheye, redbanded, and sharpchin rockfish were encountered in fairly distinct habitat types.

We identified habitat types with high densities of rockfish species within each classification method. In general, the multibeam classifications were too broad to be consistent with the high variability of the finer scale video classifications. However, when we compared the two classification methods using generalized features (i.e., boulder, sand, mud), densities for some species were more consistent, particularly on hard substrates such as boulders and cobble. We also considered depth as an additional factor for determining species distributions. Major commercial rockfish species were clearly delineated by depth, occupying specific ranges. This finding was consistent with previous studies on adult rockfish distributions. We concluded that

more general habitat classifications such as substrate hardness combined with depth might be a better predictor for rockfish species distributions over large areas.

For more information, contact Kalei Shotwell at (907) 789-6056, Jon Heifetz at (907) 789-6054, or Dana Hanselman at (907) 789-6626.

Localized Depletion in Alaskan Rockfish – Localized depletion is defined as the reduction in population size over a relatively small spatial area due to intensive fishing. Some rockfish distributions in Alaska are patchy, aggregated, and stationary; therefore, localized depletion may be a conservation concern. Fishing seasons are short and intense and confined to small areas. Localized depletion becomes problematic if it diminishes the ability of rockfish to replenish fished areas such that local spawning populations are eliminated.

To attempt to detect localized depletion, we examined areas of high fishing effort for Pacific Ocean perch (POP), northern rockfish, and dusky rockfish during 1991-2004. Eighteen blocks with areas of ~10,000 km^2 were selected that had regular rockfish harvests during these years in the Gulf of Alaska (GOA) and Aleutian Islands (AI). These areas were then halved to make 36 ~5,000 km^2 blocks to investigate scale in the detection of localized depletion. Of 249 area-year-species combinations analyzed, 43 produced significant negative slopes (indicating depletion) which exceeds the ~6 that would be expected by chance. Nine regressions had a significantly positive slope (inflation) which is about what is expected by chance. Overall, POP exhibited the most significant depletions in consistent areas. The Seguam Island area (AI) exhibited consecutive depletion during 2002-2004. However, these depletions did not seem to proceed where they ended in the previous year. Because the CPUE and the estimate of initial biomass are both similar at the start of the fishing year, the area may have been replenished by new fish or the fishery may have shifted to a nearby aggregation in the same area. POP may have shown the most depletion because it had the most data available and because it is the most targeted of the commercial rockfish fisheries.

Localized depletion in northern rockfish occurred in one year in the "Snakehead" area of the GOA in 1994. Some depletion of dusky rockfish appeared to occur in the same area and year. This area was fished heavily for northern rockfish in the 1990's, but is now only lightly fished. This is likely due to the serial annual depletion that is suggested by both the fishery and survey data. Clausen and Heifetz (2002) noted that 46% of the entire GOA catch of northern rockfish was taken from this area between 1990 and 1998. Overall these two species have not shown substantial intra-annual depletions since 1991. Several explanations of this may exist: 1) the local populations may be large enough compared to the existing catch limits that significant depletions do not occur; 2) there are insufficient data to detect real depletions that are happening; and 3) the data selection criteria were aimed at the complex of targeted rockfish. If the fishery begins each year by concentrating on POP until the catch limit is reached, then subsequently targets northern rockfish and finally dusky rockfish, depletion would be exaggerated for the first target and then underestimated for the final target.

For more information contact Dana Hanselman at (907) 789-6626.

Rockfish Catchability in Trawl Surveys – The survey catchability coefficient, or q, is of paramount importance for estimating stock size with contemporary assessment methodology. The catchability coefficient is a fixed or estimated parameter that scales a survey index to an absolute biomass estimate. In most cases for stock assessment of North Pacific groundfish, catchability is fixed at unity, or constrained near a value that is based on the judgment of the fishery biologist. When catchability is greater than unity, it implies that the fishing gear catches more fish than that of the area swept by the trawl net (herding), while below unity implies that the gear catches fewer fish than the area swept (gear avoidance). When the catchability coefficient is estimated within the stock assessment it is confounded with many other parameters, particularly selectivity, fishing mortality, and natural mortality. In addition, most stock assessments do not account for possible changes in catchability over time or in conjunction with changes in stock abundance. Most stock assessments would benefit from an independent estimate of catchability from empirical observations.

Several prior studies have attempted to do so by estimating the ratio of fish density between a bottom trawl survey and line transect methods with cameras or submarines. We reviewed some of these studies as applied to North Pacific groundfish and conducted our own submarine/trawl experiment in July 2005 near Kodiak Island, Alaska for rockfish. This experiment used eight submarine transects (made by the submersible *Delta*) and eight standard NMFS biennial survey trawl hauls to attempt to estimate survey catchability for an area of high rockfish abundance. With results of these line transect estimates versus survey trawl biomass estimates, we compared estimated catchability coefficients for several species and contrasted these estimates with values from the literature. Pacific ocean perch had a high catchability coefficient of near 2, rougheye rockfish were near 1, while shortspine thornyheads had a very low value of near 0.3. We contend that different catchability coefficients between species are often not caused by gear avoidance issues, but are either an artifact of confounded parameters in the stock assessment model or related to the density of fish in trawlable versus untrawlable habitat.
For more information, contact Dana Hanselman at (907) 789-6626 or Kalei Shotwell at (907) 789-6056.

Stock Assessment

Bering Sea and Aleutian Islands

Pacific Ocean perch (POP) – Beginning this year, POP assessments will be conducted on a two year cycle to coincide with the Aleutian Islands survey cycles. Since no survey was conducted in 2005, the assessment to determine the 2006 harvest is essentially the same as the previous year with the inclusion of the 2005 catch.

The 2004 assessment updated the previous assessment by including the 2004 Aleutian Islands survey results and the 2003 Aleutian Islands fishery age composition. The Aleutian Islands survey resulted in a biomass estimate of 579,000 t, a 23% increase over 2004 and the second highest estimate during the time-series. Stock assessment model results indicate that Pacific Ocean perch total and spawning biomass were at low levels in the 1970s and increased to the present high and stable levels.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying Pacific Ocean perch for management under Tier 3. The current estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ are 142,000 t, 0.048, and 0.058, respectively. Projected spawning biomass for 2006 is 133,000 t, placing POP in sub-tier "b" of Tier 3. The maximum F_{ABC} value allowed under Tier 3b is computed as follows:

$F_{ABC} = F_{40\%} \times (B_{2005} / B_{40\%} - 0.05)/(1-0.05) = 0.048 \times (133{,}000/142{,}000 - 0.05)/0.95 = 0.045$

Projected harvesting at a fishing mortality rate of 0.045 gives a 2006 ABC of 14,800 t, which is the recommended ABC. ABCs are set regionally based on the biomass apportionment as follows: BS = 2,920 t, Eastern Aleutians (Area 541) = 3,210 t, Central Aleutians (Area 542) = 3,165 t, Western Aleutians (Area 543) = 5,305 t. The OFL fishing mortality rate is computed under Tier 3b as follows:

$F_{OFL} = F_{35\%} \times (B_{2004} / B_{40\%} - 0.05)/(1-0.05) = 0.058 \times (133{,}000/142{,}000 - 0.05)/0.95 = 0.054$

Projected harvesting at a fishing mortality rate of 0.054 gives a 2006 catch of 17,600 t, which is the authors' and Plan Team's recommended OFL for the BSAI. The OFL for BSAI is not regionally apportioned. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The assessment authors presented an Appendix with the results of an analysis on the management consequences of maternal effect on fecundity and implications for stock productivity. The authors found that the reduced effectiveness of younger spawners resulting in reduced reproductive output conserved for a given fishing mortality tended to be counteracted by the increased resiliency in stock recruitment relationships due to an equivalent number of recruits associated with reduced reproductive output.

Northern rockfish – Beginning this year, northern rockfish assessments will also be conducted on a two year cycle to coincide with the Aleutian Islands survey cycles. Since no survey was conducted in 2005, the assessment to determine the 2006 harvest is essentially the same as the previous year with the inclusion of the 2005 catch.

The 2004 assessment updated the previous assessment with the 2004 Aleutian Islands survey results, 2004 catch and the age composition for the 2000 and 2003 Aleutian Islands fisheries. The combined 2004 Bering Sea and Aleutian Islands survey estimate of 192,000 t was a 9% increase over the 2002 combined estimate. The stock assessment model indicates that the northern rockfish stock has steadily increased from 133,000 t in 1977 to 200,000 t in 2004.

Northern rockfish, which had previously been managed under Tier 5, are now managed under Tier 3 due to the availability of reliable estimates for $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ (46,000 t, 0.049, and 0.059 respectively). Since the female spawning biomass (66,600 t) is greater than $B_{40\%}$, sub-tier "a" would be applicable. Under Tier 3a, the maximum permissible ABC would be 8,530 t, which is the recommendation for the 2006 ABC. Under Tier 3a, the 2006 OFL would be 10,100 t for the Bering Sea/Aleutian Islands combined. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Shortraker/rougheye rockfish – Since there was no Aleutian Islands survey in 2005, the assessment was not updated this year. The 2004 Aleutian Islands survey biomass estimates for shortraker and rougheye rockfish were 33,257 t and 15,039 t, respectively. These estimates are of the same magnitude of other surveys conducted in the Aleutian Islands since 1991. The stock assessment model indicates that the rougheye rockfish resource has slowly declined to 12,000 t, about half of the biomass estimated for 1980, the initial year in the model. Similarly, shortraker rockfish are estimated to have declined 25% from the 1980 biomass of 35,000 t to the 2005 estimate of 26,500 t.

Although a stock assessment model has been developed for these species and provides more reliable estimates of biomass than the trawl surveys, species identification in the commercial catch remains a problem. Therefore, these species remain in Tier 5 for the present time and also remain combined for management purposes.

F_{ABC} is set at the maximum permissible level under Tier 5, which is 75% of M. Accepted values for M for these stocks are: rougheye rockfish--0.025, shortraker rockfish--0.030. The authors recommended a combined BSAI 2006 OFL and ABC for shortraker rockfish of 774 t and 580 t and a combined BSAI 2006 OFL and ABC for rougheye rockfish of 299 t and 224 t. The management of these small OFLs will be challenging. These species are not targeted but are harvested incidentally in numerous target fisheries. It is not possible to determine whether these species are overfished or whether they are approaching an overfished condition because they are managed under Tier 5.

Other rockfish complex – The BSAI "Other Rockfish" also will be managed on a two year cycle in future years to coincide with years when an Aleutian Islands survey is conducted. This complex formerly consisted of 28 *Sebastes* and *Sebastolobus* species, but now considers only the 8 species that have been caught at least once during AFSC research surveys or appeared in more than 1% of observed fishery hauls between 1990 and 2001. The last assessment included 2004 Aleutian Islands and Bering Sea survey biomass, catches in the EBS and AI, updated length frequency data and analyses of growth of light dusky rockfish and shortspine thornyheads. The authors recommend assigning a separate ABC and OFL to shortspine thornyheads and leaving the remaining 7 rockfish species within the other rockfish complex. This recommendation was based on the fact that shortshine thornyheads are the most abundant and valuable species in the complex and inhabit deeper regions of the shelf and slope than the others. The authors recommend using Tier 5 criteria to assign separate ABCs and OFLs in the EBS and AI for shortspine thornyheads (using the 5-year survey average for biomass and M=0.07), and using Tier 6 (average catch from 1998-2002) criteria for the remaining species in the "Other Rockfish" complex.

The Tier 5ABCs and OFLs for thornyheads were based on biomass estimates that the author considered reliable. However, biomass estimates for the remaining "other rockfish" did not appear to be reliable. The actual catches of the remaining "other rockfish" species have been much larger (by a factor of 6) than the OFLs would have been had this species group been managed under Tier 5 in 1992-2002. This, combined with the fact that the Aleutian Island area survey biomass estimates for this group have generally increased for the last 13 years, suggested

that the biomass estimates for this group are unreliable. Using Tier 6 criteria for the remaining "other rockfish" resulted in an OFL that was similar to catches for 1999-2002. As with Tier 5, the Tier 6 OFL for this subgroup is inappropriate (i.e., it seemed unlikely that biomass would keep increasing for 13 years if catches had equaled or exceeded OFL on average). Therefore, thornyheads were not split from the "other rockfish" complex at this time.

For 2006, the ABCs and OFLs were set for the entire "other rockfish" complex including thornyheads. F_{ABC} was set at the maximum value allowable under Tier 5, which is 75% of M (0.07), or 0.053. Multiplying this rate by the best estimates of "other rockfish" biomass yields 2006 ABCs of 810 t in the EBS and 590 t in the AI. OFL was set for the entire BSAI area, which under Tier 5 is calculated by multiplying the best estimate of total biomass for the area by M (0.07), which yields an OFL of 1,870 t.

For further information, contact Paul Spencer at (206) 526-4248.

Gulf of Alaska

Pacific Ocean perch – Pacific Ocean perch (POP), *Sebastes alutus*, is the dominant fish in the slope rockfish assemblage and has been extensively fished along its North American range since 1940. Since 2005, Gulf of Alaska rockfish have been moved to a biennial stock assessment schedule to coincide with the biennial trawl survey. On odd years (such as 2005's assessment for the 2006 fishery) when there is new survey information, a full stock assessment is done. There were no major changes in the 2005 model from 2004. The groundfish trawl survey biomass estimate for Pacific ocean perch increased by 61% from 2003, and was relatively precise compared to previous large estimates. This large estimate was tempered by the model, but still resulted in an increase in spawning biomass and ABC. For the 2006 fishery, we recommended an ABC of 14,261 mt in the Gulf of Alaska. This ABC was up about 5% from the 2005 ABC of 13,575 mt. Female spawning biomass remains above $B_{40\%}$, with projected biomass stable.

For more information contact Dana Hanselman at (907) 789-6626.

Northern rockfish – A full assessment was completed for Gulf of Alaska northern rockfish in 2005 to coincide with the 2005 Gulf of Alaska biennial bottom trawl survey. The model was updated to include the 2005 survey biomass estimate, updated catch from 2004, preliminary catch for 2005, survey age composition from 2003, fishery age composition from 2004, and updated fishery age compositions with additional ages from a backlog of available otoliths for the years 1998 – 2004. Fishery length compositions were removed for the years 1998-2003, because fishery age compositions were utilized for these years. For northern rockfish, an alternative age-structured model was recommended that allowed for estimation of natural mortality with an informative log normal prior and estimation of average historical fishing mortality in computations of initial numbers at age in 1977. The model will be evaluated for implementation in 2006.

For more information contact Dean Courtney at (907) 789-6006.

Rougheye rockfish – In 2005, we formalized the use of the generic rockfish model as the primary assessment tool for rougheye rockfish (*Sebastes aleutianus*). This model followed the general framework of the model used to describe Pacific ocean perch stock status in the Gulf of Alaska which was developed in a workshop held at the Auke Bay Laboratory in February 2001. The model was constructed with AD Model Builder software and is a separable age-structured model with allowance for size composition data that is adaptable to several rockfish species. The data sets used include total catch biomass, fishery size compositions, trawl and longline survey biomass estimates and size compositions, and trawl survey age compositions.

New data added to the model were the 2003 survey age composition, estimated 2005 fishery catch and size composition, and estimated 2005 trawl and longline survey biomass estimates and size compositions. Consecutive trawl survey biomass estimates have remained relatively stable. New age agreement tests were conducted that allowed the development of an age error matrix based on rougheye rockfish specimens. Additionally, another method for determining the proportion of rougheye rockfish fishery catch in the shortraker/rougheye complex from 1993-2004 was considered. We provided results from three separate age-structured models to analyze the effects of the new age error structure and catch data. Models using the new age error structure had relatively similar fits and parameter estimates. We recommend the use of Model 3, which used the new age error structure based on rougheye ages and the more accurate estimates of rougheye rockfish fishery catch.

The estimate of current total biomass for rougheye rockfish is 37,449 mt. The projected ABC derived from the recommended model (Model 3) for 2006 is 983 mt which is about 2% lower than last year's ABC of 1,007 mt. The decrease in ABC is likely due to the decrease in the longline survey relative population weight in the 2005 survey. The stock is not overfished, nor is it approaching an overfished condition. Historical collections of age data are currently being processed by the AFSC age-and-growth unit, and we anticipate several more years of age data for future assessments.

For more information, contact Kalei Shotwell at (907) 789-6056.

Shortraker and other slope rockfish – Previously, shortraker rockfish and rougheye rockfish in the Gulf of Alaska were always combined in a single management category and were assessed together. Starting in 2005, however, the two species were divided for management purposes, and a separate assessment report is now done for rougheye rockfish. Shortraker rockfish and "other slope rockfish" are distinct management categories, but their assessments are presented in a combined report because both assessments are based on biomass estimates from trawl surveys, instead of modeling. Exploitable biomass for each management category was estimated by the average biomass in the three most recent biennial trawl surveys (2001, 2003, and 2005), excluding the estimated biomass in the 1-100 m stratum. The 1-100 m depth stratum was removed from the estimate because most rockfish in this stratum are small juvenile fish, and thus are not considered exploitable. This results in an exploitable biomass of 37,461 mt for shortraker rockfish and 93,552 mt for "other slope rockfish". Applying either an F=0.75M or an $F=F_{40\%}$ rate (depending on the species) to these values of exploitable biomass results in recommended ABCs for the Gulf of Alaska in 2006 of 843 mt for shortraker rockfish and 4,150 mt for "other slope rockfish".

Some potentially significant new information about shortraker rockfish became available in 2005. Charles Hutchinson at the AFSC age-and-growth unit completed a study on an experimental ageing technique for this species. Previously, attempts at ageing shortraker rockfish were not considered successful. The new study determined the first von Bertalanffy parameters for shortraker rockfish, and these parameters were used to indirectly compute an age of 50% maturity of 21.4 years for females. This method appears to be quite promising, and production ageing of shortraker rockfish could begin in 1-2 years. If so, this would allow development of an age-structured model for shortraker rockfish.

For more information contact Dave Clausen at (907) 789-6049.

Thornyheads

Stock Assessment

Gulf of Alaska

Although an age structured model has been developed for the thornyheads, the lack of age composition data from GOA trawl surveys, sablefish longline surveys, and improved length sampling from longline and trawl fisheries has prevented its use for determining ABC and TAC for these species. Thornyhead rockfish are commercially valuable species which are presently not targeted in a directed fishery but are caught incidentally as bycatch in directed fisheries for rockfish, flatfish and sablefish. The catch in recent years is well below the TAC and has been declining. The exploitable biomass for determining the harvest level is calculated as the average of the biomass estimates from the 2003 and 2005 trawl surveys, which is 98,158 t.

The ABC was determined using Tier 5 methodology by multiplying the exploitable biomass by M=0.03 and 0.75 giving 2,209 mt**.** The corresponding OFL recommendation results in 2,945 mt. The OFL fishing mortality rate under Tier 5 is set equal to the estimate of M, so F_{OFL}=0.03. Area apportionments for thornyhead ABC's in 2006 and 2007 are as follows.

Western	Central	Eastern	Total
513	989	707	2,209

For further information, contact Dr. James Ianelli (206) 526-6510.

Sablefish

Research

Bering Sea, Aleutian Islands, and Gulf of Alaska

2005 Sablefish Longline Survey – The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987-2005. The survey is a joint effort involving two divisions of the AFSC: ABL and RACE. It replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from 1978-94 and also samples gullies not sampled during the cooperative longline survey. In 2005, the twenty-seventh annual longline survey of the upper continental slope of the Gulf of Alaska was conducted, along with a similar survey of the eastern Bering Sea. One hundred-fifty-two longline hauls (sets) were completed between June 2, 2005 and September 1, 2005 by the chartered fishing vessel *Ocean Prowler*. Sixteen kilometers of groundline were set each day, containing 7,200 hooks baited with squid.

Sablefish (*Anoplopoma fimbria*) was the most frequently caught species, followed by giant grenadier (*Albatrossia pectoralis*), Pacific cod (*Gadus macrocephalus*), and arrowtooth flounder (*Atheresthes stomias*). A total of 81,460 sablefish were caught during the survey compared to 90,226 in 2004. A total of 4,244 sablefish, 566 shortspine thornyhead (*Sebastolobus alascanus*), and 58 Greenland turbot (*Reinhardtius hippoglossoides*) were tagged and released during the survey. Electronic temperature-depth tags were surgically implanted in 27 Greenland turbot. Four Greenland turbot tagged with electronic tags have been recovered by the fishery since tagging began in 2003. Length-weight data and otoliths were collected from 2,239 sablefish. Killer whales (*Orcinus orca*) took fish from the longline at four stations in the western Gulf of Alaska and two stations in the Bering Sea. Sperm whales *(Physeter macrocephalus*) were common near the vessel in the eastern Gulf, west Yakutat, and central Gulf regions and were observed taking fish from the line at ten stations.

Several special projects were conducted during the 2005 longline survey. Corals caught on the line were collected for identification and sample preservation. A seabird occurrence study was conducted for the fourth year which helps to address where and when certain seabird species occur in Alaska waters. Giant grenadier were sampled in the Southeastern and Yakutat areas to determine sexual maturity as part of a study that began in the 2004 longline survey. In addition, spiny dogfish were also sampled in the Southeastern and Yakutat areas for biological studies conducted by graduate students from the University of Alaska-Fairbanks and University of Washington. Finally, a two-day experiment was conducted off Yakutat to collect genetic tissues of rougheye rockfish (*Sebastes aleutianus*) and to investigate depth distribution patterns of "light" and "dark" color phases of rougheye rockfish.

For more information, contact Chris Lunsford at (907) 789-6008.

Auke Bay Laboratory Sablefish Tag Recovery Program – Processing tag recoveries and administration of the reward program continued during 2005. Total tags recovered for the year so far are 626, which includes 577 fish tagged as adults and 49 as juveniles. Four sablefish at liberty 32 years and one at liberty 33 years were recovered in 2005. These fish were all

released in Chatham Strait, Southeast Alaska, in 1972 or 1973. Four of the fish were recovered in Chatham Strait, but the fifth and oldest fish was recovered in outside waters in the vicinity of Cross Sound in northern Southeast Alaska.

Tagging continued on the 2005 sablefish longline survey, with 4,244 sablefish tagged and released. Database sablefish releases now total over 327,000 and recoveries total 26,575. Shortspine thornyheads and Greenland turbot are also tagged and released on the longline survey, and their records maintained in the sablefish tag database. To date there are 5,075 shortspine thornyhead and 1,002 Greenland turbot releases.

For more information, contact Nancy Maloney at (907) 789-6060.

Juvenile Sablefish Studies – Juvenile sablefish studies have been conducted by the Auke Bay Laboratory in Alaska since 1984 and were continued in 2005. A total of 611 juvenile sablefish (age 1+) were tagged with spaghetti tags and released during a cruise of the NOAA vessel *John N. Cobb* at St. John Baptist Bay near Sitka in April-May 2005. During the same cruise, an additional 87 juvenile sablefish were implanted with electronic archival tags. This relatively small bay is the only known location in Alaska where juvenile sablefish have been consistently found on an annual basis.

The electronic archival tags will provide information on juvenile sablefish behavior and habitat during their transition from nearshore rearing areas to the age at which they are intercepted by the fishery. Since 2003, a total of 322 electronic archival tags have been released on juvenile sablefish in St. John Baptist Bay. These tags record the temperature and depth experienced by the fish and are designed for recovery in the commercial fishery when the fish are age 2+ or greater.

For more information, contact Thomas Rutecki at (907) 789-6051.

Stock Assessment

Bering Sea, Aleutian Islands, and Gulf of Alaska

The 2005 sablefish assessment showed that sablefish abundance increased during the mid-1960's due to strong year classes from the 1960's. Abundance subsequently dropped during the 1970's due to heavy fishing; catches peaked at 53,080 mt in 1972. The population recovered due to exceptional year classes from the late 1970's; spawning abundance peaked again in 1987. The population then decreased as these exceptional year classes died off.

The longline survey abundance index decreased 2.5% from 2004 to 2005 and follows a 1% decrease from 2003 to 2004. These decreases follow recent increases, so that relative abundance in 2005 is 6% higher than in 2000. The fishery abundance index increased 6% from 2003 to 2004 (the 2005 data are not available yet). As a result of this increase, relative fishery abundance in 2004 returned to the same level as 2000.

Spawning biomass is projected to remain stable from 2005 to 2006, but decrease slightly in 2007. Sablefish abundance is moderate; projected 2006 spawning biomass is 38% of unfished

biomass. Abundance has increased from a low of 33% of unfished biomass during 1998 to 2000. The 1997 year class is an important part of the total biomass and is projected to account for 19% of 2006 spawning biomass. The 2000 year class likely is above average and should also account for 19% of spawning biomass in 2006. The 1998 year class, once expected to be strong, appears average.

We recommend a 2006 ABC of 21,000 mt for sablefish in federally managed waters of Alaska, based on an adjusted $F_{40\%}$ strategy. This ABC is identical to that recommended for 2005 and is lower than the 2004 ABC of 23,000 mt.

The apportionment of ABC between areas changed substantially in 2006 with a 7% decrease in the Gulf of Alaska and 18% and 25% increases in the Aleutian Islands and Bering Sea. The main reason for this high variability is because of a substantial change in the apportionment in the 2004 assessment in the opposite direction, which was caused by a combination of very low survey and fishery CPUEs in the Bering Sea and Aleutian Islands. The current apportionment returns to percentages that have been more characteristic of years prior to last year's assessment.

For more information, contact Dana Hanselman at (907) 789-6626.

Flatfish

Stock Assessment

Bering Sea

Yellowfin sole – The 2005 stock assessment incorporates the 2005 catch and survey biomass as well as the age compositions from the 2004 survey and 2004 catch. This 2005 EBS bottom trawl survey resulted in a biomass estimate of 2,768,000 t, an increase of 9% from 2004. The stock assessment model indicates that the stock has been slowly declining over the past twenty years, although still at a high level, due to recruitment levels which are less than those which built the stock to high levels in the late 1960s and early 1970s. The time-series of survey age compositions indicate that only 2 of the past 10 year classes have been above the long term average. The 2005 catch of 90,625 t represents the largest flatfish fishery in the United States and the average exploitation rate has been 5% the past five years for this stock. This assessment features an estimate of the relationship between survey catchability and annual mean bottom water temperature and also estimates a Ricker form of the spawner recruit relationship within the model. Results indicate that catchability, averaged over 23 years, = 1.27.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying yellowfin sole for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the assessment are 412,000 t, 0.11, and 0.14, respectively. Given that the projected 2006 spawning biomass of 484,800 t exceeds the estimate of $B_{40\%}$, ABC and overfishing recommendations for 2006 were calculated under sub-tier "a" of Tier 3. F_{ABC} was set at the $F_{40\%}$ (0.11) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2006 ABC of 121,400 t.

The overfishing level was also determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.14 gives a 2006 OFL of 144,000 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

In response to SSC recommendations, the authors analyzed stock-recruitment data to consider an alternative assignment of yellowfin sole harvest policy under Tier 1. The authors fit Ricker stock-recruitment curves to two different time-series of data (1954-1999 and 1978-1999) inside the model and obtained very different estimates of MSY and F_{msy} depending on which time-series was utilized. Concerns regarding the reliability of the stock-recruitment model fit to these data precluded their use to implement a tier 1 harvest strategy at this time.

Northern rock sole – Changes to the input data for the 2005 assessment include addition of the 2004 fishery age composition, 2004 survey age composition, and 2005 trawl survey biomass point estimate and standard error. The 2005 bottom trawl survey resulted in a biomass estimate of 2,119,000 t, a 3% decrease over last year's estimate of 2,182,000 t. The assessment continued the investigation of catchability (q) began in 2002. As in past assessments, a value of 1.4 obtained from a trawl "herding" experiment was used as the mean of a prior distribution on q. The updated value from this assessment gives a q estimate of 1.52. Natural mortality was estimated as a free parameter (with q constrained as stated above) giving the best fit at M = 0.16. The model estimates that the biomass of rock sole has increased the past two years after declining from a peak value observed in 1995. The increase is due to strong recruitment from the 2001 and 2002 year classes which are now entering the observable portion of the population. The model estimates the 2005 biomass of rock sole at 1,490,000 t, an increase of 4% over 2004 and about 20% less than the peak level observed in 1995.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore this stock qualifies for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 228,000 t, 0.15, and 0.18, respectively. Given that the projected 2006 female spawning biomass of 440,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2006 were calculated under sub-tier "a" of Tier 3. The recommended F_{ABC} is at the $F_{40\%}$ (=0.15) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2006 ABC of 125,000 t.

The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.18 gives a 2008 OFL of 149,600 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The authors responded to a request by the SSC to examine rock sole for possible management under Tier 1. In the case of rock sole, the time series of recruitment estimates from this assessment is 28 years. In the stock assessment model, a Ricker form of the stock-recruit relationship was fit to these data. Very different estimates of F_{MSY} and B_{MSY} were obtained depending on which years of data were included. Recent research indicates a decadal scale shift in atmospheric forcing, which may affect the recruitment of rock sole. Given these concerns, the authors plan to perform a simulation study to determine the appropriateness of applying a harvest strategy resulting from fitting the full time series for a fish stock experiencing temporal less

productive reproductive potential due to changing oceanic conditions. Therefore, management under Tier 1 is not recommended at the present time.

Flathead sole – The latest assessment updated the previous by incorporating new catch, discard, survey biomass, length composition, and age composition data. The 2005 trawl survey biomass estimate of 620,000 t was about 2% lower than last year's estimate of 629,000 t. Survey biomass has been relatively stable over the past four years compared to the decrease observed from 1998-2000. The assessment again investigated the relationship between temperature anomalies and survey biomass anomalies whereby the survey catchability coefficient was modeled as a function of the temperature anomalies. This addition had an effect on survey biomass estimates since 1998, during which time temperature fluctuations were greater.

Model estimates of age 3+ biomass indicate that the stock has steadily declined from a peak of 1,025,100 t in 1993 to the 2005 level of 632,100 t, a decline of 38%. The decline is attributable to a reduction in recruitment during the 1990s relative to that observed in the 1980s. The stock remains lightly harvested and well above $B_{40\%}$.

It has been determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying it for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 123,600, 0.30, and 0.36, respectively. Given that the projected 2006 spawning biomass of 233,800 t exceeds $B_{40\%}$, ABC and OFL recommendations for 2006 were calculated under sub-tier "a" of Tier 3 where F_{ABC} is set at the $F_{40\%}$ (=0.30) level, the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2006 ABC of 59,800 t. The OFL was also determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.36 gives a 2006 OFL of 71,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

At the request of the SSC, flathead sole productivity and estimation of F_{MSY} were investigated by fitting both Ricker and Beverton-Holt spawner recruit models inside the stock assessment model. Both spawner-recruit models were fit to all the data (1976-2000) and to just the post 1988 data. Very different estimates of stock productivity resulted from this analysis depending on which data set was used (the stock was much more productive when all the data were included). Also, density dependent factors may be confounding the interpretation of the effect of the regime shift on stock productivity. Thus the results of the estimation of MSY and F_{MSY} from the spawner-recruit models are not considered reliable at this time.

Alaska plaice – The 2005 assessment incorporated the 2005 shelf survey biomass estimate (503,900 t) and the 2005 catch data into the stock assessment model. The survey biomass estimate was 3% higher than in 2004. The stock is estimated to be at a high and stable level with relatively stable recruitment since the 1970s and a low level of harvest which is typically bycatch from other target fisheries. Catchability investigations do not indicate a temperature effect as shown for other shelf flatfish.

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore qualifying it for management under Tier 3. The updated point estimates are $B_{40\%}$ = 109,400 t, $F_{40\%}$ = 0.77, and $F_{35\%}$ = 1.08. Given that the projected 2006 spawning biomass of 208,200 t exceeds $B_{40\%}$, the

ABC and OFL recommendations for 2006 were calculated under sub-tier "a" of Tier 3. Projected harvesting at the $F_{40\%}$ level gives a 2008 ABC of 188,000 t. The OFL was determined from the Tier 3a formula, where projected harvesting at $F_{35\%}$ gives a 2006 OFL of 237,000 t. Because the age at 50% selection in the fishery is 10.3, Alaska plaice has the potential to spawn twice before it is recruited to the fishery. Additionally, the high natural mortality of 0.25 indicates that the lifetime spawner per recruit potential is rapidly reducing at the ages of highest fishing selectivity. Recruitment has been stable from the late 1970s through present. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The authors also analyzed stock-recruitment data to consider assessment of Alaska plaice under Tier 1. The authors fit both Ricker and Beverton-Holt stock recruitment curves using two different time series of data. The full time series (1979 – 2001) and the portion of the time series since the possible 1989 regime shift (1989-2001) were examined. Neither stock-recruitment curve fit the data well. Both curves imply that Alaska plaice is highly unproductive and that even a small fishery could not be maintained. The population has been fairly stable in recent years and the authors do not feel that the estimates of productivity implied by these stock-recruitment relationships are accurate, and therefore conclude that management of Alaska plaice under Tier 1 is not advisable at this time.

Other flatfish – The "other flatfish" complex currently consists of Dover sole, rex sole, longhead dab, Sakhalin sole, starry flounder, and butter sole in the EBS and Dover sole, rex sole, starry flounder, butter sole, and English sole in the AI. Starry flounder, rex sole, and butter sole comprise the vast majority of the species landed. For example, Starry flounder and rex sole comprised 90% of the "other flatfish" catch in 2005. Because of insufficient information about these species, no model analyses are possible. The latest assessment incorporates 2005 total catch and discard and 2005 trawl survey information. The 2005 EBS bottom trawl survey resulted in biomass estimates of 121,000 t, a decrease from the estimate of 143,000 t from the 2004 survey. The biomass of these species in the Aleutian Islands is 14,980 t from the 2004 survey, the highest observed since 1983.

"Other flatfish" are classified as Tier 5 species complex with an assumed natural mortality rate of 0.2. F_{ABC} was set at the 0.75 *M* level (=0.15), which is the maximum permissible level under Tier 5. Projected harvesting at the 0.75 *M* level gives a 2006 ABC of 18,100 t. The overfishing level was set with an F_{OFL} value of 0.20, giving a 2006 OFL of 24,100 t. It is not possible to determine whether the "other flatfish" complex is overfished or approaching an overfished condition because it is managed under Tier 5.

Greenland turbot – The 2005 assessment model incorporated new catch and length frequency data from the fishery. It also included an aggregated longline survey index and updated trawl survey information on biomass and length frequency data. Biomass and size composition data were also included from the EBS slope survey. The stock assessment model indicates that this stock has continued to decline due to the reduced recruitment levels observed in the last 20 years relative to the strong recruitment observed in the 1970s. The stock is still above the $B_{40\%}$ reference level and is lightly harvested. Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present

assessment are 47,400 t, 0.48, and 0.61, respectively. Projected spawning biomass for 2006 is 43,500 t.

Greenland turbot therefore qualify for management under Tier 3a. The maximum permissible value of F_{ABC} under this tier translates into a 2006 catch of 11,400 t. The assessment authors recommend setting the 2006 ABC at a value less than the maximum permissible. Using F_{ABC} = 5-year average results in a 2006 ABC of 2,740 t corresponding to a full selection fishing mortality rate of 0.095. The proposed harvest is apportioned by area on the basis of relative survey biomass, giving an EBS ABC of 1,827 t and an AI ABC of 913 t. The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} = 0.56$, and translates into an overfishing level of 14,200 t.

Arrowtooth flounder – The present assessment continues to utilize catchability as a function of the annual average bottom temperature during the EBS shelf trawl survey and also uses the EBS shelf trawl survey sex ratios as prior information to estimate sex-specific population numbers at age. This year's EBS shelf bottom trawl survey resulted in a biomass estimate of 757,700 t, the highest ever estimated on the shelf and 210,000 t higher than the 2004 estimated. A slope survey was conducted in 2004 and resulted in an estimate of 68,600 t. Combined, the two surveys represent the highest biomass estimate for arrowtooth flounder since the surveys began. The last eight year classes are all estimated to be at or above the time series average. The stock remains very lightly harvested with fish caught primarily as bycatch in other fisheries. Discarding occurs at a rate exceeding 50%.

Since more female arrowtooth flounder are caught in trawl surveys throughout Alaska compared to males, and because the oldest female fish have been determined to be older than the oldest males, it is hypothesized that there are different natural mortality values for each sex. With the female natural mortality rate fixed at 0.2, male natural mortality was profiled over a range of values to determine which value provided the best fit to all the observable population characteristics and still gave reasonable estimates of male selectivity to the survey trawl. The male natural mortality rate that provided the best fit was 0.33. With the stock assessment model configured in this way, the population biomass was estimated at 947,000 t, the highest level for the modeled abundance trend which begins in 1976.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying arrowtooth flounder for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 300,300 t, 0.26, and 0.32, respectively. Given that the projected 2006 spawning biomass of 666,800 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2006 were calculated under sub-tier "a" of Tier 3 by *se*tting F_{ABC} (=0.26) which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2006 ABC of 135,500 t. The OFL fishing mortality rate under Tier 3a is $F_{35\%}$ (=0.33), or a 2005 OFL of 166,100 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

For further information, contact Thomas Wilderbuer (206) 526-4224.

Gulf of Alaska

Arrowtooth flounder – The 2005 arrowtooth flounder assessment features new biomass and length composition data from the 2005 NMFS bottom trawl survey and updated catch and fishery length data for 2005. The model also includes survey age composition data from each survey except for 2005 (ages not determined yet). The 2005 estimated age 3+ biomass of 2,109,700 mt is based on abundance estimates derived from an age structured model and indicates that the population is at a historical (past 40 years) high level. Data from halibut trawl surveys in the 1960's, groundfish trawls in the 1970's, and NMFS triennial trawl surveys from 1984 to 2005 were included in the model. Similar to the previous assessment, the model matched the observed higher proportion of females in the larger size intervals of both survey and fishery data by allowing males a higher mortality rate than females.

The ABC estimate was based on Tier 3a calculations due to the fact that the estimated 2005 female spawning biomass (1,095,700 mt) is greater than the $B_{40\%}$ estimate (545,900 mt). Therefore, $F_{OFL}=F_{35\%}=0.168$ and $F_{ABC}=F_{40\%}=0.142$ resulting in an ABC recommendation of 177,844 t. The overfishing level for arrowtooth flounder is estimated to be 207,700 mt. The Plan Team recommended that ABC be apportioned among regulatory areas in proportion to biomass distributions in the 2005 trawl survey as follows:

Western	Central	West Yakutat	East Yakutat/SE	Total
20,154	134,907	15,954	6,830	177,844

Gulf of Alaska flatfish – New data for the 2005 flatfish assessment included the 2005 NMFS bottom trawl survey biomass estimates and the 2005 catch. The 2005 survey biomass estimates were used to calculate ABC's for 2006 for all species except Greenland turbot and deepsea sole, where the mean catch from 1978 to 1995 was used. The survey sampled to 700 m depth while the distribution of these deep water species extends deeper. Dover sole, the main constituent of the deep water group, is now assessed in using an age structured model. These stocks remain lightly harvested relative to their estimated biomass because the annual catch is almost always less than the TAC levels which are typically set less than the ABC.

The flatfish group is subdivided into arrowtooth flounder, deep water flatfish, flathead sole, rex sole and shallow water flatfish. Flathead sole and arrowtooth flounder, and rex sole are presented in separate assessments using age-structured models. The 2006 exploitable biomass for each group (except for those species with age-structured models) is based directly on results from the 2005 NMFS trawl survey. ABC and OFL were calculated by species, with individual species identified as Tier 4, 5, or 6 depending upon the available data. The ABC's for northern and southern rock sole were estimated based on Tier 4 with $F_{ABC}= F_{40\%}$ (Southern rock sole $F_{40\%}=0.162$; Northern rock sole $F_{40\%}=0.204$) and $F_{OFL}=F_{35\%}$ (southern rock sole $F_{35\%}=0.192$; northern rock sole $F_{35\%}=0.245$) while other flatfish ABC's were estimated with $F_{ABC}=0.75$ M and $F_{OFL}=$M (Tier 5).

The stock assessment model for Dover sole indicates that age 3+ biomass estimates increased slightly while female spawning biomass estimates continue to remain relatively unchanged. Recruitment may have been high in 2002 and catches remain well below the TAC. The 2006

ABC using $F_{40\%}$ = 0.142 was estimated at 8,842 t, which is 1,842 t more than the 2005 ABC. The 2006 OFL using $F_{35\%}$= 0.184 was estimated at 10,764 t.

Greenland turbot and deep-sea sole ABC's were estimated at Tier 6 with ABC=0.75 OFL (183 t) and OFL=average catch from 1978 to 1995 (244 t). Total flatfish ABC for 2006 was 1,225 mt greater than in 2005. ABC's were apportioned among the regulatory areas by applying the average fraction of the survey biomass in each area in 2005. As in 2005, the ABC was split between the eastern GOA and the WY and EYAK/SEO sub areas.

2006 ABC area apportionment:

Flatfish Group	Western	Central	WYAK	EYAK/SEO	Total
Deep Water	420	4,139	2,661	1,445	8,665
Shallow Water	24,720	24,258	628	1,844	51,450

Flathead sole – New data for the 2005 flathead sole assessment includes the 2005 survey biomass estimate and length data, and 2005 catch and fishery length data. Maturity parameters were updated and estimates of reference fishing mortality were estimated from spawner per recruit analysis. The 2006 biomass estimate from the age-structured model was 291,400 t, continuing a stable trend since the mid 1980s.

The projected 2006 female spawning biomass is estimated to be well above the $B_{40\%}$ level therefore flathead sole ABC and OFL are calculated using Tier 3a calculations. Under this definition, $F_{OFL}=F_{35\%}$, and F_{ABC} is less than or equal to $F_{40\%}$. The ABC for 2006 using $F_{40\%}$ = 0.36 was estimated at 37,820 mt. The overfishing level using $F_{35\%}$ = 0.46, results in 47,003 mt. Area apportionments of flathead sole ABC's for 2006 (using $F_{40\%}$) are based on the fraction of the 2005 survey biomass in each area:

Western	Central	West Yakutat	East Yakutat/SE	Total
10,548	25,195	2,022	55	37,820

For further information, contact Jack Turnock (206) 526-6549 and William Stockhausen (206) 526-4241.

Walleye Pollock

Research

Echo Integration-Trawl Surveys

Gulf of Alaska

Winter echo integration-trawl surveys in the vicinity of Shumagin Islands and Sanak Trough, Shelikof Strait, and the shelf break near Chirikof Islands – The MACE Program conducted a winter echo integration-trawl (EIT) survey aboard the NOAA ship *Miller Freeman*, which targeted walleye pollock in the Shumagin Islands and Sanak Trough. The

Shumagin Islands portion of the survey was conducted between 11-14 and 16-19 February along parallel transects. Transects were spaced 5-nmi apart within Shumagin Trough, 1-nmi apart east of Renshaw Point, and 2.5-nmi apart elsewhere. The Sanak Trough survey was conducted between 15-16 February along transects spaced 2-nmi apart.

In the Shumagin Islands, the densest pollock aggregations were observed off Renshaw Point and in northern Unga Strait. Pollock size compositions were generally unimodal and mean estimates of fork lengths (FL) ranged around 46-48 cm. Thus, fish caught off Renshaw Point, in West Nagai Strait, and in Stepovak Bay were characterized by a mean FL of 47 cm, fish in Unaga Strait by a mean FL of 48 cm, and fish in Shumagin Trough by a mean FL of 46 cm. Few fish shorter than 40 cm FL were observed anywhere in the area. The unweighted maturity composition for males longer than 40 cm was 0% immature, 12% developing, 49% pre-spawning, 33% spawning, and 7% spent. The female maturity composition of fish longer than 40 cm was 0% immature, 8% developing, 64% pre-spawning, 5% spawning, and 23% spent. The mean gonado-somatic index (GSI: ovary weight/body weight) for mature pre-spawning females was 0.13. Pollock EIT survey abundance estimates in the Shumagin Islands area were 64 million fish weighing 52,000 metric tons (t), based on catch data from 10 trawl hauls and acoustic data from 390-nmi of survey transects. The area off Renshaw Point accounted for 56% of the biomass.

The densest pollock aggregations in Sanak Trough were detected in the southern part of the trough off Sanak Island. Most of these pollock exceeded 40 cm FL although some were about 25-29 cm FL. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 2% developing, 32% pre-spawning, 59% spawning, and 6% spent. The female maturity composition of fish longer than 40 cm FL was 0% immature, 6% developing, 70% pre-spawning, 7% spawning, and 17% spent. The average GSI for pre-spawning females was 0.15. The abundance estimates for Sanak Trough were 72 million fish weighing 66,000 t, based on catch data from 6 trawl hauls and acoustic data from 108-nmi of survey transects.

The MACE Program also conducted winter EIT surveys aboard the NOAA ship *Miller Freeman*, which targeted walleye pollock in the Shelikof Strait area and southeast of Chirikof Island. The Shelikof Strait sea valley was surveyed from north Kuliak Bay on the Alaska Peninsula to south of Chirikof Island during 24-29 March along parallel transects spaced 7.5-nmi apart. A survey of the shelf break southeast of Chirikof Island to near the mouth of Barnabas Trough was conducted during 30 March-3 April along parallel transects spaced 6-nmi apart.

In the Shelikof Strait area, dense aggregations of mature, pre-spawning pollock were detected from Kuliak Bay to Cape Unalishagvak, and significant quantities of adult pollock were detected south of the Strait proper (between Cape Ikolik and Wide Bay) to about 56°N. Pollock in the near-bottom echosign between Kuliak Bay and Cape Unalishagvak on the western side of the Strait were mostly 35 to 50 cm FL (1999 and 2000 year classes), and pollock in the near-bottom echosign south of Cape Ikolik and on the Kodiak Island side of the Strait were mostly 9-16 and 17-24 cm FL (1-and 2-year old pollock), although adults dominated by weight. Mid-water pollock layers in the southern portion of the survey area were primarily 9-16 cm FL (age-1). The unweighted maturity composition for males longer than 40 cm was 0% immature, 3% developing, 24% pre-spawning, 72% spawning, and 0% spent. The female maturity composition

of fish longer than 40 cm was 0% immature, 16% developing, 75% pre-spawning, 7% spawning, and 1% spent. These results are similar to previous survey results in terms of the relatively low numbers of spawning and spent female fish, which suggests that the survey timing was appropriate. A logistic model provided a reasonable fit to the female maturity-at- length data and predicted that 50% of females were mature at a length of 41 cm. The average GSI for mature pre-spawning females was 0.15. The pollock abundance estimates for Shelikof Strait were 2.3 billion fish weighing 356,000 t, based on catch data from 23 trawl hauls and acoustic data from 950-nmi of survey transects.

Along the Chirikof shelf break, most echosign attributed to pollock occurred in midwater layers between 275-500 m depth near W154° over bottom depths of 350-800 m. Pollock size composition in these layers ranged from 30-67 cm, with a mode at about 46 cm FL. The unweighted maturity composition for males longer than 40 cm was 0% immature, 1% developing, 17% pre-spawning, 60% spawning, and 21% spent. The female maturity composition of fish longer than 40 cm was 0% immature, 12% developing, 47% pre-spawning, 8% spawning, and 33% spent. The high percentage of spawning and post-spawning females indicates that peak spawning may have already occurred. The average GSI for pre-spawning females was 0.17. The pollock abundance estimates for the Chirikof Island area were 95 million fish weighing 77,000 t, based on catch data from 6 trawl hauls and acoustic data from 162-nmi of survey transects.

Summer GOA echo integration-trawl survey along the shelf and shelf break, Shelikof Strait, Barnabas Trough, and Chiniak Trough – An EIT survey of the Gulf of Alaska (GOA) was conducted from July 1-30, 2005 aboard the new NOAA research vessel *Oscar Dyson*. The survey design consisted of parallel transects at 20-nmi spacing over the GOA shelf and shelf break from the Islands of Four Mountains eastward to near the Shumagin Islands, and then seaward of the shelf break from the Shumagin Islands eastward to Amatuli Trough. Alternate transect pairs extended about 30-nmi beyond the shelf break. Barnabas and Chiniak Troughs were surveyed using 6-nmi spacing, and Shelikof Strait was surveyed using 10- or 20-nmi spacing. Echo integration and trawl data that were used for the pollock abundance estimates were collected during daylight hours only. Nighttime operations included additional trawling, physical oceanographic sampling, and re-running portions of transects for day-night comparisons. Several regions that had substantial pollock quantities during the 2003 GOA survey, including the Shumagin Island's area, Nakchamik Island area, Alitak Bay, and Marmot Bay were not surveyed due to vessel operating restrictions.

Pollock was the most abundant species caught in the 28 midwater hauls, comprising 59% of the total catch by weight, and followed by Pacific ocean perch (35%). In the 10 bottom trawl hauls, Pacific ocean perch (32%) was the most abundant species caught, followed by pollock (20%) and Atka mackerel (20%). Euphausiids (41%) were the dominant species in macro-zooplankton trawl hauls.

Walleye pollock were detected in all areas of the survey except along the offshore transects. Most of the adult pollock echosign was detected along the shelf break south of Kodiak Island, and in Chiniak and Barnabas Troughs. Pollock comprised unimodal size distributions that centered around 48 cm FL along the shelf and shelf break, around 51-53 cm FL in Chiniak

Trough, and around 52-54 cm FL in Barnabas Trough. A few smaller pollock were also detected in Chiniak Trough (15-22 cm FL). Dense aggregations of juvenile pollock along with some adult pollock were detected in Shelikof Strait. Pollock size composition in Shelikof Strait ranged from 12-61 cm FL with the primary mode at 17 cm FL. Based on 2,093-nmi of transects and 38 trawl hauls, the pollock abundance estimate for the entire region surveyed was 1,442 million fish weighing 224,000 t. Shelikof Strait accounted for most of the pollock abundance (89.54%) and about a third of the biomass (36.44%) of the entire summer survey area. Areas along the shelf and shelf break accounted for 8.94% of the abundance and about half of the pollock biomass (51.22%). Chiniak and Barnabas Troughs had similar quantities relative to the rest of the survey area (Chiniak: 0.89% by number, 6.72% by weight; Barnabas: 0.63% by number, 5.62% by weight).

Bering Sea

Winter echo integration-trawl survey - in the southeast Aleutian Basin near Bogoslof Island – The MACE Program conducted an echo integration-trawl (EIT) survey aboard the NOAA ship *Miller Freeman* during March7-12, which targeted walleye pollock in the southeastern Aleutian Basin near Bogoslof Island. The survey was conducted along 22 north-south parallel transects spaced 5-nmi apart, which covered 3,112 nmi^2 of the Central Bering Sea Convention Specific Area.

Pollock were concentrated northeast of Umnak Island off Cape Idak, and just north of Samalga Pass between the Islands of Four Mountains and Umnak Island. Although pollock ranged between 37 cm and 73 cm FL for each of the two regions, pollock off Cape Idak were predominately 42-45 cm FL (2000 year class), while most of the pollock in the Samalga Pass area were about 59-63 cm FL. The unweighted maturity composition for males was 0% immature, 4% developing, 27% pre-spawning, 68% spawning, and 1% spent. The female maturity composition was 0% immature, 12% developing, 63% pre-spawning, 6% spawning, and 19% spent. The average GSI for mature pre-spawning females was 0.18. The pollock abundance estimates for the southeastern Aleutian Basin area were 225 million fish weighing 253,000 t, based on catch data from 19 trawl hauls and acoustic data from 622-nmi of survey transects. This was the highest abundance estimated since the 2000 Bogoslof EIT survey. About 66% of the total biomass was in the Samalga Pass region.

For more information, please contact Chris Wilson, (206) 526-6435.

Stock Assessment

Gulf of Alaska

The age-structured model developed using AD Model Builder and used for GOA pollock assessments in 1999-2002 is fundamentally unchanged for the 2006 assessment. This year's pollock assessment features the following new data: (1) total catch and age composition from the 2004 fishery; (2) biomass and age composition from the 2005 Shelikof Strait echo integration trawl (EIT) survey; (3) biomass and length composition from the 2005 ADF&G

crab/groundfish trawl survey, and (4) 2005 NMFS bottom trawl survey biomass and size composition estimates.

The results from the different surveys did not indicate any consistent trend in Pollock biomass. The 2005 NMFS bottom trawl survey biomass estimate decreased 10% from the 2003 estimate. The 2005 Shelikof Strait EIT survey biomass estimate remained similar to the 2004 estimate, but the biomass was redistributed, appearing higher in Kodiak and lower in the western GOA. Biomass estimates of Shelikof Strait fish > 42 cm (a proxy for spawning biomass) increased by 78% over last year, primarily due to maturation of the relatively strong 1999 and 2000 year classes and the redistribution of biomass towards the central GOA. The 2005 ADF&G crab/groundfish survey biomass estimates decreased 20% from 2004.

The stock assessment authors evaluated four models: Model 1 estimated the NMFS trawl survey catchability; Model 2 fixed trawl survey catchability at 1.0 (similar to previous assessments) and estimated other catchabilities; Model 3 was similar to 2, except that the weights used to fit the model to the ADF&G survey time series were reduced; Model 4 was similar to Model 2 except that the weights used to fit the model to the EIT survey time series were reduced.

There is concern regarding the apparent lack of strong recruitment since the 2000 year class and the attendant projected decline in biomass after 2006. Therefore, Model 2 is the model of choice, since it fixes survey catchability at 1.0 which represents a more conservative approach to the estimate of Pollock biomass. Model 2 estimates 2006 spawning biomass at 193,092 t, or 35% of the unfished spawning biomass level. The $B_{40\%}$ estimate is 224,000 t, thus GOA Pollock are managed in Tier 3b. The projected 2006 3+ total biomass estimate is 608,370 t. Markov chain Monte Carlo analysis indicated the probability of the stock being below $B_{20\%}$ to be less than 1% in 2006 and subsequent years. The 2006 OFL under Tier 3b is 110,100 t (F_{OFL}=0.27). Spawning biomass is projected to decline after 2006 until at least 2008 due to a lack of significant recruitment since the 2000 year class. While there are some indications of a potentially strong 2004 year class, it is not included in projections at this time. The ABC for 2006 based on Model 2 abundance estimates and Tier 3b harvest calculations is 80,390 t for GOA waters west of 140 degrees W longitude.

No new survey information is available for pollock east of 140 degrees W. longitude (Southeast Alaska). Southeast Alaska pollock are in Tier 5 and the ABC and OFL recommendations based on natural mortality (0.30) and the biomass from the 2005 survey. This results in a 2006 ABC of 6,157 t (27,362 t * 0.75 M) and a 2006 OFL of 8,209 t (27,362 * M).

For more information, contact Dr. Martin Dorn 526-6548.

Eastern Bering Sea

The Eastern Bering Sea Pollock resource remains at a high and stable level while sustaining average annual harvest levels greater than 1 million tons. The 2005 stock assessment incorporated revised estimates of age composition from the 2005 Echo integration survey (EIT) as well as the 2005 bottom trawl survey estimate and the 2005 fishery information. The 2005 bottom trawl survey estimated a biomass of 5,130,000 t, an increase of 37% from the 2004

estimate. The estimates of average weight at age from the fishery were revised with more recent measurements.

Six alternative models approaches were considered, all of which follow the statistical age-structured approach that has been used for the last several years. All of the models give point estimates of 2006 age 3+ biomass in the range 7,610,000 t to 11,810,000 t. The assessment authors based their recommendations for 2006 on the reference model (Model 1), which is identical to last year's model. The current assessment provides estimates of the biomass time series that are in close agreement with those from last year except the new estimates are slightly higher for recent years. This increase is due in part to an increase in the estimated strength of the 2000 year class. This estimate of the 2000 year class has increased in each of the past assessments and was stronger this time due to its presence in the 2005 bottom trawl survey and the revised age composition from the 2004 EIT survey. This is in contrast to the other estimates of year class strength since 1996 which appear weaker than average with the exception of the 1999 year class.

The SSC of the NPFMC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for this stock, and that EBS walleye pollock therefore qualify for management under Tier 1. The senior assessment author continues to feel that the Tier 1 reference points are reliably estimated given the structure of the model. The updated estimate of B_{MSY} from the present assessment is 2,120,000 t, compared to 2,230,000 t from last year's *NPFMC Bering Sea and Aleutian Islands SAFE assessment*. The projected spawning biomass for 2006 is 3,220,000 t, placing EBS walleye pollock in sub-tier "a" of Tier 1. As in last year's assessment, the maximum permissible ABC harvest rate was based on the ratio between MSY and the equilibrium age 3+ biomass corresponding to MSY. The harmonic mean of this ratio from this year's assessment is 0.235, very close to the value obtained in last year's assessment. This ratio is multiplied by the geometric mean of the projected age 3+ biomass for 2006 (8,050,000 t) to obtain the maximum permissible ABC for 2006, which is 1,930,000 t. This ABC is about 3% higher than the 2006 yield corresponding to an *F40%* strategy, which is 1,888,000 t.

The overfishing harvest ratio under Tier 1a is 0.250, the arithmetic mean of the ratio between MSY and the equilibrium age 3+ biomass corresponding to MSY. The product of this ratio and the geometric mean of the projected age 3+ biomass for 2006 (8,230,000 t) gives the overfishing level for 2006 of 2,090,000 t. The walleye pollock stock in the EBS is not overfished and is not approaching an overfished condition.

Aleutian Islands

In last year's assessment, preliminary explorations of several age-structured models were provided for the first time, all of which focused on the portion of the stock to the west of 174°W. In this year's assessment, five alternative age-structured models were developed and evaluated. The assessment focuses on two of those models, one of which (Model 1) uses data only from the portion of the stock to the west of 174°W, and the other of which (Model 1B) includes survey data from the entire Aleutian Islands management area. The time series of survey biomass estimates for the entire Aleutian Islands management area tends to show greater year-to-year consistency than the time series for the portion west of 174°W. For example, the 2002 and 2004

estimates for the entire Aleutian Islands management area are 175,283 t and 130,451 t, respectively, whereas the corresponding estimates for the portion west of 174°W are 121,915 t and 19,201 t, respectively. The SSC continues to use a precautionary approach for 2006 and sets ABC from the Tier 5 harvest strategy for Aleutian Islands Pollock where F_{ABC} is calculated as 0.75 * M. With M=0.3 the ABC harvest level is 29,400 t and the overfishing level is 39,100 t. As a Tier 5 stock, it would not be possible to determine whether Aleutian pollock is overfished or whether it is approaching an overfished condition.

Bogoslof

The 2005 hydroacoustic survey of the Bogoslof region resulted in a biomass estimate of 253,000 t, an increase of 28% from 2003 (no survey in 2004). Prior to this year, the Bogoslof Pollock stock was managed on the basis of the most recent survey biomass estimate. In this years assessment 7 new age-structured models were presented. Based on the recommended model, it is estimated that age 5+ biomass peaked in 1983 at 5 million t, primarily from support of the 1978 year class. Following the decline from this peak level, biomass has been fairly stable since 1992. Since non of the models contains catch information from the donut hole area (thought to be all from the Bogoslof stock), Tier 5 calculations of ABC are still used to set the 2006 harvest.

Last year, the SSC determined that Bogoslof Pollock qualified for management under Tier 5. The maximum permissible ABC under Tier 5 is 75% of the product of the natural mortality rate (0.20) and biomass, giving a value of 29,700 t. The overfishing level under Tier 5 is the product of the natural mortality rate and biomass, giving an OFL of 39,600 t for 2005. As a Tier 5 stock, it is not possible to determine whether Bogoslof pollock is overfished or whether it is approaching an overfished condition.

For further information, contact Dr. James Ianelli, (206) 526-6510.

Dogfish

Research

NMFS Auke Bay Laboratory and University of Alaska Fairbanks Joint Research on Spiny Dogfish in the Gulf of Alaska

Scientists from the NMFS Auke Bay Laboratory, the University of Alaska School of Fisheries and Ocean Sciences, and the University of Washington School of Aquatic and Fishery Sciences continued a joint study on spiny dogfish (*Squalus acanthias*) in the Gulf of Alaska. Little is known about the life history or ecological role of spiny dogfish in the North Pacific despite the fact that they comprise a relatively large biomass in coastal northeast Pacific waters. One aspect of this research is to collect a time series of life history and ecological information from spiny dogfish in Yakutat Bay where they are commonly encountered as bycatch.

In 2005, a total of 807 spiny dogfish were captured in Yakutat Bay for tagging and biological sampling aboard the chartered commercial fishing vessel *Sea View*. Electronic archival tags were surgically implanted in 62 spiny dogfish. A fluorescent pink disc tag with the words "reward for tag inside fish" was attached to the first dorsal fin of each electronically tagged spiny

dogfish. The Auke Bay Laboratory is offering a $200 reward for return of the electronic archival tags. 595 spiny dogfish were tagged with externally attached modified anchor tags. Anchor tags are uniquely numbered on one side and have the Auke Bay Laboratory address printed on the other side. 138 spiny dogfish were taken for biological sampling including lipid analysis, age determination from dorsal spines, maturity, and diet.

For more information, contact Dean Courtney at (907) 789-6006.

Other Species

Research

Electronic Tagging of Pacific Sleeper Shark in Upper Chatham Strait, Southeast Alaska
Scientists from the NMFS Auke Bay Laboratory continued electronic tagging studies of Pacific sleeper sharks (*Somniosus pacificus*) in the Gulf of Alaska. Pacific sleeper sharks are a deepwater shark of the North Pacific Ocean. Little information is available for Pacific sleeper sharks, although they are considered common in boreal and temperate regions of shelf and slope waters of the North Pacific. Pacific sleeper sharks are captured incidentally in commercial longline fisheries for halibut and sablefish in the Gulf of Alaska. Pacific sleeper sharks are not retained in commercial fisheries, but the incidental bycatch provides an opportunity for tagging research. The recovery of temperature, depth, and location from electronic tags will aid in the identification of Pacific sleeper shark habitat utilization and distribution, and identify potential interactions between Pacific sleeper sharks and other species in the Gulf of Alaska.

In 2005, a total of 44 Pacific sleeper sharks were captured in upper Chatham Strait, Southeast Alaska aboard the chartered commercial fishing vessel *Williwaw*. Average length was 210 cm for both males and females. Electronic archival tags were attached externally to the first dorsal fin of 41 Pacific sleeper sharks. A fluorescent orange anchor tag was attached dorsally to each electronically tagged Pacific sleeper shark. The Auke Bay Laboratory is offering a $200 reward for return of the electronic archival tags.

For more information, contact Dean Courtney at (907) 789-6006.

Stock Assessment

Shark Bycatch in Alaskan Waters
The shark stock assessment chapter from 2004 for the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) was updated for 2005 and presented to the North Pacific Fishery Management Council BSAI Plan Team in November 2005 and to the Scientific and Statistical Committee in February 2006.

Incidental catch estimates for sharks by species in the BSAI and GOA were updated for the years 2003, 2004, and 2005 with estimates provided by the NMFS Alaska Regional Office. Previous incidental catch estimates were available for the years 1997 – 2002. Eastern Bering Sea shelf survey biomass data were updated for 2005. Previous survey data were available from NMFS AFSC bottom trawl surveys in the Eastern Bering Sea (EBS) shelf (1979 – 2004), EBS slope

(historical 1979-1991, and new time series 2002, 2004), Aleutian Islands (1980 – 2002), and GOA (1984 – 2003).

There are currently no directed commercial fisheries for shark species in federally or state managed waters of the BSAI or GOA and most incidentally captured sharks are not retained. In the BSAI, average bycatch of Pacific sleeper sharks from 1997 – 2005 (408 tons) represented 2% of the available Pacific sleeper shark biomass from BSAI bottom trawl surveys 1996 – 2005 (Total of average biomass from three surveys 17,647 tons). Historical BSAI survey catches of Pacific sleeper sharks were rare, and abundance trends from the surveys were unreliable as evidenced by the high uncertainty in the biomass estimates. The new EBS slope bottom trawl survey (2002 and 2004) showed a substantial biomass of Pacific sleeper sharks on the EBS slope in 2002 (25,445 mt) but not in 2004 (2,260 mt). Consequently, biomass estimates from this survey varied widely for Pacific sleeper sharks from year to year. Spiny dogfish and salmon sharks were rarely encountered in commercial fisheries or bottom trawl surveys in the BSAI. Therefore, spiny dogfish and salmon sharks were not assessed separately in the BSAI.

In the GOA, average bycatch of spiny dogfish from 1997 – 2005 (345 tons) represented less than 1% of the available spiny dogfish biomass from GOA bottom trawl surveys in 1996 – 2003 (average of 47,685 tons). The 2001 survey did not include all areas of the Eastern GOA; hence, it may not be comparable with the other surveys for species such as spiny dogfish which appear to be relatively abundant in the Eastern GOA. Average bycatch of Pacific sleeper sharks from 1997 – 2005 (240 tons) represented less than 1% of the available Pacific sleeper shark biomass from GOA bottom trawl surveys 1996 – 2003 (average of 32,568 tons). Average bycatch of salmon sharks from 1997 – 2005 (53 tons) was relatively small, and GOA bottom trawl survey biomass estimates for salmon sharks were unreliable because salmon sharks were only caught in three hauls from 1996 – 2003.

For more information, contact Dean Courtney at (907) 789-6006.

Grenadiers in Alaska

In 2005, the Auke Bay Laboratory, in collaboration with the AFSC Resource Ecology and Fishery Management Division (REFM), updated an analysis of data on grenadiers in Alaska that was originally prepared in 2004. Results of this analysis were incorporated as a section in the Ecosystem Considerations Appendix to the annual Stock Assessment and Fishery Evaluation (SAFE) report that is prepared for the North Pacific Fishery Management Council (NPFMC). Also in 2005, the NPFMC's Scientific and Statistical Committee requested that a preliminary stock assessment for Alaska grenadiers be prepared for the first time. This assessment was necessary because of the possibility that grenadiers may be included in the NPFMC's Groundfish Management Plans. Presently, grenadiers are not "specified" in these management plans, and thus no previous assessments have been done, and fishermen are free to catch as many of these fish as they want.

Giant grenadier (*Coryphaenoides acrolepis*) appears to be the only grenadier species to warrant management concern in Alaska at the present. Survey information indicates that giant grenadier is the most abundant fish on the continental slope at depths of 400-1,000 m in all surveyed areas of Alaska except the eastern Gulf of Alaska. As such, it has a significant role in the slope

ecosystem and is an important predator in this habitat. Although there has been little or no directed fishery for giant grenadier in Alaska, substantial numbers are taken as bycatch and discarded in the sablefish and Greenland turbot longline fisheries. Estimated annual catches of giant grenadier in Alaska have ranged between 13,000 mt and 21,000 mt in the years 1997-2004. By geographic region, these catches averaged 3,225 mt in the eastern Bering Sea (EBS), 2,443 mt in the Aleutian Islands (AI), and 11,769 mt in the Gulf of Alaska (GOA).

In the preliminary assessment, data from AFSC bottom trawl and longline surveys were used to compute corresponding biomass estimates of giant grenadier as follows: EBS, 546,453 mt; AI, 1,294,286 mt; and GOA, 486,627 mt. The assessment applied an F=M=0.074 approach to these biomass estimates to compute overfishing levels (OFLs) for giant grenadier in each region, and then multiplied the OFLs by 0.75 to compute the following ABCs: EBS, 30,528 mt; AI, 71,833 mt, and GOA, 27,119 mt. Although the OFLs and ABCs indicate that giant grenadiers are not being overfished at this time, the reported longevity and slow growth of this species makes it susceptible to overfishing. Furthermore, a high proportion of the catch is likely female because mostly female giant grenadier live at the depths where the commercial fishery operates. Disproportionate removal of females by the fishery could put stocks of giant grenadier at greater risk.

In addition to the data analysis and preliminary assessment of giant grenadier, a field and laboratory study is currently in progress on the reproductive biology of this species. Observations of female and male sexual maturity taken during the annual AFSC longline survey suggest that nearly all the fish caught in the commercial fishery are mature. Preserved ovaries are being sampled in the laboratory to determine fecundity, to collect histological samples for maturity verification, and to investigate whether giant grenadier are determinate or indeterminate spawners.

For more information, contact Dave Clausen at (907) 789-6049.

D. OTHER RELATED STUDIES

Forage Fish in the Nearshore Bering Sea

Nearshore waters of the Bering Sea provide habitat for several forage fish species that are important in the diet of marine mammals, sea birds, and other fishes. In June 2005, scientists from the Auke Bay Laboratory sampled shallow nearshore waters (<5 m deep) of the Bering Sea with a beach seine to estimate forage fish distribution and relative abundance. Three habitat types were sampled: non-vegetated sandy substrate, vegetated cobble substrate, and vegetated bedrock substrate. A total of 70 sites were seined on Akutan, Akun, and Unalaska Islands. Total catch was 84,077 fish representing 27 species. Catches varied widely from no fish to over 15,000 fish per seine haul. Pacific sand lance was the dominant forage fish species captured - approximately 35,000 were caught, and they occurred in 60% of all seine hauls. Mean size of sand lance captured was 106 mm fork length (FL). Other commonly captured forage fish were young-of-the-year Pacific sandfish (mean FL = 36 mm) and young-of-the year gadids (mean FL = 31 mm). Catch per seine haul (all fish species) was 1,170 fish in non-vegetated sandy substrate sites, 1,648 fish in vegetated cobble sites, and 98 fish in vegetated bedrock substrate

sites. Most sand lance (98%) were caught in non-vegetated sandy substrate sites, and most sandfish (96%) and gadids (97%) were caught in vegetated cobble substrate sites. Although we caught forage fish in shallow nearshore waters in June, use of the nearshore by forage fish in other seasons and other areas of the Bering Sea is unknown.

For more information, contact John Thedinga at (907) 789-6025.

Effects of Fishing on Sea Floor Habitat

Deep-Sea Coral Distribution and Habitat in the Aleutian Islands

This project by the Auke Bay Laboratory seeks to provide the first detailed mapping of coral and sponge habitats for the Aleutian Islands, where species diversity appears to be unusually high and where incidental mortality of corals and sponges is a challenging problem in the area's fisheries that use bottom contact gear. A statistical model will be made to predict coral and sponge distribution as a function of measurable environmental characteristics, and if successful, this predictive model can be used to inform management decisions for protecting corals and sponges in areas lacking detailed mapping and dive-supported observations. Further, this work will provide estimates of the relative abundance of corals and sponges, their importance to commercially valuable fish and invertebrates, and the degree to which these living substrates have been disturbed, including disturbance by fishing gear. All field work for this project has been completed, and the majority of the effort in 2005 was spent on collecting data from video transects. Transcription of video data and habitat classification of the multi-beam sonar maps is about half complete. Development of the predictive habitat model continued as additional video transect data became available. Exploratory data analysis is underway to identify physical habitat features most strongly correlated with coral distribution using a subset of transects.

For more information, contact Robert Stone at (907) 789-6031 or Jon Heifetz at (907) 789-6054.

Habitat Evaluation of Major Fishing Grounds

The Sustainable Fisheries Act of 1996 was passed to attain long-term protection of essential fish habitat, and it specifically requires that NMFS minimize adverse impacts to essential fish habitat by fisheries that it manages. While considerable legal and administrative effort has been expended to meet the requirements of the Act, there has been little effort to observe the habitat where ongoing fisheries occur. NMFS has limited knowledge of bottom habitat where major fisheries occur. Any regulatory measures adopted to minimize impacts without the knowledge of whether or where vulnerable habitat is at risk may be ineffective or unnecessarily restrictive. Mapping the seafloor and characterizing benthic habitat are the first steps toward defining the relationships between the physical environment and benthic species density and diversity. The Auke Bay Laboratory initiated this study in 2001 on the Portlock Bank area northeast of Kodiak Island to obtain such knowledge of benthic habitat on major fishing grounds.

In a collaborative effort, six multibeam sonar surveys were completed throughout the Gulf of Alaska with associated maps of the geologically classified benthic habitat (Portlock Bank, Cape

Ommaney, Hazy Islands, Pamplona Spur, South Yakutat, and Albatross Bank). Most of these mapped areas are in the vicinity of extensive bottom trawl and longline fisheries for groundfish. The main objective of this study was to explore the utility of existing biological data within these habitats for describing rockfish species (*Sebastes* spp.) distribution. We characterized the benthic habitats for each site and defined comparable habitats between sites. Bottom trawl survey and fishery data were used for analysis of rockfish species composition, species density, and commercial rockfish fishing intensity by common habitat and site. Despite the paucity of data for some of the mapped sites, some general patterns emerged. Habitats that were typically deeper and much smaller in total area such as the landslide or canyon slope habitat types seemed to contain fewer species and were more consistent in composition than the other habitat types. Large aggregations of only a few rockfish species were detected on some habitats; however data were extremely limited for density calculations. A range of fishing intensities was detected on most habitats, suggesting that other factors such as management restrictions may be driving fishing intensity in any given area. We recommend a focused survey be conducted over the mapped sites to better determine the relationship between benthic habitat and rockfish species distribution and suggest exploring the integration of different sampling techniques to refine habitat classification and identify areas for future conservation efforts.

For more information, contact Kalei Shotwell at (907) 789-6056 or Jon Heifetz at (907) 789-6054.

Habitat and Ecological Processes Research (HEPR) Program

The Alaska Fisheries Science Center (AFSC) initiated the Habitat and Ecological Processes Research (HEPR) Program in February 2005 to develop scientific research that supports implementation of an ecosystem approach to fishery management. The HEPR Program focuses on integrated research studies involving habitat and ecological processes. The Program consists of a HEPR Core Team with representatives from each AFSC Division (Robyn Angliss, NMML; Anne Hollowed, REFM; Jennifer Ferdinand, FMA; Bern Megrey, RACE; Jon Heifetz, ABL) and a Program Leader (Mike Sigler). The HEPR Core Team facilitates the development of research projects and fosters integration of existing projects that are responsive to NOAA Fisheries' goal of implementing ecosystem approaches to management. The HEPR Core Team is responsible for identifying emerging scientific issues with potential management implications and formulating approaches to assess, predict, and respond to the impacts of these issues on living marine resources. Two emerging issues were initially identified as research areas for the HEPR Program:

Loss of Sea Ice (LOSI). Specific research questions are: How can AFSC scientists improve their understanding of the natural and anthropogenic processes in the Bering Sea that influence sea ice thickness, timing, and seasonal extent, and how do changes in sea ice properties influence living marine resources? How can this information enable more accurate forecasts of future ecosystem status and trends? How can this information be incorporated into management advice and thresholds for regulatory actions? Three LOSI research areas are planned: 1) Expand existing surveys to cover apparent northern migration of species; 2) Create new surveys of ice-dependent species not presently assessed; 3) Acquire the understanding to create spatially-

explicit models to predict the effects of loss of sea ice on fish and marine mammal abundance trends. LOSI funding is scheduled to begin FY 2008.

Essential Fish Habitat (EFH) / Critical Habitat (CH). Critical Habitat is a legal definition that refers to the habitat of threatened or endangered species. The specific research question is: How can AFSC scientists improve the definition (i.e. quantity, quality and extent) of important habitat (EFH and CH) for living marine resources? Two EFH research areas are planned: 1) Characterize habitat, utilization, and productivity of marine habitat of Alaska, focusing effort on habitats most affected by human activities; 2) Reduce uncertainty of predictions of anthropogenic effects on habitat, as well as reduce their impacts, focusing effort on habitats most affected by human activities.

For more information, contact Mike Sigler at (907) 789-6037.

RACE Habitat Research Team

Research by the RACE Division Habitat Research Team addresses Congressional mandates to describe and identify essential fish habitat (EFH) of federally managed species in Alaska. In practice, systematic trawl survey data are used to designate EFH as those areas supporting the highest relative abundance. This presumes that density data reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. Subsequent characterization of these areas requires systematic mapping of the relevant biotic and abiotic variables. In general, environmental data are lacking and a substantial effort is devoted to the identification of suitable variables and the development of tools for mapping them over large areas. The HRT also investigate activities with potentially adverse effects on EFH, such as bottom trawling.

2004 HRT Field and Laboratory Research

Bogoslof Island mapping and colonization – Colonization of benthic invertebrates at hard-bottom sites on Bogoslof Volcano is being studied to provide estimates of recovery rates from benthic fishing activities. Bogoslof provides a natural laboratory for this work because lava and tephra from historical eruptions (since 1796) have resurfaced different areas of the shallow seafloor around the island. The results will help managers define an upper bound on recovery time. The project involves three separate stages of research: mapping the seafloor, matching seafloor areas to specific eruptions (dates), and conducting an ROV census of benthic invertebrates within seafloor areas of known ages. The first phase of the project was completed in July 2004 when the seafloor surrounding Bogoslof (20-750 m depths) was successfully mapped with a multibeam echosounder (100 kHz Reson SeaBat 8111). Video tapes from a previous ROV cruise at Bogoslof, as well as mini-sub dive tapes from different research cruises at a resurfaced area off Kanaga Island, will be analyzed in order to provide preliminary information about colonization, growth, and succession processes on hard-bottom Alaskan seafloor areas.

Long-range fisheries sidescan sonar R&D – The broad scope of the EFH mandate requires an efficient process for identifying and mapping habitat. Although research indicates surficial

sediments affect the distribution and abundance of many groundfish species, direct sampling with benthic grabs and remote sensing with multibeam echosounders are prohibitively expensive over large areas. The development of a Long Range Fishery Sonar (180 kHz) capable of very broad coverage (1.5 km swath) portends an advance in acoustic technology that can more efficiently and effectively extract seafloor characteristics to benefit fisheries and habitat research. Field testing of the LRFS and its fiber-optic interface has been proceeding since 2004. An electronics integration test of the LRFS with the NOAA ship FAIRWEATHER was conducted recently in preparation for a 21-day Bering Sea cruise (FISHPAC, see below) scheduled for summer 2006.

Acoustic backscatter for Essential Fish Habitat characterization (FISHPAC) – The first field study will be conducted in the eastern Bering Sea in the summer of 2006 aboard the NOAA ship FAIRWEATHER. The study will investigate the utility of acoustic backscatter for EFH characterization. Acoustic surveys will be conducted along strong gradients of groundfish abundance as shown by a time series of fixed-station annual trawl survey catches. The benefits and costs of several different acoustical systems will be compared with data from multiple passes along the survey tracklines. A new Long Range Fishery Sonar (LRFS, see above) will be tested alongside an interferometric side scan sonar (455 kHz), two hull-mounted multibeam echosounders (50 kHz, 100 kHz), and a 38 kHz vertical incidence echosounder mounted on the LRFS towbody. The performance of each system will be based on the degree of statistical correlation between normalized backscatter and fish density. A towed video package and sediment grab sampler will be used for groundtruthing. Field tests of equipment, cruise planning and preparations are in progress. Subsequent studies will aim to validate and/or refine any backscatter-abundance relationships by trawl sampling that targets specific backscatter levels.

Short-term trawling effects and recovery monitoring in the eastern Bering Sea – This ongoing multi-year study is a process-oriented investigation of short-term effects and recovery using a BACI experimental design. The study area is located within the Crab and Halibut Protection Zone 1 closed area in Bristol Bay. During a 35-day cruise in 2001, 6 pairs of predesignated 10-mi long research corridors were sampled before and after a trawling disturbance with commercial gear (NETS 91/140 Aleutian cod combination). Quantitative assessments of epifauna and infauna populations were undertaken before and after trawling. The experimental and control corridors were also surveyed before and after trawling using a Klein 5410 side scan sonar system. The corridors were revisited in 2002 to monitor recovery. Preparations are underway to conduct the final sampling event in the Summer of 2007.

Evaluating single beam echosounders for synoptic seabed classification – Nearly 8 million digitized echo returns from the seafloor were simultaneously collected at two frequencies (38 and 120 kHz) along a 9,000 nm trackline in the eastern Bering Sea (EBS) during a 1999 hydroacoustic fishery survey on the NOAA ship MILLER FREEMAN. Collaborative research with QTC has resulted in a fully-automated objective classification process involving a new application of the Bayesian Information Criterion (BIC). Data have also been processed using standard QTC methods. An optimal classification scheme for the EBS shelf has been identified (14 distinct classes of bottom types for 38 kHz data) and these results have been merged with 23 years of RACE trawl survey data from the EBS shelf (1982-2004). Statistical analyses are being

conducted to examine the degree to which acoustic variability corresponds to environmental features that influence the distribution and abundance of groundfish and benthic invertebrates.

Reconnaissance mapping with side scan sonar – A reconnaissance of Bristol Bay seafloor habitats was undertaken in 2002 using a high-resolution 455 kHz side scan sonar (Klein 5410). The reconnaissance effort was centered on an 800 mi^2 area of central Bristol Bay that has never been surveyed by NOAA hydrographers. A 150 m swath of bathymetric data and imagery were collected along survey lines totaling nearly 600 linear miles. In addition to providing spatial context for the ongoing trawl impact study in Bristol Bay (cited elsewhere in this document), the survey also intersected 18 RACE Division trawl survey stations and followed 78 mi of seabed previously classified using a *QTC View* single beam acoustic system. Imagery was systematically groundtruthed using an underwater video camera and van Veen grab samples. Although acoustic systems are designed for broad-scale remote sensing of seabed properties, it is generally unknown whether they measure seabed properties that are important to marine species. This reconnaissance survey provides a dataset for investigating this question. Analysis is in progress to evaluate the contribution of seabed parameters derived from *QTC SIDEVIEW* sidescan image processing to modeling groundfish habitat.

Commercial-grade echosounder analysis – This project is exploring the utility of analyzing Simrad ES-60 38kHz data with Quester Tangent Corporation (QTC) Impact to describe different habitat types in the Gulf of Alaska that might account for distributions of groundfish.

For further information, contact Dr. Bob McConnaughey, (206) 526-4150.

Sampling Efficiency Estimated for Poly Nor'Eastern Trawl Used on Gulf of Alaska and Aleutian Islands Bottom Trawl Surveys

Animal density can be estimated from bottom trawl catch-per-swept-area data provided there is knowledge of the whole-gear sampling efficiency or the proportion of animals that are captured within the area spanned by the trawl doors. One approach to the estimation of whole-gear sampling efficiency is to consider it as a function of the efficiencies of herding, mesh retention, and other components of the trawl catching process, because such components are often more tractable to field experimentation and estimation.

For flatfish, which are unlikely to pass over the trawl headrope or through the mesh and are herded only by the section of the lower bridle that is sufficiently close to the bottom to elicit a behavioral response, a mathematical model of trawl efficiency can be formulated as

$$E = k_n (W_n + hW_{on}) / W_d$$

where W_n and W_d are the trawl net and door spread, k_n is the net efficiency or proportion of fish retained at the trawl footrope, W_{on} is the width of the area swept by the bridles and h is the fraction of the flatfish within W_{on} that are herded into the net path.

Evaluating this model requires data from three distinct experiments. In this study, k_n was estimated from data obtained from a net efficiency experiment which consisted of attaching an auxiliary bag under the trawl to capture fish escaping beneath the footrope, h was estimated from

data obtained from a herding experiment which consisted of repeatedly conducting trawl hauls in which W_d was varied by varying the length of the bridles, and W_{on} was estimated from data obtained on a bridle measurement experiment using bottom contact sensors to measure the off-bottom distance along the lower bridle.

These experiments were directed at four flatfish species (flathead sole, rex sole, Dover sole and arrowtooth flounder) using the Poly Nor'Eastern trawl, the standard trawl used by the AFSC on its bottom trawl surveys of the Gulf of Alaska and the Aleutian Islands.

Estimates of the herding coefficient (h) averaged 0.55 for the three sole species (rex sole=0.53; Dover sole=0.58; flathead sole=0.55), all of which were higher than arrowtooth flounder (0.391). Thus, roughly 40-50% of the flatfish encountering the lower bridle were ultimately herded into the path of the net. Estimates of the net efficiency (k_n) for arrowtooth flounder, flathead sole and rex sole increase with fish length and reach maximum values between 0.85 and 0.95. Estimates of k_n for Dover sole, however, decrease with increasing size both because small fish were not sampled and because this species apparently becomes more adept at escaping under the footrope with increasing size.

Trawl efficiency (E) estimates for arrowtooth flounder, flathead sole, and rex sole increased with increasing fish length and reached maxima of 0.45, 0.42 and 0.43, indicating that slightly more than 40% of the largest individuals that passed between the doors of the trawl were ultimately caught. In contrast, the efficiency estimates for Dover sole were considerably lower over the sampled size range, and monotonically decreased with increasing length.

Since bottom trawl surveys conducted by the AFSC calculate swept area in terms of wing spread rather than door spread, as is the convention for most International Council for the Exploration of the Sea (ICES) sponsored surveys, to be useful in stock assessment models the above values must be multiplied by the quotient of the door spread and net spread, which for the Poly Nor'Eastern trawl is approximately equal to 3 (47.8 m/16.1 m). Thus maximum efficiency for these species is slightly greater than 1.2.

Details of this study are available in a draft manuscript by Dave Somerton, Peter Munro, and Ken Weinberg titled "Whole-gear efficiency of a benthic survey trawl for flatfish."

For further information, please contact Dave Somerton (206) 526-4116 or Ken Weinberg (206) 526-6109.

E. Other Items

GIS Resources

Here's a tip that might help fisheries researchers. Many people forget that ENCs (Electronic Navigational Charts) are now readable into ArcView/ArcInfo in a GIS format. That is, the ENC comes in as discreet entities instead of an image. Bathymetry, soundings, coastlines and any other entity in the ENC are all separate layers that can be used independently. The key item is

whether the chart you want is in ENC format. Check at
http://ocsdata.ncd.noaa.gov/ChartServerV2.0/jsp/index.jsp .
Then use the ENC data handler from the Coastal Services site at
http://www.csc.noaa.gov/products/enc/arcgis9x.html .
This gives detailed instructions on how to read in the ENC. Unfortunately it is difficult to merge items from different charts as the scales are different.

For more information, contact Jan Benson (206) 526-4183.

APPENDIX I

Alaska Fisheries Science Center
Groundfish-Related Publications and Documents In Press – January 2005 through April 2006
(AFSC authors in bold text)

Alaska Fisheries Science Center (AFSC)
Peer-Reviewed Journal Reports and Technical Memoranda in 2005
(AFSC authors are in bold).
Note: 2005 Groundfish Stock Assessment Reports and 2005-2006 Processed Reports are listed separately in following sections.

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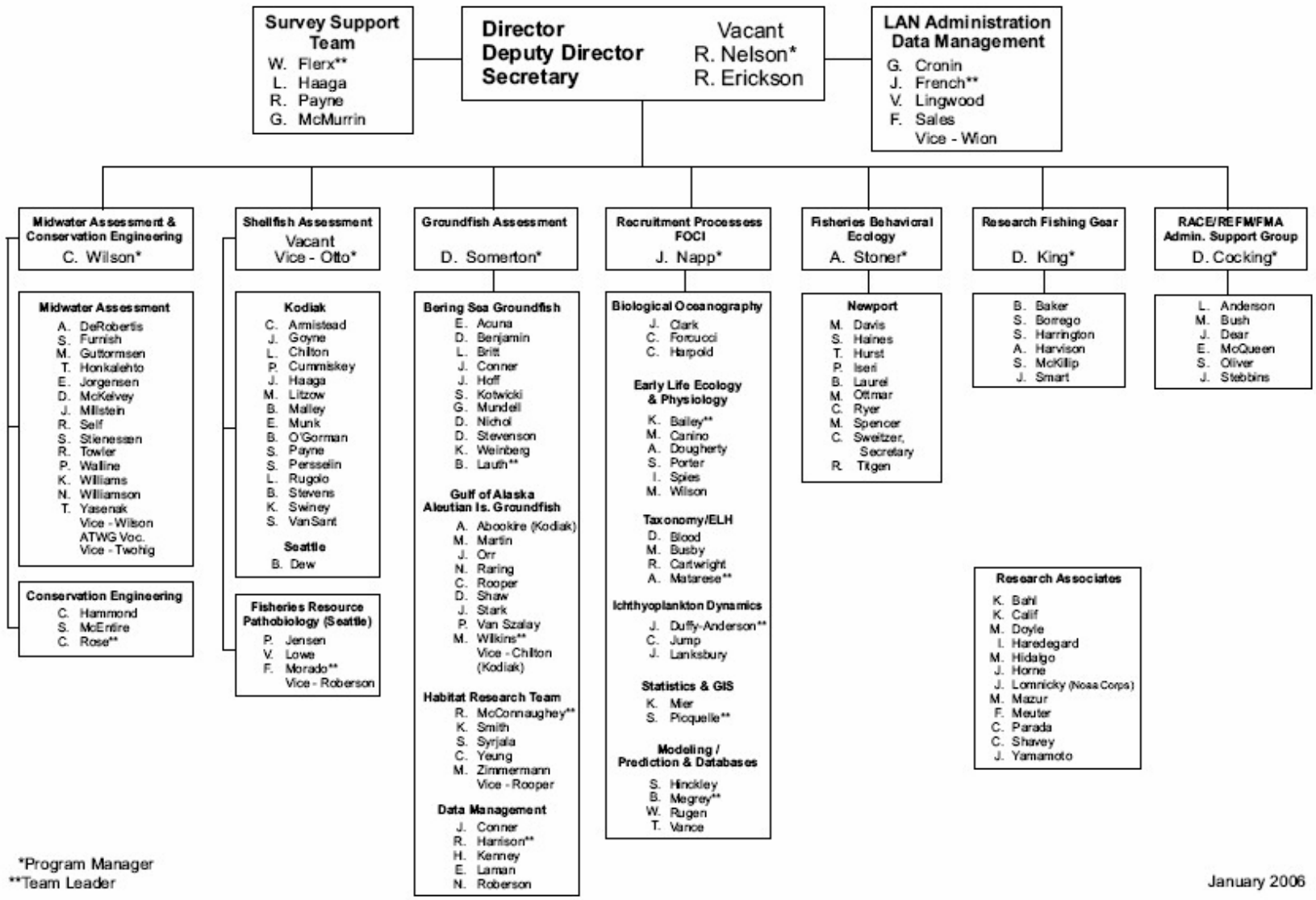
RESOURCE ASSESSMENT AND CONSERVATION ENGINEERING DIVISION
ORGANIZATION CHART
2006



APPENDIX III.--RESOURCE ECOLOGY AND FISHERIES MANAGEMENT DIVISION

Patricia Livingston -- Director
Loh Lee Low -- Deputy Director

Administrative Support	Age Determination Unit	Status of Stocks and Multispecies Modeling	Resource Ecology and Ecosystems Modeling	Socio-Economic Assessment
Ito, Daniel -- NEPA coordinator	Kimura, Dan -- Supervisor	Hollowed, Anne -- Supervisor	Aydin, Kerim BActing Supervisor	Felthoven, Ron -- Leader
Goiney, Bernie	Anderl, Delsa	Conners, Liz	Buckley, Troy	Haynie, Alan
	Benson, Irina	Dorn, Martin	Derrah, Christopher	Hiatt, Terry
	Gburski, Chris	Greig, Angie	Lang, Geoffrey	Lew, Dan
	Goetz, Betty	Gaichas, Sarah	Yang, Mei-Sun	Sepez, Jennifer
	Hutchinson, Charles	Ianelli, James		Seung, Chang
	Johnston, Chris	Logerwell, Libby		
	Kastelle, Craig	Lowe, Sandra		
	Foy, Dan	Munro, Peter		
	Kautzi, Lisa	Pearce, Julie		
	Shockley, Wes	Spencer, Paul		
	Short, Jonathan	Thompson, Grant		
	Piston, Charlses	Turnock, Jack		
	Brogan, John	Stockhousen, Buck		
		Wilderbuer, Thomas		
		Neidetcher, Sandi		
		McDermott, Susanne		

ADP

Blaisdell, Mark
Wennberg, Sherrie

Revised April 2005

APPENDIX IV - Auke Bay Laboratory Groundfish Assessment Program Staff

Name	Duties
Phil Rigby	Program Manager
Dave Clausen	Rockfish, Alaska Groundfish
Dean Courtney	Rockfish, Sharks, Stock Assessment
Dave Csepp	Forage Fish, Hydroacoustics
Jeff Fujioka	Sablefish, Rockfish, Stock Assessment, Effects of Fishing
Dana Hanselman	Rockfish, Sablefish, Stock Assessment
Jon Heifetz	Effects of Fishing, Rockfish, Sablefish, Stock Assessment
John Karinen	Gulf of Alaska Groundfish
Mitch Lorenz	Essential Fish Habitat
Chris Lunsford	Rockfish, Sablefish, Stock Assessment, Longline Survey
Nancy Maloney	Sablefish Tag Database, Longline Survey, and Seamounts
Tom Rutecki	Sablefish, Webmaster
Kalei Shotwell	Groundfish Habitat, Rockfish, Stock Assessment
Robert Stone	Seafloor Ecology, Effects of Fishing, Coral and Sponge Life History

Other ABL Staff Working on Groundfish

Scott Johnson	Essential Fish Habitat, Forage Fish
John Thedinga	Essential Fish Habitat, Forage Fish
Christine Kondzela	Rockfish Genetics

Committee of Age-Reading Experts

2006 Committee Report

Prepared for the Forty-Seventh Annual Meeting of the Technical Subcommittee of the Canada-USA Groundfish Committee

May 2 – 3, 2006

Prepared by

Patrick J. McDonald
2004-2006 CARE, chairperson
Pacific States Marine Fisheries Commission
2032 SE OSU Drive
Newport, OR 97365

CARE 2006 Annual Report
To the Technical Subcommittee of the
Canada-USA Groundfish Committee

A. CARE Overview, 2005-2006

History

The Committee of Age-Reading Experts, CARE, is a subcommittee of the Canada-USA Groundfish Committee's Technical Subcommittee, charged with the task to develop and apply standardized age determination criteria and techniques, and operates within the Terms of Reference approved by the TSC in 1986.

1. The last biennial CARE Workshop/Conference was held on April 18-20th, 2006. The minutes are currently being drafted and should be available for the 2007 TSC meeting. Workshop participants and their corresponding contact information (Appendix I) and the Workshop agenda (Appendix II) are included in this report. The structure exchange table and the summary of age reading methods table have been modified based on TSC recommendations and CARE to CARE recommendations, respectively. A draft copy of the structure exchange table has been provided for review and comment (Appendix IV). A draft copy of the new summary of age reading methods was not available at the time of this report.

2. No dates have been set for the next biennial CARE Workshop, but it is expected to be held prior to the 2007 TSC meeting.

B. CARE Working Group Reports

Manual/Glossary Subcommittee– Shayne MacLellan (chair, report contributor), Betty Goetz, Kristen Munk

Groundfish Ageing Manual species specific ageing chapter additions

1. Lingcod: Author John Sneva (WDFW) – approved by membership.
2. Dover sole: Author Lisa Lysak (NOAA Fisheries-NWFSC-PSMFC) – approved by membership.
3. Pacific whiting: Author Patrick McDonald (NOAA Fisheries-NWFSC-PSMFC) and Shayne MacLellan (Pacific Biological Station, Nanaimo, BC) – in progress.
   (a) Groundfish Ageing Manual chapter additions – other.
   Statistical analysis/tools: Author Michael Schirripa (NOAA Fisheries-NWFSC) – in progress.
   (b) No new updates to the glossary.

Web Page Subcommittee– Jon Short (chair), Delsa Anderl, Brenda Erwin

1. The minutes from the 2004 CARE meeting and the CARE Charter have been sent to the Web Page Subcommittee Chair and will be available soon on-line.
2. The CARE web site is available at http://www.psmfc.org/care.

Charter Subcommittee – Shayne MacLellan, Kristen Munk, Betty Goetz
No new updates to the CARE Charter.

C. Agency Structure Exchanges

The structure exchange table (Appendix III) was updated to include all inter-lab exchanges that occurred between the last two previous CARE meetings (see CARE Workshop Business for changes to the structure exchange table).

D. Interim Workshop Updates

These interim or supplemental hands on workshops were discussed at the 2006 CARE.

a. Sablefish: The ADFG, CDFO, NOAA-Fisheries AFSC and NOAA Fisheries-NWFSC-PSMFC labs discussed the opportunity to get together in 2007 to document ageing methodologies and interpretations of growth patterns.

b. Petrale sole: WDFW and NOAA-Fisheries-NWFSC-PSMFC labs discussed getting together possibly in 2007 or in 2008 outside of CARE to calibrate our methods for ageing US West Coast petrale.

E. CARE Workshop Business

Status of 2005 Recommendations from TSC to CARE

Recommendation withdrawn

Status of 2004 Recommendation from TSC to CARE

Recommendation: TSC recommends eliminating the summary statistics and adding hyperlinks to any reports pertinent to the exchange. The TSC also supports the CARE representative's suggestion of standardizing the format of age structure exchange reports.

Update: This recommendation was presented to the membership and initiated the following CARE to CARE recommendation.

2006-1 CARE to CARE Recommendation:

The CARE Age Structure Exchange (CASE) table presently identifies inter-agency exchanges occurring on species of interest to the TSC, or other inter-agency calibrations as needed. CARE recommends to itself to modify the CASE table and process. We will continue to track structure exchanges per the CARE Charter, however we will drop precision test results from the CASE table. We will develop a CASE invoice, accessible on the CARE website. Upon initiating an

exchange, the originating agency will contact the CASE coordinator for an exchange id number. The originating agency will conduct the exchange, fill out all information in the CASE invoice, and submit it to the CASE coordinator upon its completion. The CASE coordinator or designee will update the website to allow linked access within the CASE table. Inclusion of precision statistics is optional.

2006-2 CARE to CARE Recommendation:

CARE recommends making changes to the Summary of Ageing table regarding format and information included. The current table info will be split into two tables; one to include "Methods" information (agency, species, method, validation, area, structure, validation & validation citation). The method, validation & citation columns would provide anecdotal information that will be updated. The method column would include all methods used historically or currently and provide dates when methods were adopted. The validation column would indicate method and extent (e.g. all ages, up to age 30, longevity) and the validation citation column would indicate dates and contact. The new 2nd table would include agency, species, calendar year and number of fish per species aged. Total fish and total species aged would be calculated. Numbers of readers involved per calendar year for all fish aged will also be included. It is recommended that this data would reside on the website and that a small relational database would house the data. A mechanism would be developed to query the database to assess the breadth and depth of expertise for species by agency for all species aged. Development of database will be in small steps. The Vice-chair will be responsible for updating both tables on an annual basis.

2006-1 CARE to TSC Recommendations:

The biennial CARE meetings have been traditionally held at the Seattle NMFS-AFSC facilities. The Pacific Biological Station (PBS), Nanaimo representatives offered to host the 2008 CARE meeting. Two reasons were given for this proposed departure. First, this invitation coincides with the PBS 100th anniversary (1908-2008). Second, agency travel policy can prohibit all age readers from different participating agencies and labs to attend the CARE meeting at the Seattle AFSC facilities. The CARE requests TSC members to support this recommendation and encourage travel funding. This rotation will allow PBS to share in the hosting responsibilities and for greater CARE participation among their personnel. It would also appropriately acknowledge PBS's substantial contributions to the field of fish age and growth.

F. During the workshop portion of the meeting, structures from at least 15 species of fish examined:

Petrale sole, arrowtooth flounder, sablefish, lingcod, Pacific hake, P. cod, sardine, shortspine thornyheads, spiny dogfish, canary rockfish, yelloweye rockfish, Quillback rockfish, rougheye rockfish, black rockfish and longnose skate.

Appendix I. – 2006 CARE Attendee List

	Last	First	Agency	Email
1	Munk	Kris	ADFG-ADU	Kristen_munk@fishgame.state.ak.us
2	Neil	Jodie	ADFG-ADU	jodi_neil@fishgame.state.ak.us
3	Cowen	Phil	ADFG-Homer	philip_cowan@fishgame.state.ak.us
4	Dunne	Willy	ADFG-Homer	willy_dunne@fishgame.state.ak.us
5	Russ	Chris	ADFG-Homer	chris_russ@fishgame.state.ak.us
6	Brodie	Joan	ADFG-Kodiak	joan_brodie@fishgame.state.ak.us
7	Gillespie	Darlene	DFO	GillespieD@pac.dfo-mpo.gc.ca
8	MacLellan	Shayne	DFO	MacLellanSh@pac.dfo-mpo.gc.ca
9	Blood	Cal	IPHC	cal@iphc.washington.edu
10	Forsberg	Joan	IPHC	joan@iphc.washington.edu
11	Gibbs	Linda	IPHC	lindagibbs17@gmail.com
12	Wischniowski	Steve	IPHC	steveW@iphc.washington.edu
13	Cailliet	Greg	MLML	Cailliet@mlml.calstate.edu
14	Anderl	Delsa	NOAA-Fisheries-AFSC	delsa.anderl@noaa.gov
15	Benson	Irina	NOAA-Fisheries-AFSC	irina.benson@noaa.gov
16	Brogan	John	NOAA-Fisheries-AFSC	john.brogan@noaa.gov
17	Foy	Dan	NOAA-Fisheries-AFSC	dan.foy@noaa.gov
18	Gburski	Christopher	NOAA-Fisheries-AFSC	christopher.gburski@noaa.gov
19	Goetz	Betty	NOAA-Fisheries-AFSC	betty.goetz@noaa.gov
20	Hutchinson	Charles	NOAA-Fisheries-AFSC	charles.hutchinson@noaa.gov
21	Johnston	Chris	NOAA-Fisheries-AFSC	chris.johnston@noaa.gov
22	Kastelle	Craig	NOAA-Fisheries-AFSC	craig.kastelle@noaa.gov
23	Kimura	Dan	NOAA-Fisheries-AFSC	dan.kimura@noaa.gov
24	Piston	Charlie	NOAA-Fisheries-AFSC	charlie.piston@noaa.gov
25	Shockley	Wes	NOAA-Fisheries-AFSC	wes.shockley@noaa.gov
26	Short	Jon	NOAA-Fisheries-AFSC	jon.short@noaa.gov
27	Atkins	Nikki	NOAA-Fisheries-NWFSC-PSMFC	nikki.atkins@noaa.gov
28	Kamikawa	Betty	NOAA-Fisheries-NWFSC-PSMFC	betty.kamikawa@noaa.gov
29	McDonald	Patrick	NOAA-Fisheries-NWFSC-PSMFC	patrick.j.mcdonald@noaa.gov
30	Rodriguez	Omar	NOAA-Fisheries-NWFSC-PSMFC	omar.rodriguez@noaa.gov
31	Thompson	Josie	ODFW	thomjosi@onid.orst.edu
32	Rosenfield	Sandy	WDFW	rosenslr@dfw.wa.gov
33	Topping	Jennifer	WDFW	toppijat@dfw.wa.gov

Appendix II -- 2006 Biennial Meeting Agenda

Committee of Age Reading Experts
A Working Group of the Technical Subcommittee
of the Canada-USA Groundfish Committee

2006 Biennial Meeting Agenda
April 18-20, 2006

NOAA-NMFS Alaska Fisheries Science Center
Seattle, WA

Tuesday – April 18th, 2006

8:30am – 10:00am

I. Introductions, Attendance and Announcements
II. Approval of 2006 Agenda
III. Approval of 2004 Minutes
IV. Working Group Reports - Updates
    A. Charter (MacLellan, Goetz, Munk)
    B. Manual/Glossary (MacLellan, Goetz, Munk)
        1. Ageing Chapter Additions
    C. Web site (Short/Anderl)
V. Additional Updates
    A. Summary of Age Reading Methods
        1. Definitions
        2. Modifications
VI. Inter-lab Structure Exchanges (Kris Munk)

Morning Break

10:20am – 12:00pm

VII. Overview and Updates by Agency (Ageing Priorities, personnel, research, workshops/meetings attended, publications, new species responsible for ageing).
    A. ADFG (Kris Munk)
    B. CDFO (Shayne MacLellan)
    C. CDFG –Could Not Attend
    D. IPHC (Joan Forsberg/Steve Wischniowski)
    E. NMFS – AFSC (Dan Kimura)
    F. ODFW (Josie Thompson)
    G. WDFW (Sandy Rosenfield/Jennifer Topping)
    H. NMFS-NWFSC-PSMFC (Betty Kamikawa/Omar Rodriguez)

VIII. Recommendations
    2005 Recommendations from TSC to CARE:
        1. None

B. 2004 Recommendations from CARE to CARE:
   1. CARE members are encouraged to hold workshops/calibration sessions as needed to address specific age reading issues.
   2. Draft a chapter on statistics to include in the CARE manual.

C. 2004 Recommendations from TSC to CARE:
   1. In response to CARE's request for guidance on the content of their "Summary of Age Structure Exchanges" table (refer to http://care.psmfc.org/structtable.htm), the TSC recommends eliminating the summary statistics and adding hyperlinks to any reports pertinent to the exchange. The TSC also supports the CARE representative's suggestion of standardizing the format of age structure exchanges reports.

12:00pm – 1:15pm
Lunch

1:15pm – 3:15pm
Recommendations continued, if needed

IX. Presentations
   A. Craig Kastelle (AFSC) – Age validation of POP using Bomb Radiocarbon
   B. Darlene Gillespie (CDFO) – Progress on Developing a Method for Ageing Pacific Cod
   C. Charles Hutchinson (AFSC) – Developing Ageing Criteria for Shortraker Rockfish
   D. Jodi Neil (ADFG) – Age validation of SST using Bomb Radiocarbon

3:15pm – 3:30pm
Break

3:30pm – 4:45pm
   E. Jon Short (AFSC) – Age reading demonstration; an interactive ageing program
   F. Shayne MacLellan (CDFO) – Greenland Halibut Ageing Workshop Summary

X. Election of 2006-2008 CARE Officers
   A. Chair (Kris Munk)
   B. Vice Chair/Age Structure Exchange Coordinator
   C. Secretary/Rapporteur

Wednesday – April 19th, 2006
8:15am – 8:45am
XI. Age and Growth Lab Overview and Updates by Agency
   A. Moss Landing Marine Laboratories (Greg Cailliet)

8:45am – 10:15am
Microscope Work at Scheduled Workstations
Species Specific Meetings

Morning Break

10:30am – 12:00pm
On-going Microscope Work at Scheduled Workstations

12:00pm – 1:15pm
Lunch

1:15pm – 3:15pm
On-going Microscope Work at Scheduled Workstations

Afternoon Break

3:30pm – 5:00pm
On-going Microscope Work at Scheduled Workstations

****
6:00pm Evening Social event and potluck hosted by Cal Blood and Family!
****

Thursday – April 20th, 2006
8:00am – 12:00pm
On-going Microscope Work at Scheduled Workstations

12:00pm – 1:15pm
Lunch

1:15pm – 3:00pm
Wrap-Up Unfinished Microscope Work
Afternoon Break

3:15pm – 4:15pm
Business/Unfinished Business Wrap-Up

4:30pm
Meeting Adjourned

Appendix III -- Truncated copy of the updated CARE structure exchange table with highlighted rows indicating the changes from the last update in 2004.

EXCHANGE ID NO.	EXCHANGE YEAR	ORIGINATING AGENCY	COORDINATOR	COOPERATOR(S)	DATE INITIATED	SPECIES
98-001	1998	WDF	J. SNEVA	ODFW	1998-1999	English Sole
98-002	1998	WDF	J. SNEVA	ODFW	1998-1999	Black Rockfish
99-001	1999	ODFW	B. MIKUS	CDFG,IPHC,NMFS	spring 1999	Dover Sole
99-002	1999	ADFG-Kodiak	C. WORTON	ADFG-Juneau	spring 1999	Black Rockfish
99-003	1999	ADFG-Kodiak	C. WORTON	ADFG-Juneau	spring 1999	Pacific Cod
99-004	1999	ADFG-Homer	S. MEYER	IPHC	1999	Halibut
99-005	1999	WDFW	J. SNEVA	CDFO,NMFS-Tiburon	spring 1999	Lingcod
99-006	1999	ADFG-Juneau	K. MUNK	CDFO,ODFW	/1999	Rougheye Rockfish
99-007	1999	ADFG-Juneau	K. MUNK	CDFO,ODFW,WDFW	10/25/1999	Yelloweye Rockfish
99-008	1999	ADFG-Juneau	K. MUNK	CDFO,ODFW	10/25/1999	Thornyhead rockfish
99-009	1999	ADFG-Juneau	K. MUNK	CDFO,ODFW,WDFW	10/25/1999	Quillback Rockfish
99-010	1999	ADFG-Juneau	K. MUNK	CDFO,ODFW,WDFW	10/25/1999	Dusky Rockfish
99-011	1999	ADFG-Homer	C. STOCK	CDFO?	10/1/1999	Lingcod
99-012	1999	CDFO	S. MacLELLAN	NMFS-AFSC	1/31/1999	Pacific Whiting
00-001	2000	ADFG-Juneau	K. MUNK	ODFW,NMFS-AFSC	1/15/2000	Sablefish
00-002	2000	ODFW	B. MIKUS	CDFG,IPHC,NMFS,CDFO	1/27/2000	Dover Sole(1)
00-003	2000	ODFW	B. MIKUS	CDFG,IPHC,NMFS	1/27/2000	Dover Sole(2)
00-004	2000	ODFW	B. MIKUS	CDFG,IPHC,NMFS	1/27/2000	Dover Sole(3)
00-005	2000	ADFG-Juneau	K. MUNK	NMFS-AFSC	3/1/2000	Pollock
00-006	2000	ADFG-Juneau	K. MUNK	CDFO	3/1/2000	Thornyhead rockfish
01-001	2001	ADFG-Juneau	K. MUNK	CDFO	1/12/2000	Yelloweye Rockfish
01-002	2000	WDFW	J. SNEVA	WDFW,DFO,ODFW	2001	Lingcod
01-003	2001	NMFS-Seattle	D.ANDERL	NMFS-AFSC,ODFW	1-Aug	Pacific Whiting
01-004	2001	ODFW	P. MCDONALD	ODFW,NMFS-AFSC	1-Nov	Pacific Whiting
02-001?	2002	NMFS-Seattle	D.ANDERL	ADFG-Juneau	12/?/01	Sablefish(known-age)
02-002	2002	ODFW	B. MILLER	ODFW,NMFS-AFSC, CDFG, IPHS	Feb-02	Dover sole
02-004	2002	ODFW	P. MCDONALD	ODFW,NMFS-AFSC,DFO,ADFG-Juneau	1-Dec	sablefish
03-001	2003	ODFW	B. MIKUS			Dover sole
03-002	2003	PSMFC	O. RODRIGUEZ	PSMFC-CAP, CDFO	Oct-03	Pacific Whiting

EXCHANGE ID NO.	EXCHANGE YEAR	ORIGINATING AGENCY	COORDINATOR	COOPERATOR(S)	DATE INITIATED	SPECIES
03-003	2003	CDFO	S. MacLELLAN	CDFO, PSMFC-CAP	Nov-03	Pacific Whiting
03-004	2003	ADFG-Kodiak	J. Brodie	NMFS-AFSC	Dec-03	Pacific Cod
04-001	2004	NMFS-AFSC	C. KASTELLE	NMFS-AFSC, ADFG - Juneau	Spring 2002	Pollock
04-002	2004	PSMFC-CAP	P. MCDONALD	PSMFC-CAP, NMFS-AFSC	Feb-04	sablefish
04-003	2004	PSMFC-CAP	J. MENKEL	PSMFC-CAP, NMFS-AFSC	Mar-04	Darkblotched rockfish
04-004	2004	ODFW	B. MIKUS	ODFW, PSMFC-CAP, CDFG	Mar-04	Dover sole
04-005	2004	NOAA-CAP	Omar Rodriguez	CDFO	05-Aug-04	Hake
04-006	2004	CDFO	Omar Rodriguez	NOAA-CAP	20-Aug-04	Hake
04-007	2004	NOAA-CAP	Omar Rodriguez	CDFO	17-Nov-04	Hake
05-001	2005	CDFO	Omar Rodriguez	NOAA-CAP	17-Mar-05	Hake
05-002	2005	CDFO	Omar Rodriguez	NOAA-CAP	13-Nov-05	Hake
05-003	2005	NOAA-CAP	Omar Rodriguez	CDFO	11-Nov-05	Hake
05-004	2005	NMFS-NWFSC	S. CONCETTI	NMFS-AFSC	Dec-05	Pacific Ocean Perch
06-001	2006	ADFG	K. MUNK	ODFW,NMFS-AFSC,DFO,ADFG-Juneau	Jan 1 2006	Sablefish
06-002	2006	ODFW	P. MCDONALD	ODFW,NMFS-AFSC,DFO,ADFG-Juneau	Jan 1 2006	Sablefish
06-003	2006	CDFO	S. MacLELLAN	ODFW,NMFS-AFSC,DFO,ADFG-Juneau	Jan 1 2006	Sablefish
06-004	2006	NMFS-AFSC	D.ANDERL	ODFW,NMFS-AFSC,DFO,ADFG-Juneau	Jan 1 2006	Sablefish
insert rows above this line						

Agencies

ADFG = Alaska Department of Fish and Game (ADFG-ADU [Juneau]; ADFG-Kodiak; ADFG-Homer)

CDFG=California Department of Fish and Game

CDFO= Canada Department of Fisheries and Ocean

IPHC=International Pacific Halibut Commission

NOAA-NMFS=National Oceanic and Atmospheric --- National Marine Fisheries Service

ODFW= Oregon Department of Fish and Wildlife

PSMFC=Pacific States Marine Fisheries Commission

WDFW= Washington Department of Fish and Wildlife

Appendix IV

This is a rough draft copy of CARE Age Structure Exchange Invoice (CASE) that will take the place of the current Age Structure Exchange Table shown in Appendix III.

COMMITTEE OF AGE READING EXPERTS

AGE STRUCTURE EXCHANGE INVOICE

EXCHANGE ID NO.	DRAFT COPY NOT FINALIZED	SPECIES	
EXCHANGE YEAR		AREA	
ORIGINATING AGENCY		STRUCTURE	
O.A. COORDINATOR*		TECHNIQUE	
COOPERATOR(S)		PURPOSE	
		SAMPLE n=	
DATE INITIATED		NO. READERS	

SPECIMEN NUMBER	CAPTURE MM/DD/YY	AGENCY (1)	AGENCY (2)	AGENCY (3)	AGENCY (4)	AGENCY (5)	ORIGINAL SAMPLE ID
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
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22							
23							
24							
25							

COMMENT

DRAFT VERSION NOT FINALIZED

USE AND USER INFO: A CARE member initiates an exchange by requesting an Exchange Id number from the CARE Age Structure Exchange (CASE) Coordinator, the CARE vice chair. The CARE member conducts and completes the exchange and submits this completed invoice to the CASE Coordinator. Precision statistics are optional. This CARE Age Structure Exchange Invoice documents data resulting from a formal interlab exchange. Questions of these or associated data may be made to the above listed *coordinator of the originating agency.

PRECISION STATISTICS

AVERAGE % ERROR		INDEX OF PRECISION			
COEFFICIENT OF VARIATION		%AGREEMENT			

CANADA

British Columbia Groundfish Fisheries and Their Investigations in 2005

May 2006

Prepared for the 47th Annual Meeting of the Technical Sub-committee of the Canada-United States Groundfish Committee
May 2-3, 2006.
Otter Rock,
Oregon, U.S.A.

Compiled by

R.D. Stanley
Fisheries and Oceans Canada
Science Branch
Pacific Biological Station
Nanaimo, British Columbia
V9T 6N7

REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT, AND MANAGEMENT

Agency Overview

Fisheries and Oceans Canada (DFO), Science Branch, operates three principal facilities in the Pacific Region: the Pacific Biological Station (PBS), the Institute of Ocean Sciences (IOS), and the West Vancouver Laboratory (WVL). These facilities are located in Nanaimo, Sidney and West Vancouver, BC, respectively. Dr. Laura Richards is the Regional Director of Science. The Divisions and Sections are as follows:

Division Heads in Science Branch reporting to Dr. Richards are:

Canadian Hydrographic Service	Dr. Denis D'Amour
Ocean Science	Mr. Robin Brown
Salmon & Freshwater Ecosystems	Dr. Brian Riddell
Marine Ecosystems & Aquaculture	Mr. Ted Perry

Section Heads within the Marine Ecosystems & Aquaculture Division (MEAD) are:

Groundfish	Mr. Jeff Fargo
Invertebrates	Mr. Jim Boutillier
Pelagic Fish Research	Mr. Jake Schweigert (acting)
Conservation Biology	Mr. Jim Boutillier (Dr. Chris Wood, April 2006)
Applied Technologies	Mr. Ken Cooke (acting)
Fish Health and Parasitology	Dr. Susan Bower
Aquaculture and Environmental Research	Dr. Steve MacDonald

Groundfish research and stock assessments are conducted primarily in the Groundfish Section and groundfish ageing and acoustics work is conducted in the Applied Technologies Section. The Canadian Coast Guard operates DFO research vessels. These vessels include the *W.E. Ricker*, *J.P. Tully* and *Neocaligus.*

The Pacific Region Headquarters of Fisheries and Oceans Canada are located at 401 Burrard Street (Vancouver BC, V6C 3S4). Management of groundfish resources is the responsibility of the Pacific Region Groundfish Coordinator (Ms. Diana Trager) within the Fisheries Management Branch in Vancouver, BC. Fishery Managers receive assessment advice from MEAD through the Pacific Scientific Advice Review Committee (PSARC). The Chair of PSARC (Mr. Al Cass) advises the Regional Management Committee on stock status and biological consequences of fisheries management actions, and works in consultation with the Canadian Stock Assessment Secretariat (CSAS) in Ottawa. Research documents can be viewed on the CSAS website http://www.pac.dfo-mpo.gc.ca/sci/psarc/ResDocs/res_docs_e.htm.

Trawl, sablefish (trap and hook-and-line), and halibut (hook-and-line) fisheries continue to be managed with Individual Vessel Quotas (IVQs). IVQs can be for specific areas or coastwide.

Within the general IVQ context, managers also use a suite of management tactics including time and area specific closures and bycatch limits. Management plans can be viewed on the website at http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/MPlans.htm.

Managers are currently implementing the "Groundfish Integration Strategy" for the 1996/1997 fishing years. In particular, DFO and the commercial fishery sectors (geartypes) are working towards an integrated fishery plan. Details can be viewed at http://www-comm.pac.dfo-mpo.gc.ca/pages/release/bckgrnd/2006/bg001_e.htm. The plan calls for movement towards individual and transferable quotas in the remaining commercial groundfish sectors. All vessels will require 100% monitoring of their discarded and retained catch.

Multispecies or Ecosystem Models

No update available at the time of report preparation.

By Species

Pacific Cod

Research Program

An age-determination protocol has been developed for Pacific cod using fin rays as the ageing structure. Comparisons were made between age readings from otoliths and fin rays, and fin rays gave a clearer interpretation. Five hundred fish, sampled during an abundance survey for the species in 2003, were aged using this technique. New samples will be collected from the west coast of Vancouver Island in 2006.

Stock Assessments

No new stock assessments for Pacific cod were conducted in 2005, or are planned for 2006.

Rockfish – offshore

Research Programs

Currently, DFO's groundfish survey program (synoptic surveys) controls all research work for the slope rockfish species. There was no directed research on slope rockfish in 2005.

Stock Assessment

There was no research directed at updating quota recommendations on slope rockfish in 2005. This section prepared stock status reports summarizing known information for three species – redbanded rockfish (*Sebastes babcocki*), rougheye rockfish (*S. aleutianus*), and longspine thornyhead (*Sebastolobus altivelis*). These documents act primarily as peer-reviewed papers that can be cited by the Canadian Ministry of Environment's Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to assess species potentially at risk. These reports will also

appear as 2006 research documents on the CSAS website (http://www.dfo-mpo.gc.ca/csas/Csas/Home-Accueil_e.htm).

Research Activities for 2006

No research activities are planned for slope rockfish planned in 2006. There is a possibility that Pacific ocean perch (*S. alutus*) will be assessed for quota recommendations. A status report on shortspine thornyhead (*Sebastolobus alascanus*) may also be requested.

Rockfish – Shelf

Research Programs in 2005

There was no new directed work on any shelf rockfish species in 2005. Staff efforts were directed at the multiple species bottom trawl surveys (see below).

Stock Assessments in 2005

In conjunction with non-DFO authors, DFO staff developed a stock status report on canary rockfish (*Sebastes pinniger*) for internal review and submission to COSEWIC. It is currently under review by COSEWIC. A formal recommendation on its status is scheduled for 2007. The DFO version will appear as a 2006 research documents on the CSAS website (http://www.dfo-mpo.gc.ca/csas/Csas/Home-Accueil_e.htm).

Research Activities Planned for 2006

Staff will continue to participate in the conduct and analysis of bottom trawl surveys. There are no plans for directed research work on shelf rockfish for 2005.

Rockfish – Inshore

Research Programs in 2005

Since 2003, an observer has been deployed on the International Pacific Halibut Commission (IPHC) Area 2B setline survey to collect complete hook-by-hook catch data and conduct biological sampling of non-halibut catch. The survey was conducted from May to July in 2005 onboard three charter vessels: *F/V Pender Isle*, *F/V Proud Venture*, and *F/V Star Wars II*. One hundred and seventy sets were completed in depths up to 268 fathoms. Spiny dogfish dominated the catch at 42% of the total number of fish landed, followed in rank by Pacific halibut, sablefish, arrowtooth flounder, redbanded and yelloweye rockfish, respectively. A total of 14 species of rockfish were landed on the survey and close to 3,500 were sampled for length, sex, maturity and otoliths. This program is funded by the Pacific Halibut Management Association (PHMA) in addition to funding a half-time position from the Pacific Biological Station's Ageing lab to assist in the ageing of rockfish samples.

A longline survey, designed in 2003 and repeated in 2004 in the northern portion of the Strait of Georgia (4B) Statistical Areas (SA) 12 and 13, was moved to survey the southern Strait of Georgia, SAs 14 – 20, 28 and 29 in August and September 2005. Survey locations were selected using a depth stratified (41 – 70 m and 71 – 100 m) random design. Eight percent of the total number of blocks in each statistical area were randomly selected and fished, for a total of 89 sets. Over 6000 fish were sampled on the survey including 412 rockfish. Spiny dogfish dominated the catch and represented 91% of the total numbers of fish landed. Seven species of rockfishes were encountered on the survey, including 211 yelloweye and 146 quillback rockfishes which were the most commonly observed rockfish species. Quillback rockfish catch rates were significantly lower in the southern portion, compared with the northern portion of the Strait of Georgia. No differences were seen in the yelloweye rockfish catch rates between these two areas.

Using a small ROV, a 5 km by 6 km area was surveyed off the east coast of Gabriola Island in the southern portion of the Strait of Georgia (4B) in March 2005. Research was conducted to develop ROV survey methods and provide fish density and habitat data for use in quillback rockfish biomass estimation. Over all habitats, densities were 4200 fish/km^2 (95% CI 2760).

A submersible survey was conducted in the Juan Perez Sound area of the Queen Charlotte Islands in May 2005. Habitat maps were developed using acoustic multibeam data and a survey grid was stratified by habitat type (high and low proportions of rock ridge). Grid blocks for each stratum were chosen at random to survey with the Aquarius submersible. Quillback density by habitat type was determined and expanded to abundance by the amount of habitat in the 220 km^2 survey area. The preliminary abundance estimate of quillback rockfish in the survey area is about 2 million fish.

A short 5-day survey using the ROV '*ROPOS*' was conducted in the southern portion of the Strait of Georgia in the fall of 2005. The work focused on surveying rocky reefs in the area of Trincomali Channel to obtain visual population estimates which could be compared to population estimates derived from a genetic tagging study undertaken by SFU over the past several years. A number of rocky reefs, identified by a commercial rockfish harvester as rockfish habitat, were also surveyed.

Stock Assessment

No stock assessments were conducted in 2005. National Advisory Process (NAP) and COSEWIC status reports were prepared for yelloweye and quillback rockfishes. COSEWIC will review the status of these rockfish species in 2006 and determine whether a listing is warranted.

Management Actions for 2005

In 2004 and 2005, the rockfish sustainability team (RST), worked with stakeholders through various advisory processes, publicly held workshops and the Department's consultation website to identify Rockfish Conservation Areas (RCAs) that encompass 20% of rockfish habitats on the outside coast area (excluding area 4B) and 30% of the rockfish habitats within in the Strait of Georgia (area 4B). RCAs are used as a management tool to protect rockfish. Fishing activities

likely to catch rockfish are prohibited (http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/fisheriesmgmt/rockfish/default_e.htm)

Research Activities Planned for 2006

A two-day workshop was held in Richmond BC with participation from the Alaska Department of Fish and Game (ADFG) in Sitka, Washington Department of Fish and Wildlife (WDFW) in Montesano and Mill Creek; National Marine Fisheries Service Northwest (NWFSC) and Southwest (SWFSC) Fisheries Science Centers; and DFO. The first day of the workshop was devoted to agency presentations. The second day was devoted to demonstrations of software and GIS tools developed and used by agencies to manipulate, analyze and display habitat data. A steering committee was formed and all agencies were asked to designate a member to the committee. The steering committee will plan the logistics for a comprehensive workshop around the proposed themes of GIS tools, survey methods and stock assessment methods and has suggested it take place in the winter of 06/07.

DFO will continue to coordinate and compile the hook-by-hook catch composition and rockfish biological sample collection on the IPHC setline survey in 2006. The cost of the contracted observer and additional vessel costs are borne by the halibut industry.

An ROV survey is planned for June in the upper portion of the Strait of Georgia (4B) management region to develop survey methods for the Phantom ROV and compare abundance and catch rate estimates. Ten study sites in this area were surveyed using jig fishing gear in 2004. Further DNA genetic analyses are planned to delineate the inside from the outside coastal yelloweye rockfish stock.

Design and development of a research and monitoring program for the assessment of rockfish conservation areas (RCAs) is planned in collaboration with the University of British Columbia. The research will address three questions:

1. What determines the effectiveness of RCAs for promoting recovery of rockfishes?
2. What are the effects of RCAs on near-shore community structure and ecosystem function?
3. How are RCAs connected by larval dispersal and how does this shape population structure, abundance and resilience along the coast?

A stock assessment model and rebuilding analysis for yelloweye rockfish within a Species at Risk (SARA) framework is underway.

Sablefish

Stock Assessment Activities in 2005

Sablefish stock assessment and management in British Columbia is conducted cooperatively by DFO and the Canadian Sablefish Association (CSA). This cooperative relationship is formalized

as a Joint Project Agreement (JPA) that identifies the respective responsibilities of the two parties and provides a mechanism for joint contributions to fishery management and science activities for sablefish. Government management, enforcement and science staff are in part funded by the CSA through the JPA. The CSA also contributes their expertise related to the commercial fishery and fishing methods and hires contracted scientific staff to collaborate with DFO staff.

An assessment of sablefish completed in January 2005 (Haist et al. 2005) relied on the interpretation of trends in four stock indices that relate to the trap-vulnerable component of the BC sablefish population. The stock indices were nominal commercial trap catch rates (kg/trap), standardized commercial trap catch rates (kg/trap), standardized trap survey catch rates (numbers/trap), and tagging estimates of trap-vulnerable biomass. A tagging model with monthly time steps was integrated with the catch rate based indices of relative abundance. Model assumptions included constant rates of natural mortality and emigration from the BC trap-vulnerable population. Recruitment parameters were estimated for each year and these represented all additions to the trap-vulnerable biomass in BC including new year-classes entering the trap-vulnerable population for the first time, fish immigrating to the region and becoming vulnerable to the trap fishery, and fish becoming vulnerable to trap gear through behavioural or other mechanisms. Age-structured data were not available because unresolved problems in ageing methodology have postponed the accumulation of catch at age information since 1996. A Bayesian approach, based on the Markov Chain Monte Carlo (MCMC) algorithm was used to estimate the joint posterior distribution of model parameters. The integrated tagging model was used to conduct 5-year stock projections at constant TAC levels. A series of performance measures were calculated for each projection to assist in the selection of short-term TACs.

Subsequent to the 2005 assessment, catch rates from the fall 2005 standardized survey continued to indicate above average sablefish abundance compared to the historical record, and especially high abundance compared to the historic low 2001-2002 period. Although coast-wide standardized survey catch rates were about twice as high in 2005 compared to 2002, they have declined by approximately 20% and 26% by numbers and weight, respectively since 2004. The 2005 stratified random survey is approximately 10% lower by weight and 25% lower by numbers than in 2003; however, both weight and numbers per trap are essentially unchanged since 2004. Trap fishery data to July 31, 2005 indicated mean monthly catch rates during the winter of 2004-2005 were lower than the long term average, but were greater than catch rates achieved during the 2001-2002 period. Shallow-water (<550m) trawl catch rates of sablefish showed distinct peaks in 2001-2004 for Area 3C (southern west coast of Vancouver Island) and in 2002-2004 for Area 3D (northern west coast of Vancouver Island). The pattern over time in the trawl data is consistent with the expected timing of 1999/2000 year-class fish entering the offshore region, and is also consistent with increases in survey and fishery catch rates. Trawl catch rates of sablefish during 2005 are considerably lower indicating that these recruiting fish have probably left the shallow-water trawl zone. Patterns of stock index data in BC appear to be consistent with recent stock assessments completed for the Gulf of Alaska and west coast sablefish stocks in the United States.

Stock Assessment Activities Planned for 2006

No stock assessment for BC sablefish is scheduled at this time. Updating of stock indices takes place annually and these data are summarized for fishery managers and industry advisory committees. A management strategy evaluation for BC sablefish was initiated in early 2006 and the coast-wide research and stock assessment survey is planned for fall 2006.

Research Activities in 2005

The annual research and stock assessment survey program was conducted in the fall of 2005 using two chartered commercial fishing vessels (Wyeth et al. 2006a, b). The traditional fixed locality standardized survey and tagging program was repeated using longline trap gear at offshore and mainland inlet sites. A new stratified random survey (5 spatial and 3 depth strata coast-wide) was introduced as a pilot project in 2003 and was continued in 2004 and 2005. Like the fixed locality survey, the stratified random survey uses trap gear similar to that employed by the directed trap fishery. Sablefish were tagged and released, standardized catch rate data collected, and biological samples were obtained. The long-term intent is to replace the fixed locality standardized survey and tagging program with the new stratified random survey that simultaneously accomplishes both stock indexing and tag releases. Survey tasks in 2004 and 2005 were divided between the two chartered commercial fishing vessels.

The standardized charter vessel conducted sets at nine fixed offshore indexing localities and five mainland inlet localities. Catch rates from these sets provide a relative abundance index from 1990 to the present. In addition, sablefish were tagged and released from the sets fished in the mainland inlet localities.

The tagging charter vessel conducted tagging sets at six offshore tagging localities and nine offshore indexing localities. These traditional tagging sets followed protocols used since 1995. The tagging charter vessel also conducted the stratified random sampling survey.

Of the 55,462 sablefish captured during the 2004 survey (Wyeth et al. 2006a), 19,039 were tagged and released, 294 previously tagged sablefish were recovered, and 10,379 fish were sampled for biological data. A report that summarizes the 2005 survey is in preparation (Wyeth et al. 2006b).

Research Activities Planned for 2006

Research over the next several years will be focused on completing a management strategy evaluation for sablefish in British Columbia. The first phase of this project in 2006/2007 will require the development of computer software and several stock management scenarios to provide a basis for collaborative discussion with fishery managers and the fishing industry. Closed-loop simulations conducted in the course of the evaluation will be used to identify a robust harvest rule and to evaluate the requirements for survey and fishery dependent data programs. The annual research and stock assessment coast-wide survey is planned for fall 2006.

Flatfish

Stock Assessment Activities in 2005

Two flatfish assessments were prepared in 2005, Arrowtooth flounder (*Atheresthes stomias*), commonly referred to as turbot and Rock sole (*Lepidopsetta bilineata*). Arrowtooth flounder was assessed in response to a request from the Groundfish Management Unit (GMU) to examine the basis for increased levels of harvest. Arrowtooth flounder has long been difficult to market with, on average, over half the catch weight discarded annually. However in 2005 catches and landings increased dramatically as a result of improved markets. GMU initially responded to this increase by allowing turbot catches to remain uncapped and to request a PSARC paper which would design an "adaptive management" experimental increase in harvest. Monitoring programs, survey data, and biological samples where reviewed and analyses of CPUE, by-catch and spatial trends in the fishery were presented. It was recommended that the existing catch of 20,000 t be continued for two more years to allow indexing surveys to obtain an additional data point following the increase in catches as well as improved biological sampling and updated analysis the following year.

This paper was rejected by the PSARC sub-committee because there was a consensus amongst committee members that the principle recommendation of the paper, a maintained harvest of 20,000 t, was not supported by the data or analyses presented in the paper. Further it was felt that the recommendation did not reflect the uncertainty in the data, was not precautionary, and was not an adaptive management experiment owing to the lack of a control or reserve area.

Rock sole were last assessed in 2000. The intent of the assessment was to examine new data including a full 10 years of at sea observer catch data, updated and expanded catch/age matrices, and expanded synoptic bottom trawl survey data. In addition, the assessment afforded the first opportunity to examine the impacts of the IVQ program on catch reporting, discarding, and fisher behavior.

The rock sole stock in region 5AB (Queen Charlotte Sound) was assessed using a females-only delay-difference model tuned to biomass indices derived from fishery catch per unit effort (CPUE) and mean fish weight data derived from commercial landings. The main uncertainty investigated in the region 5AB modeling was the difference in stock status associated with a standardized or nominal arithmetic biomass index series generated from the analysis of fishery CPUE data. The rock sole stock in region 5CD (Hecate Strait) was assessed using a females-only age-structured age model tuned to commercial trawl fishery catch rates and two fishery-independent surveys. The interpretation of rock sole status in Hecate Strait was also dependent on whether a standardized or nominal arithmetic fishery catch rate abundance index was modeled.

Both stock assessments used a Bayesian approach to portray output uncertainty. In each case the model and the posterior probability density were used to conduct stock projections over a range of constant annual catch levels. The projections indicate the expected outcomes that arise from adopting a fixed annual catch over the projection period. Performance measures were calculated for each projection to assist the selection of short-term catches.

The principal recommendation of the assessment was a reduction of the quota in area 5AB from 875 to ~ 400 t, the quota recommendation for area 5CD remained essentially unchanged and advice was not given for area 4B or 3CD.

Stock Assessment Activities Planned for 2006-2007.

No assessments are planned for 2006-2007.

Research Activities in 2005

Excluding the multispecies groundfish swept area trawl surveys conducted in 2005 and planned for 2006; no directed research on the flatfish stocks was conducted in 2005 or planned for 2006.

Pacific Hake

Stock Assessment

A new stock assessment had been prepared jointly by Canadian and US scientists. The new stock assessment included additional data for catch, catch-at-age and juvenile pre-recruit abundance in 2005 and a new acoustic survey. As was the case in previous years, the major source of uncertainty was the value of the catchability coefficient (q) for the acoustic survey. As was done in the two previous assessments, two scenarios for the stock size and catch projections were developed based on alternative models (q=1.0 and q=0.69). Both were identified as equally likely, and decision tables were generated for both models.

Elasmobranchs

Research Programs in 2005

An examination of potential age determination methods for big skate (*Raja binoculata*) was accepted for publication. Vertebral centra sectioned longitudinally, immersed in ethanol, stained with crystal violet and enhanced with a thin layer of mineral oil produced the best results. Age compositions were produced and growth curves estimated. The method was also utilized for centra of longnose skate with good results.

A tag/recapture program to examine stock discreteness of big skate, initiated in 2003 was continued in 2004 and 2005. Approximately 4316 big skate were tagged and released, bringing the total number of skates tagged and released to 11661 fish. As of December 2005, 876 skates were recaptured (267 were re-released).

In October 2005, a synoptic longline survey for spiny dogfish was conducted at 10 sites (5 depth strata /site) in the Strait of Georgia. The objectives of the survey were: 1) collect biological and catch/effort data at all sites/depths, and 2) compare catch rates of dogfish to previous surveys conducted in 1986 and 1989.

Stock Assessment in 2005

No assessments were conducted on BC elasmobranchs. COSEWIC status reports on big skate, longnose skate, sandpaper skate, six-gill shark, brown cat shark, and soupfin shark are being prepared and will be submitted in April 2006.

Management

There are no directed fisheries allowed for sharks (excluding spiny dogfish, *Squalus acanthias*) in BC waters; therefore sharks are bycatch only. There is no immediate concern regarding the bycatch of sharks in BC fisheries, therefore no specific recommendations are made. However, the bycatch should be monitored by species and area in order to ensure that future productivity of BC sharks is not compromised.

Increases in directed catch of skate prompted management to examine options for the 2002/2003 and subsequent fishing years. This resulted in a catch "cap" of 850 t on Hecate Strait (Area 5C/D) big skate in 2002/03, which was continued in 2005/06.Of this the trawl fleet has a quota of 567 t. No quotas are in effect in other areas. In April 2004, a monthly landing limit (coastwide) of 5.7 t was implemented for longline vessels.

Research Activities Planned for 2006.

The tagging program for big skate will be continued in 2006.

Lingcod

Research Programs in 2005

Lingcod abundance surveys were continued in the Strait of Georgia in 2005 -- a hook and line for juveniles and adults, a larval survey, bottom trawl for young of year, and a dive survey for juvenile and adults. Community dive surveys for lingcod and rockfish densities, coupled with egg mass surveys sponsored by DFO, were expanded and included communities throughout the Strait of Georgia.

Stock Assessment

No assessment was conducted on offshore lingcod stocks in 2005. No assessment was conducted on Strait of Georgia lingcod stocks in 2005 but a Management Framework was developed for the Strait of Georgia lingcod population which identified rebuilding targets and timeframes for this severely depressed stock.

Research Activities Planned for 2006

The lingcod abundance surveys will be continued in the Strait of Georgia in 2006.

D. Other Related Studies

Statistics and Sampling

Database Work in 2005

Principal statistics and sampling activities in 2005 included the ongoing population of the groundfish biological database (GFBio). This database now includes about 7,100,000 specimens. Data entry activities continue to concentrate on input of current port sampling and observer biological data and recent research cruises. When time is available, the database is backfilled with research cruise data collected before 1997. This past year involved a considerable effort in the entry of historic sablefish and Pacific hake research cruises. Approximately 50% of the person year dedicated to Groundfish Statistics and Sampling was committed to assisting in data uploads of the trawl observer biological data and providing catch data summaries. The groundfish trawl fishery continues to be covered by 100% dockside and virtually 100% observer coverage. These observers also provided 529 length/sex/age samples and 294 length samples in 2005. Port samplers provided an additional 177 samples, 143 samples with ageing structures (length/sex/age/weight) and 46 without structures (length/sex/weight). The focus of their sampling efforts was from those fisheries not covered by at-sea observers.

Hook-and-line and sablefish trap landings have 100% dockside validation. Observer coverage in the hook-and-line fishery was initiated in 2000 and continues to provide about 5-15% coverage.

Field Work in 2005

Staff participated in various bottom trawl surveys including the Hecate Strait and Queen Charlotte Sound groundfish surveys, and the Queen Charlotte Sound and West Coast Vancouver Island shrimp trawl surveys. This group also included the port sampling activity (1.8 person-years) in the Vancouver and Prince Rupert areas.

Proposed Field Work for 2006

Port sampling will continue in 2006, as will staff participation in the bottom trawl surveys (West Coast of Vancouver Island and the new West Coast Queen Charlotte Islands groundfish synoptic surveys, as well as the shrimp trawl survey in Queen Charlotte Sound and the west coast of Vancouver Island.

Proposed Catch Monitoring Research and Development in 2006

Staff will be participating in implementation of the Electronic monitoring system in the hook and line fisheries. The overall implementation of the new Groundfish Integration Strategy will require support from Science Branch. The key elements of the system are:

1) full accountability for all catches (retained and discarded);
2) updates of individual fishers' catch histories within 24-hours of unloading;

3) the ability of the system to collate data from multiple providers (multiple contractors) at the same time.

Staff will also develop one Discussion Paper on the adequacy and cost effectiveness of the current package of "population indexing" surveys. It appears that almost $4 million/y is spent on surveys which provide time series of relative abundance for groundfish populations. It seems prudent to review the entire survey package with respect to cost effectiveness and for an examination of its strengths and weaknesses. Staff is also developing a second Discussion Paper with the intent of a comprehensive review of the current bio-sampling of groundfish in the BC region. This paper will represent a companion paper to the review of the survey package.

APPENDIX 1. REVIEW OF CANADIAN GROUNDFISH FISHERIES

1. Commercial fisheries

All catch figures for 2005 are preliminary. Canadian domestic trawl landings of groundfish (excluding halibut) in 2005 were 136,110 t, an increase of 30% from the 2004 catch. This increase was mainly accounted for by a 34% increase in landings of Pacific hake and a 204% increase in landings of turbot. The major species in the trawl landings were Pacific hake (65%), turbot (12%), Pacific Ocean perch (4%), and yellowtail rockfish (3%). Principal areas of trawl production were 3C (54%), 5D (9%), 4B (7%), 5B (7%) and 3D (6%).

Canadian landings of groundfish caught by gear other than trawl in 2005 totalled 8,816 t. Landings by trap and longline gear accounted for 4,416 t, approximately 73% by trap gear and 27% by longline gear. Sablefish accounted for more than 99% of the landed amount. Landings of species other than sablefish by longline, handline and troll gear accounted for 5,656 t (85% dogfish, 13% rockfish and 13% lingcod).

2. Recreational Fisheries

Each year, the Fisheries Management Branch of DFO conducts creel surveys of the recreational angling fishery in the Strait of Georgia. Principal target species are Chinook and Coho salmon. In 2005 these surveys covered the months of May to October. Provisional estimates of 2005 catches, landings and discards, for this 6-month period were 10,908 fish for lingcod, 14,764 fish for all rockfish species, 23 fish for halibut, 8,637 fish for flatfish, 16,139 fish for dogfish, 1,832 fish for greenlings, 393 fish for cabezon and 94 fish for others.

Creel surveys were also conducted in Juan de Fuca Strait during 2005. These surveys covered the months of January to December. Provisional estimates of 2005 catches were 9,817 fish for lingcod, 13,565 fish for all rockfish species, 7,626 fish for dogfish, 1,468 fish for halibut, 372 fish for flatfish, 597 fish for cabezon, 3,222 fish for greenlings and 5,635 fish for other species.

Along the west coast of Vancouver Island catch estimates have been generated from creel surveys and fishing lodge reports. Data are available for June to September. Provisional estimates of 2005 catches were 9,867 fish for lingcod, 42,830 fish for all rockfish species, 37,042 fish for halibut, 6,100 fish for dogfish, 496 fish for flatfish, 474 fish for cabezon, 1,327 fish for greenlings and 4,974 fish for other species.

In Johnstone Strait, catch estimates have been generated from creel surveys and fishing lodge reports for July and August. Provisional estimates of 2005 catches were 1,362 fish for lingcod, 4,764 fish for all rockfish species, 4,235 fish for halibut, 2,678 fish for dogfish, 1,767 fish for flatfish and 263 fish for greenlings.

3. Joint-venture fisheries

In 2005, 29 Canadian catcher vessels delivered Pacific hake and incidental species to one processing vessel in a co-operative fishing arrangement. This fishery took place off the southwest coast of Vancouver Island (Area 3C). A total of 58,892 t of Pacific hake was processed by a single Russian vessel. The quotas and catches are outlined below:

Nation	Species	Quota (t)	Catch (t)
Poland	Hake	15,178	15,695
	Pollock	incidental	tr.
	Rockfish	incidental	55
	Other	incidental	422

4. Foreign fisheries

There were no national or supplemental fisheries for Pacific hake off southwest Vancouver Island (Area 3C) in 2005.

APPENDIX 2. GROUNDFISH RELATED REPORTS PUBLISHED IN 2005/06.

1. Primary Publications

Andrews, A.H., L.A. Kerr, G.M. Cailliet, T.A. Brown, C.C. Lundstrom, and R.D. Stanley. (in press). Age validation of the canary rockfish (*Sebastes pinniger*) using two independent otolith techniques: lead-radium dating and the bomb radiocarbon chronometer. Marine and Freshwater Research.

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Beamish, R.J., G.A. McFarlane and A. Benson. 2006. Longevity overfishing. Prog. in Oceanography 68: 289-302.

Branch, T.A., K. Rutherford and R. Hilborn. 2006. Replacing trip limits with individual transferable quotas: implications for discarding. Marine Policy. 30: 281-292.

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McFarlane, G.A. and J.R. King. (in press). Age and growth of big skate (Raja binoculata) and longnose skate (Raja rhina) in British Columbia waters. Fish. Res.

McFarlane, G.A. and J.R. King. (in press). Re-evaluating the age determination of spiny dogfish (Squalus acanthias) using oxytetracycline and fish at liberty up to twenty years. Am. Fish. Soc. Sym.

Schnute, J. 2005. Mathematics and fisheries: match or mismatch? 2004 Conference on Differential Equations and Applications in Mathematical Biology, Nanaimo, BC, Canada. Electronic Journal of Differential Equations, Conference 12, 2005, pp. 143–158. ISSN: 1072-6691. URL: http://ejde.math.txstate.edu or http://ejde.math.unt.edu, ftp ejde.math.txstate.edu (login: ftp)

Sinclair, A.F., and Crawford, W.R. 2005. Incorporating an environmental stock-recruitment relationship in the assessment of Pacific cod (Gadus macrocephalus). Fish. Ocean. 41: 138-150.

Shelton, P.A., Sinclair, A.F., Chouinard, G.A., and Mohn, R. 2006. Fishing under low productivity conditions is further delaying recovery of Northwest Atlantic cod (Gadus morhua). Can. J. Fish. Aquat. Sci. 63: 235-238.

Stanley, R.D. and A.R. Kronlund. 2005. Life history characteristics for silvergray rockfish (Sebastes brevispinis) in British Columbia waters and the implications for stock assessment and management. Fish. Bull. 103: 670-684.

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Wrona, F., T.D. Prowse, and J.D. Reist (Contributing Authors: R.J. Beamish, J.J. Gibson, J. Hobbie, E. Jeppesen, J.R. King, G. Koeck, A. Korhola, L. Lévesque, R. Macdonald, M. Power, V. Skvortsov, W. Vincent). 2005. Chapter 8: Freshwater Ecosystems and Fishes pp. 353-452. In Arctic Climate Impact Assessment Scientific Report. Cambridge University Press. 1042 p.

2. Other Publications

Beamish, R.J., A. Yatsu, E.P. Dulepova, X. Jin, J.R. King, J.Y. Kim, S. Kim., V.B. Klyashtorin, L.L. Low, G.A. McFarlane, and C.I. Zhang. (in press). Impacts of climate and climate change on the key species in the subarctic Pacific. PICES Working Group 16 Final Report. PICES Scientific Report No.33.

Haggarty, D.R. and J.R. King. 2005. Hook and Line Survey of Lingcod (Ophiodon elongatus) and Rockfish (Sebastes sp.) Stocks in Northern Strait of Georgia (Statistical Areas 13, 14 and 15) June 14 – July 9, 2004. Canadian Technical Report of Fisheries and Aquatic Sciences 2590. 57 p.

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Haigh, R., N. Olsen, and P. Starr. 2005. A review of longspine thornyhead *Sebastolobus altivelis* along the Pacific coast of Canada: biology, distribution, and abundance trends. Canadian Science Advisory Secretariat, Research Document, 2005/097, 38 pp.

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Haist, V., A.R. Kronlund, and M.R. Wyeth. 2005. Sablefish (*Anoplopoma fimbria*) in British Columbia, Canada: Stock Assessment for 2004 and Advice to Managers for 2005. Canadian Science Advisory Secretariat Research Document 2005/031.

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Wallace, S., G. McFarlane and J.R. King. 2006. COSEWIC status report on brown cat shark (Apristurus brunneus). Committee on the Status of Endangered Wildlife in Canada. Ottawa. 26 p.

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Yamanaka, K.L., Lacko, L.C., Withler, R., Grandin, C., Lochead, J. K., Martin, J.C., Olsen, N., and Wallace, S.S. 2006. A review of yelloweye rockfish *Sebastes ruberrimus* along the Pacific coast of Canada: biology, distribution and abundance trends. Canadian Science Advisory Secretariat Research Document 2006, 54 p.

Yamanaka, K.L., Lacko, L.C., Miller-Saunders, K., Grandin, C., Lochead, J. K., Martin, J.C., Olsen, N., and Wallace, S.S. 2006. A review of quillback rockfish *Sebastes maliger* along the Pacific coast of Canada: biology, distribution and abundance trends. Canadian Science Advisory Secretariat Research Document 2006, 54 p.

APPENDIX 3. GROUNDFISH STAFF IN 2005

S. Acheson	Groundfish port sampling
W. Andrews	Elasmobranchs
K. Anderson	Groundfish port sampling
E. Choromanski	General stock assessment and biology, flatfish, field technician
K. Cooke	Database technician
J. Fargo	Section Head, stock assessment and biology, flatfish
C. Grandin	Biologist, GIS, programmer, inshore rockfish
R. Haigh	Statistical and exploratory data analysis, thornyhead and slope rockfish
D. Haggerty	Lingcod
V. Hodes	Lingcod and elasmobranchs
G. Jewsbury	Seconded to salmon group
J. King	Lingcod, climate studies
B. Krishka	Biological data control and analysis, thornyhead and slope rockfish
R. Kronlund	Sablefish, analytical programs
L. Lacko	Hook and line database manager, GIS specialist, inshore rockfish
J. Lochead	Inshore rockfish stock assessment and biology
G. A. McFarlane	Groundfish population dynamics and biology, fish/ocean interaction, elasmobranchs
L. MacDougall	Research planning and coordination
J. Martin	Inshore rockfish stock assessment and biology
W. Mitton	Sablefish
N. Olsen	Biologist/programmer/GIS, Shelf rockfish
K. Rutherford	Biologist/database manager, Shelf rockfish
J. Schnute	Stock assessment; mathematical analysis, mentoring, thornyhead and slope rockfish
A. Sinclair	Pacific cod assessment and ecosystem research
R. Stanley	Shelf rockfish stock assessment and biology, groundfish statistics.
M. Surry	Lingcod
G. Workman	Port sampling, Pacific Cod, Survey design
M. Wyeth	Sablefish stock assessment and biology
L. Yamanaka	Inshore rockfish stock assessment and biology

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

International Pacific Halibut Commission Staff
January 17, 2006

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.

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 the 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 was 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

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 FY 2006 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. FY 2006 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 are 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. T he 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 FY 2006 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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 one to seven 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.

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.

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.

Northwest Fisheries Science Center

National Marine Fisheries Service

2006 Agency Report to the Technical Subcommittee

of the Canada-U.S. Groundfish Committee

April 2006

Review of Agency Groundfish Research, Assessments, and Management

A. Agency Overview

The Northwest Fisheries Science Center (NWFSC) provides scientific and technical support to the National Marine Fisheries Service (NMFS) for management and conservation of the Northwest region's marine and anadromous resources. The Center conducts research in cooperation with other federal and state agencies and academic institutions. Five divisions, Conservation Biology, Environmental Conservation, Fish Ecology, Resource Enhancement and Utilization Technologies, and Fishery Resource Analysis and Monitoring, conduct applied research to resolve problems that threaten marine resources or that deter their use. The Center's main facility and laboratories are located in Seattle. Other Center research facilities are located in Pasco, Big Beef Creek, Mukilteo, and Manchester, Washington; Newport, Hammond, and Clatskanie, Oregon; and Kodiak, Alaska.

The Fishery Resource Analysis and Monitoring Division (FRAMD) is the source focus for most of the research reported by the NWFSC to the Technical Subcommittee of the Canada-US Groundfish Committee. The FRAMD works in partnership with state and federal resource agencies, universities, and the groundfish industry to achieve a coordinated groundfish program for the West Coast.

FRAM consists of a multi-disciplinary team with expertise in fishery biology and ecology, stock assessment, mathematical modeling, statistics, computer science, and field sampling techniques. Members of this program are stationed at both the NWFSC in Seattle and in Newport, Oregon. Together, they work to develop and provide scientific information necessary for managing West Coast marine fisheries and strive to provide useful and reliable stock assessment data with which fishery managers can set ecologically safe and economically valuable harvest levels. FRAM researchers develop models for managing multispecies fisheries; design programs to provide information on the extent and characteristics of bycatch in commercial fisheries, as they look at methods to reduce fisheries bycatch; characterize essential habitats for key groundfish species; investigate the design, feasibility, function, and value of marine protected areas; and employ advanced technologies for new assessment.

During 2004, the FRAMD continued to: implement a West Coast observer program; build a survey program that will conduct West Coast groundfish hydroacoustic and trawl surveys previously conducted by the AFSC; and further augment its stock assessment, economics, and ecosystem research. Significant progress continues in all programs.

For more information on FRAMD and groundfish investigations, contact the Division Director, Dr. M. Elizabeth Clarke, at Elizabeth.Clarke@noaa.gov, (206) 860-3381.

The Conservation Biology Division is responsible for characterizing the major components of biodiversity in living marine resources, using the latest genetic and quantitative methods. It also has responsibility for identifying factors that pose risks to these components and the mechanisms

that limit natural productivity. The Division's multi-disciplinary approach draws on expertise in the fields of population genetics, population dynamics, and ecology.

The Environmental Conservation Division (ECD) conducts nationwide research on the effects of chemical pollution and harmful algal blooms on habitat quality and fisheries resources. ECD is also a leader in NMFS' National Marine Mammal Health and Stranding Response Program's biomonitoring and quality assurances projects.

The Fish Ecology Division's role is to understand the complex ecological linkages among important marine and anadromous fishery resources in the Pacific Northwest and their habitats. The Division particularly places emphasis on investigating the myriad biotic and abiotic factors that control growth, distribution, and survival of important species and on the processes driving population fluctuations.

The Resource Enhancement and Utilization Technologies Division draws together multi-disciplinary groups to address existing and developing challenges of captive rearing of salmon and other marine fish, improved hatchery practices, smolt quality, disease control, and developing technologies for full utilization of bycatch and fish processing waste.

For more information on Northwest Fisheries Science Center programs, contact the Center Director, Dr. Usha Varanasi, at Usha.Varanasi@noaa.gov, (206) 860-3200.

B. Multispecies Studies

Stock Assessment

SS2 Stock Assessment Model Development

This stock assessment model provides a statistical framework for calibration of a population dynamics model using a diversity of fishery and survey data. Such models were first developed in the 1980s (Fournier and Archibald, 1982; Methot, 1989). The Stock Synthesis model (Methot, 2000) was developed in 2 versions. One was an agelength structured model that was developed for assessment of west coast sablefish (Methot and Hightower, 1988) and the other was an age and geographic area model developed for Pacific whiting (Hollowed, Methot and Dorn, 1988). Both versions of synthesis were used for most West Coast groundfish and many Alaska groundfish stock assessments during the 1990s. The model documented in this report represents a conversion of synthesis from code written in FORTRAN to code written in C++ with ADMB (Otter Research Ltd., 2000). This conversion provides an opportunity to combine the two previous of synthesis while taking advantage of the advanced features of ADMB and the many lessons learned over the past 15 years with such models. Stock Synthesis 2 (SS2) is designed to deal with both age and size structure and with multiple stock sub-areas. Thus, it is most similar to A-SCALA (Maunders and Watters, 2003); Multifan (Fournier et al, 1990); Multifan-CL (Fournier, Hampton and Siebert, 1998); Stock Synthesis (Methot 2000) and CASAL (Bull, et al, 2004) in basic structure and intent. A general feature of such models is that they tend to cast the goodness-of-fit to the model in terms of quantities that retain the characteristics of the raw data. For example, age composition data that is affected by ageing imprecision is incorporated by building a sub-model of the ageing imprecision process, rather

than to pre-process the ageing data in an attempt to remove the effect of ageing imprecision. By building all relevant processes into the model and estimating goodness-of-fit in terms of the original data, we are more confident that the final estimates of model precision will include the relevant sources of variance.

For more information, please contact Dr. Richard Methot at Richard.Methot@noaa.gov

SS2 Stock Assessment Model Testing

This work was initiated in April 2005. Dr. Jim Colbert is currently writing programs to allow data output from the simulation program FSIM to be reformulated (transformed and reformatted) for use as input to the current assessment package, Stock Synthesis II (Version 19). Jim produced the first program in October 2005; that program created the length distribution, age distribution, and the length-at-age data blocks. A major revision and expansion was completed with documentation in November 2005; he wrote a design description and updated documentation for the revised program in December 2005; an expansion of the program to create a full Stock Synthesis fisheries data file (a <>.DAT file) was completed in February 2006, and we are expanding the program to produce alternate input options (viz., Age-at-Length tables) for use by SS-II to generate assessment results.

For more information, please contact Dr. Michael Schirripa at Michael.Schirripa@noaa.gov

C. By Species, By Agency

Shelf Rockfish

West Coast

Stock Assessments

The 2005-06 west coast groundfish stock assessments can be viewed online on the Pacific Fishery Management Council's website: http://www.pcouncil.org/groundfish/05gfstokasmts.html Links to each assessment document are provided below.

POP. Status and Future Prospects for the Pacific Ocean Perch Resource in Waters off Washington and Oregon as Assessed in 2005. Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/POP_05_Final_Assmt.pdf
For more information, contact Dr. Owen Hamel at Owen.Hamel@noaa.gov

Canary rockfish. Status of the U.S. Canary Rockfish Resource in 2005. Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/Canary_2005-complete_document.pdf
For more information, contact Ian Stewart at Ian.Stewart@noaa.gov

Other species assessed by the NWFSC or affiliated authors (graduate students or contracted individuals) include:

Cabezon. Status of Cabezon (*Scorpaenichthys marmoratus*) in California Waters as Assessed in 2005. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/Cabezon05_FINAL.pdf
For more information, please contact Stacey Miller at Stacey.Miller@noaa.gov

Yellowtail rockfish. Status of Yelloweye Rockfish off the U.S. West Coast in 2006. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/Yellowtail_Rockfish_Final_090605.pdf
For more information, contact John Wallace at John.Wallace@noaa.gov

Slope Rockfish

Stock Assessment

Darkblotched. Status of the Darkblotched Rockfish (*Sebastes crameri*) Resource in 2005. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/Darkblotched_Rockfish_Final_090605.pdf
For more information, contact Jean Rogers at Jean.Rogers@noaa.gov

Blackgill. Stock Assessment of the Blackgill Rockfish (*Sebastes melanostomus*) Population off the West Coast of the United States in 2005. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/BLACKGILL_ASSESSMENT_Complete_Final_8-31-05.pdf
For more information, please contact Dr. Tom Helser at Thomas.Helser@noaa.gov

Thornyheads

Stock Assessment

Longspine. Stock Assessment and Status of Longspine Thornyhead (*Sebastolobus altivelis*) off California, Oregon and Washington in 2005. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/LST_08_30_05.pdf
For more information, please contact Stacey Miller at Stacey.Miller@noaa.gov

Shortspine. Status and Future Prospects for the Shortspine Thornyhead Resource in Waters off Washington, Oregon, and California as Assessed in 2005. Can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks/SST_Assessment_Final2_8-31-2005.pdf
For more information, please contact Dr. Owen Hamel at Owen.Hamel@noaa.gov

Sablefish

Research

Sablefish recruitment in relation to oceanographic variables
Our study on sablefish recruitment was the first to study the relationship between environmental variables and recruitment. But how do we know if environmental variables really drive recruitment? We have now begun the development of a fish population dynamics modeling framework that will permit us to put known environmental input effects on recruitment, stock numbers, biomass and size distributions over time. To further explore how these types of relationships might be directly incorporated into fisheries assessment, we proposed a study that allows the examination of SS-II estimates of known, modeled environmental effects on fish populations and fisheries. FSIM (Goodyear 2005) is the model that we have chosen to generate "known" relationships. The general toolset (FSIM, Jim's programs, and SS2) will be used to examine how Stock Synthesis II fits known environmental inputs to known fish population and fishery dynamics. We will then be able to determine how the assessment software does in finding this implemented relationship between the environment and recruitment. This same package can be used to explore a much broader range of influences on the assessment process.

For more information, please contact Dr. Michael Schirripa at Michael.Schirripa@noaa.gov

Stock Assessment

Status of the Sablefish Resource off the Continental U.S. Pacific Coasts in 2005
Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/Sable05_complete.pdf
For more information, please contact Dr. Michael Schirripa at Michael.Schirripa@noaa.gov

Flatfish

Stock Assessment

English sole. Status of the U.S. English Sole Resource in 2005. Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/2005_English_sole_assessment.pdf

Dover sole. The Status of Dover Sole off the U.S. West Coast in 2005. Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/Dover05_Final.pdf.
Contact Stacey Miller at Stacey.Miller@noaa.gov for more information.

Petrale sole. Stock Assessment of Petrale Sole: 2004. Can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks/Final_Petrale_102405.pdf
Contact Stacey Miller at Stacey.Miller@noaa.gov for more information.

Pacific Hake

Stock Assessment

The 2005 hake assessment is not currently available online. However, the 2006 assessment is available.

D. Other Related Studies

Age, Growth and Maturity of Longnose Skate

This work was completed in 2005, resulting in Josie Thompson receiving a M.S. degree from Oregon State University. The results of this work are now being incorporated into a skate assessment to be presented to the Pacific Fishery Management Council in 2007.

For more information, please contact Dr. Michael Schirripa at Michael.Schirripa@noaa.gov

Stock Assessment -- Longnose Skate

During 2005, Dr. Vlada Gertseva has been collecting fisheries and survey data on Longnose skate that include catch data and biological information, such as length, sex, weight and age population structures. Presently, she is analyzing these data to obtain the essential parameters necessary for stock assessment. The stock assessment will be developed using the program Stock Synthesis II (SS2). She has been learning the structure and functions of SS2 and how to operate this program.

For more information, please contact Dr. Vlada Gertseva at Vlada.Gertseva@noaa.gov

Spatial Distribution of Groundfish

Dr. Gerteseva's second main research project is devoted to the development of a mathematical model of spatial distribution of west coast groundfish in response to multi environmental variables. This mathematical model will fundamentally improve marine fisheries stock assessment methods that currently do not account for spatial dynamics of fish due to environmental variation. Integrated into current assessment methods, this model will help correctly interpret fisheries data with consideration of environmental variation and make more accurate predictions of fish population abundance.

West Coast Essential Fish Habitat: Geologic and Geophysical Bottom Character Database and GIS for U.S. West Coast Groundfish

The database and GIS project for West Coast Essential Fish Habitat is a joint effort between Chris Goldfinger, Chris Romsos, Rondi Robison, Randall Milstein, and Beth Myers from the College of Oceanic and Atmospheric Sciences at Oregon State University, and Waldo Wakefield of the NWFSC FRAM Division.

The goal of this program, begun in 2001, was to create and use a comprehensive, helpful and easily accessible, multi-layered GIS database and associated CD-ROM-based products for groundfish habitat assessment in the Pacific Northwest. The database for Oregon and Washington has been linked to an integrated habitat database for California (Greene et al. 2004. Fisheries Habitat Characterization of the California Continental Margin, California Sea Grant Program Publication No. T-053). For the first time, marine researchers working along the U.S. West Coast have an integrated map of structural habitat for the entire region (San Diego, CA to Cape Flattery, WA). In addition, the combined GIS database for California, Oregon and Washington was used in the current Essential Fish Habitat Environmental Impact Statement for West Coast groundfish.

Version 1.0 of the maps for Oregon and Washington was completed in 2003. This release is entitled "Active Tectonics and Seafloor Mapping Laboratory Publication 02-01: Interim Seafloor Lithology Maps for Oregon and Washington Version 1.0". The interim habitat maps are now in use at the Northwest Fisheries Science Center. Investigators there are beginning to integrate fisheries data and benthic habitat data to look for associations, and to assess the state of existing benthic habitat data in terms of future needs.

The following section describes the basic elements incorporated in the initial version of the habitat maps. The interim map captured the essential habitat classifications to be found offshore Oregon and Washington, but due to time constraints, lacked ground-truthing, cross checking, and some of the components of rock prediction. Since delivery of the interim maps, work has continued in 2003 – 2005 on a second iteration of the habitat maps (Version 2) that will include detailed grain size mapping, fully cross-checked and ground-truthed rock prediction mapping, similar cross-checking, ground-truthing of lithologic data to resolve conflicts between datasets, and removal of artifacts. Version 2 will also include additional oil industry core samples from archives of the Minerals Management Service, as well as much more comprehensive interpretation of the sidescan datasets, quantitative classifications of bathymetry data, and will include significant new multibeam/backscatter datasets collected in 2002, 2003, 2004, and 2005.

For more information, contact Waldo Wakefield at Waldo.Wakefield@noaa.gov, (541) 867-0542 or Chris Goldfinger at gold@coas.oregonstate.edu.

West Coast Bycatch Reduction Research: Fish Behavior During Interactions with Bottom Trawls

The NWFSC has been collaborating with the Oregon Department of Fish and Wildlife on a project to obtain baseline information on the behavior of demersal fishes when they are overtaken by a bottom trawl. In situ information of this nature is critical to the successful development of future species-selective trawls and bycatch reduction devices for West Coast groundfish fisheries. Our project combined the use of conventional low-light video with the DIDSON ultrasonic imaging sonar (Dual-frequency IDentification SONar) to document and categorize fish behavior in front of and in the mouth of a bottom trawl. This work was conducted using a selective flatfish trawl -- a bottom trawl that has recently been shown to reduce roundfish bycatch while maintaining the catch rate of flatfishes. A complementary

project focused on building a catalog of enzyme activities as an indicator of species-specific burst swimming abilities for a broad range of groundfish species.

Milestones completed in calendar year 2005:

- This project represents the first successful application of a DIDSON sonar in bottom-tending mobile fishing gear. A novel set of mounting frames provided a stable platform for sonically imaging all areas in front of and in the mouth of the trawl (e.g., footrope, headrope, wings, and form of the footropes mud cloud).

- Acquired an extensive set of paired observations with video and DIDSON imaging of the same areas/fish targets, providing the first documentation of the efficacy of using a DIDSON sonar in mobile fishing gear.

- Pacific halibut, lingcod, Pacific hake, skates, and other flatfish were imaged routinely with the DIDSON. These preliminary observations will be the basis for the second phase of study to assess the methods to reduce bycatch.

- Provided information on the performance of the selective flatfish trawl: the speed and direction of movement of fishes, herding behavior, wing interactions, and footrope and headrope effects.

- Collected and analyzed tissue samples from over 15 species of West Coast groundfish for enzyme activities.

- Fostered collaborations on the use of the DIDSON sonar in bycatch research between the NW Fisheries Science Center, Oregon Department of Fish and Wildlife, and Alaska Fisheries Science Center.

This research was recently presented at the 14th Western Groundfish Conference (Matteson, K., W.W. Wakefield, R. Hannah, S. Parker. 2006. The first application of a DIDSON ultrasonic imaging sonar to observe fish behavior and net structure in a groundfish trawl. Presented at the14th Western Groundfish Conference, Newport, OR)

A second field season is planned for summer 2006.

For more information, contact Waldo Wakefield at Waldo.Wakefield@noaa.gov, (541) 867-0542 or Bob Hannah at Bob.W.Hannah@state.or.us, (541) 867-0300 or Keith Matteson at keith.m.matteson@state.or.us (541) 867-0300.

Cooperative Ageing Unit

The Cooperative Ageing Project (CAP) provides direct support for US West Coast stock assessments by providing ages derived primarily from otoliths. CAP has production aged the following species; canary rockfish (*Sebastes pinniger*), Pacific Ocean perch (*S. alutus*), Pacific hake (*Merluccius productus*), Dover sole (*Microstomus pacificus*), petrale sole (*Eopsetta*

jordani) and sablefish (*Anopoploma fimbria*). In addition, we are beginning to production age two new species of flatfish; arrowtooth flounder (*Atheresthes stomias*) and English sole (*Parophrys vetulus*). In addition to production ageing the CAP performs ageing related research. We examined the feasibility in utilizing otoliths versus interopercles for age determination in English sole. Otoliths are collected on NWFSC directed surveys, while interopercles are collected from state directed shoreside sampling from the commercial catch. This comparison study indicated that the otolith is acceptable in providing ages and therefore the survey collections can be utilized to gain a fishery independent estimate of biomass. We are also exploring the possibility of applying the thin section technique to darkblotched rockfish (*S. crameri*) otoliths. The otoliths from this species fade rather quickly when preparing the otoliths by break and burn. The otolith pattern should be conserved through the thin section process and therefore re-reads and re-examination of archived samples would be possible.

For more information, please contact Dr. Michael Schirripa at Michael.Schirripa@noaa.gov

Cooperative Resource Surveys

West Coast Slope and Shelf Groundfish Survey

The NWFSC conducted its eighth annual bottom trawl resource survey for groundfish off the coasts of Washington, Oregon, and California. The objective of the 2005 survey was to provide information on the distribution and relative abundance of demersal species within this region at depths from 30 to 700 fathoms. Other biological information necessary to assess the status of groundfish stocks (e.g. length, weight, sex and age structures) was collected throughout the survey period.

The NWFSC chartered commercial fishing vessels to conduct independent, replicate surveys using standardized trawl gear. Fishing vessels *Ms. Julie, Excalibur, Noah's Ark* and *Raven* were contracted to survey the area from Cape Flattery, WA to the Mexican border in Southern California, beginning in the later part of May and continuing through the third week of October. Each vessel was chartered for eight weeks with the *Ms Julie* and *Noah's Ark* surveying the coast during the initial pass from May to July. The *Excalibur,* and *Raven* operating in tandem, surveyed the coast during the second pass from mid-August to late October. The survey followed a stratified random sampling scheme with 15-minute tows at randomly selected depths. The depth strata were: shallow (30-100 fms), middle (100-300 fms), and deep (300-700 fms). The sample design consisted of 720 sampling locations, with 270 on the shelf (30-100 fms) and 450 on the slope (100-700 fms). Each of the four vessels occupied a different subset of 180 cell sites.

In 2005, we also continued to utilize the FSCS data collection system with updated software applications, and wireless networking. Established NOAA national bottom trawl protocols were used throughout the survey. As in prior years, a series of special research projects were undertaken in cooperation with other NOAA groups and various Universities.

For more information, contact Aimee Keller at (206) 795-5860, Aimee.Keller@noaa.gov.

Hake Acoustic Survey

The 2005 survey was conducted by joint US and Canadian science teams aboard the NOAA vessel Miller Freeman from 20 June to 19 August, spanning the continental slope and shelf areas the length of the West Coast from south of Monterey California (35.7º N) to the Dixon Entrance area (54.8º N). A total of 106 line transects, generally oriented east-west and spaced at 10 or 20 nm intervals, were completed. During the 2005 acoustic survey, aggregations of coastal Pacific hake were detected from approximately 37º N (Monterey Bay) and extending nearly continuously to the furthest area to the north surveyed at Dixon Entrance. Areas of prominent concentrations of hake included the waters off Point Arena (ca. 39º N) and north of Cape Mendocino, California (ca. 41º N), in the area south of Heceta Bank, Oregon (ca. 44º N), the waters spanning the US-Canadian border off Cape Flattery and La Perouse Bank (ca. 48.5E N), and local concentrations within Queen Charlotte Sound (ca. 51º N). Mid-water and bottom trawls, deployed to verify size and species composition and collect biological information (i.e., age composition, sex), found that smaller individuals - age-2 fish - were prevalent in the southern portion of the range, but the coastal Pacific hake stock continued to be dominated by representatives of the 1999 year-class (age 6) throughout most of their range, with the expected occurrence of older Pacific hake most predominant in the north.

The coastwide estimates of Pacific hake abundance totaled 2.5 billion fish weighing 1.26 million metric tons. As expected from the age and length distribution, the population was dominated by age-6 fish. These fish, the 1999 year class, contributed about 48% of the total coast-wide number and 55% of the total coast-wide biomass. Age-2 hake contributed 24% of the coast-wide number and 13% of the coast-wide biomass. The 2005 biomass estimate of 1.26 million metric tons represents a 0.58 million metric ton, or 68% decrease over the biomass estimate made for 2003. Though reduced and representing the eighth largest estimated biomass over the entire history of the survey, the 2005 estimate is at a level commensurate with recent levels. Our expectation of the level of abundance of Pacific hake was confirmed by this survey with the 2005 estimate representing declining trend in coastal hake biomass. Clearly, the increase seen in 2001 and subsequent decline in 2005 coast wide biomass can be attributed almost entirely to the 1999 year class.

NOAA Program: Fisheries And The Environment (FATE)

Dr. Jim Colbert's position has been supported 100% by the NOAA-NWFSC FATE Program for past two years and for all of CY 2005. He has worked on two studies related to this support and new software to bring more historical data into formats useful in analyses relating NE Pacific ocean physical variables (sea level, sea level pressure, Ekman transports, sea surface temperature) to fisheries questions. He updated our coastal ocean and North Pacific basin databases using the UCAR, COADS and LAS databases. We keep monthly average data for each 1-degree X 1-degree Lat./Lon. cell to provide the most currently available data for use in fisheries analyses. We have programs that allow users to summarize cells that are along the coast, to west of the coast, or interior ocean waters (e.g., Puget Sound, Straits of Georgia). The SAS macro language programs can efficiently summarize any mix of spatial cells and any of the monthly data to create study-specific summary data for use in analyses.

Science for Ecosystem-Based Management Initiative

Using Leslie matrices to identify essential fish habitat.

NMFS is required by statute to identify and protect habitat areas of particular concern (HAPCs)—subsets of EFH that are especially ecologically important, sensitive to human-induced environmental degradation, stressed by development activities, and/or rare. The degree to which fish successfully complete their lives is determined by the rates that individuals move through their life cycle. By creating a matrix of estimates of birth, growth, maturation, fertility and mortality rates for each life history stage it is possible to translate events happening to individuals to the dynamics of the population. Using elasticity analysis one can then estimate which life stages contribute most to the growth rate of the population, and thus determine which life history stages should be the focus of conservation. Once critical life stages are identified, the next task is to determine what habitats are important to those life stages. In particular, we need to know how changes (i.e. degradation or restoration) in habitat affect vital rates. Using these estimates of habitat effects on vital rates, one can model how different management actions that target specific habitats will affect populations. Thus, this set of models will ask the question, how much habitat (of different types) does one need to have in order to meet a management goal?

For more information, contact Phil Levin at Phil.Levin@noaa.gov, (206) 860-3473.

Risk Analysis of West Coast Groundfishes.

Many populations of marine fish have declined steeply over the last several decades. On the other hand, many populations have increased or remained stable. We are conducting a standardized assessment of risks faced by groundfish on the continental shelf of the US Pacific coast. Using the same techniques of population viability analysis that have been used on Pacific salmon (as well as numerous other at-risk terrestrial and marine species), we are estimating population growth rates and the probability of reaching various conservation or management benchmarks (e.g. probability of 90% decline in 100 years, probability of rebuilding in 100 years, etc.). Additional analyses will illuminate what life history attributes are associated with high risk species. Our goal is to develop this work into a "partial" assessment technique for a number of currently unassessed species.

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov

Impacts of fishing on marine community structure.

Using food web models, we are examining a range of marine communities, varying in species richness, productivity, and fishing intensity, to determine how fishing has affected community structure and some basic ecosystem parameters. Our initial work suggests that incompatibilities exist between managing for sustainable fisheries versus managing for the health of coast ecosystems — two of NMFS'missions. We are developing indices of "ecologically sustainable yield" based not on single-species fish population dynamics, but on systemic dynamics and NMFS ecosystem goals.
For more information Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov

Spatial and temporal scale effects of climate variability on groundfish assemblages.
Groundfish species on the West Coast experience different temperatures, upwelling patterns, and other climate-related variables on many spatial and temporal scales. Variability of these factors is driven by forces such as north-south gradients, large- and small-scale currents, large-scale climate events (e.g., El Niño, Pacific Decadal Oscillation), and interactions between these forces. We will examine time series of climate patterns over a 25-year period and West Coast shelf trawl survey data over the same time series to determine if there are ecologically meaningful associations between climate patterns and abundances of particular species or species assemblages of groundfish. Such information will provide some idea of how climate has contributed to population trends of many groundfish species, particularly the sharp decline in many species of *Sebastes*.

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov

Community composition of coastal shelf rockfish communities
In conjunction with the previous agenda item, we will use data from the West Coast shelf trawl surveys to identify rockfish that are most likely to coexist in predictable community assemblages in different regions. We will use statistical methods such as principal components analysis or its non-parametric analogs to determine which species tend to coexist, and under what conditions those groups are likely to be found. We can further determine if those assemblages constitute guilds, based on ecological information derived from the literature, and examine how small-scale guild population dynamics behave. For example, rather than using traditional single species stock-recruit relationships, we can see if the stock size of a guild of species influences the recruitment of that guild, or of individual species within the guild. Such information would greatly benefit managers who are interested in multi-species or community-level fisheries management plans, as opposed to single-species plans.

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov.

Groundfish bioenergetics
Bioenergetics models have proven an excellent tool in estimating the energetic demands of fishes, and thereby better understanding the amount of prey required by fish populations. Bioenergetics models are also useful for explaining fish growth trajectories as they relate to prey quality, temperature, fish size, and species- and sex-specific differences. We developed bioenergetics models for *Sebastes* species, and used these models to examine various issues such as per capita prey demand of different species, the influence of temperature anomalies (e.g., PDO shifts, El Niño) on fish growth and reproductive potential, and habitat-specific prey allocation across different life history stages of rockfish (that is, do adult and juvenile rockfish share common habitats and common prey, and if so, do the predatory demands of one age group constrain the success of the other?).

For more information, Chris Harvey at (206) 860-3228, Chris.Harvey@noaa.gov.

Fish movement and MPA design
Rational design of networks of MPAs requires an understanding of the relationship between the spatial extent of a reserve, home ranges of fish, and the distribution of resources. As a result, understanding movement patterns of fishes is of central importance to measuring MPA

effectiveness. In part, this is due to two potentially conflicting objectives of MPAs: (1) to conserve a breeding stock adult movement out of MPAs should be minimal, but (2) to augment local fisheries, some flux outside the MPAs to harvested areas is desirable. However, very little is known about the short-term movement of most economically and ecologically important temperate fish species. Here, we propose to: (1) determine the degree to which habitat structure and food resources affect movement by rockfishes, and (2) apply these data to models that can ascertain effectiveness of existing MPAs and (3) develop guidelines for designing future MPAs. Our approach involves first documenting the movement of rockfishes on rocky reefs using sonic telemetry. We will then use the information gathered during the empirical phase of our project to model MPA effectiveness as a function of fish motility and habitat structure food availability.

For more information, contact Phil Levin at (206) 860-3473, Phil.Levin@noaa.gov

Development of a spatially-explicit ecosystem model to examine effects of fisheries management alternatives in the Northern California Current

Decision analysis is intimately associated with the analysis of uncertainty: given uncertainty about future behavior of a system, what policies are most robust over the full suite of alternative future conditions? Classic fisheries science, which relies on single-species population models, has been criticized by some as inadequate for fisheries decision analysis because it considers one possible effect of fisheries policy (i.e., fishing affects abundance and age structure which, in turn, affects yield). In contrast, ecosystem-based management recognizes a broader suite of system responses, and explicitly recognizes that fish stocks respond to underlying yet unpredictable ecosystem dynamics (e.g., irreducible uncertainties) and that fishing itself can induce ecosystem changes. Thus, decision analysis frameworks ideally explore responses of populations to fishing under alternative scenarios of ecosystem forcing and fishing-mediated ecosystem change.

Do we presently have the tools to predict all elements of marine ecosystems? Absolutely not, and it is exceedingly unlikely that such a case will ever arise. Do we presently have the tools to identify potential ecosystem responses and behaviors? Fortunately, we have considerable and expanding expertise. Our knowledge of food web processes in marine ecosystems continues to grow, building a strong conceptual framework of the types of food web relationships that are common, rare, and most importantly, dangerous in the context of fisheries management. What is presently lacking, however, is an integrated modeling framework that can be used to: 1) synthesize this information; 2) analyze possible ecosystem responses; and 3) identify key processes that govern ecosystem condition.

We are developing such a modeling framework for the Northern California Current Ecosystem (NCCE). Our approach explicitly estimates the ecosystem and population-level consequences of various fisheries management alternatives in the face of a varying environment. ATLANTIS, a modeling approach developed by CSIRO scientists in Australia, achieves the crucial goal of integrating physical, chemical, ecological, and fisheries dynamics in a three-dimensional, spatially explicit domain. In ATLANTIS, marine ecosystem dynamics are represented by spatially-explicit sub-models that simulate hydrographic processes (light- and temperature-driven fluxes of water and nutrients), biogeochemical factors driving primary production, food web relations among functional groups, and the model represents key exploited species at the level of detail necessary to evaluate direct effects of fishing. The ATLANTIS model is thus ideally suited for ecosystem-based decision analysis.

The overarching goal of this project is to develop a model that allows users to examine the effects of large-scale management efforts against a backdrop of environmental variability resulting from climate events, seasonal changes, oceanographic dynamics, food web interactions, and fisheries. To achieve this goal, we are (1) collating data for the processes and functional groups included in the model; (2) defining the spatial structure of the NCCE; and (3) simulating behavior of the NCCE under alternate fisheries management policies and environmental regimes

Appendix

Publications

Brandt, S., J. Hendee, P. Levin, J. Phinney, D. Scheurer, and F. Schwing. Near-real time ecological forecasting. White paper for NOAA Ecosystem Review Task Team.

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NMFS Southwest Fisheries Science Center

Agency Report to the Technical Subcommittee of the Canada-U.S. Groundfish Committee

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Edited by John Field
with contributions from Anne Allen and Janet Mason

A. AGENCY OVERVIEW

The Southwest Fisheries Science Center (SWFSC) conducts fisheries and marine mammal research at three laboratories in California. Activities are primarily in support of the Pacific Fishery Management Council, the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), as well as a number of international fisheries commissions and conventions. The deputy director of the SWFSC is Dr. Norman Bartoo, and the Science Director is Dr. William Fox. A considerable amount of expertise on groundfish research, assessment, and management resides within all three SWFSC laboratories, and all have supported the essential needs of the NMFS and the PFMC for groundfish (and other west coast federally managed species) for over 25 years. Laboratory scientists from the Fisheries Ecology Division (FED) in Santa Cruz have been members of the PFMC's Groundfish Management Team (GMT) every year since its inception in 1977, and scientists from all three labs are regular and active members of the PFMC's Scientific and Statistical Committee (SSC) and other management teams and advisory bodies.

The Center is headquartered in La Jolla, which hosts three divisions that conduct research on a wide range of Pacific and Antarctic fish, marine mammals, sea turtles, and marine habitats; the Antarctic Ecosystem Research Division (led by Dr. Rennie Holt) , the Protected Resources Division (led by Dr. Stephen Reilly), and the Fisheries Resources Division (led by Dr. Roger Hewitt). The Fisheries Resources Division (FRD) conducts research on groundfish, large pelagic fishes (tunas, billfish and sharks), and small coastal pelagic fishes (anchovy, sardine and mackerel), and is the primary source of groundfish-related research in the La Jolla Laboratory. The La Jolla laboratory is also the primary source of federal support for the California Cooperative Oceanic Fisheries Investigations surveys that have taken place along most of the California coast since 1951, conducting integrated research on the physical, chemical and biological makeup of the California Current. Researchers at the La Jolla lab have primary responsibility for ichthyoplankton collections, studies of species abundance and distribution (including responses to climate variability), systematics, and the application of early life history information to stock assessments.

The Fisheries Ecology Division (FED), located in Santa Cruz and directed by Dr. Churchill Grimes, comprises two research branches. The Fisheries Branch (led by Dr. Peter Adams) conducts research (and stock assessments) in salmon population analysis, economics, groundfish, and fishery oceanography. The Ecology branch (led by Dr. Susan Sogard) conducts research on the early life history of fishes; salmon ocean and estuarine ecology; habitat ecology; and molecular ecology of fishes. Specific objectives of FED groundfish programs include: (1) collecting and developing information useful in assessing and managing groundfish stocks; (2) conducting stock assessments, and improving upon stock assessment methods, to provide a basis for harvest management decisions for the PFMC; (3) characterizing and mapping biotic and abiotic components of groundfish habitats, including structure-forming invertebrates; (4) disseminating information, research findings and associated advice to the fishery management and scientific communities; and (4) provide professional services (many of which fall in the above categories) at all levels, including inter-agency, state, national and international working groups. FED research is conducted in collaboration with researchers from several universities (i.e., Center for Stock Assessment Research (CSTAR), a partnership with the University of

California Santa Cruz; University of California Santa Barbara; Moss Landing Marine Labs, and others), and in cooperation with California Department of Fish and Game, USGS, and the National Marine Protected Area Center Science Institute (housed at Santa Cruz lab). Research programs are augmented with funds from NMFS' Offices of Protected Resources and Habitat Conservation, NOAA's NURP, Sea Grant, NOS Sanctuary Program, and Ocean Exploration.

The Pacific Environmental Research Division (ERD), directed by Dr. Franklin Schwing, is located at the Pacific Fisheries Environmental Laboratory (PFEL) in Pacific Grove. The ERD is a primary source of environmental information to fisheries researchers and managers along the west coast, and provides science-based analyses, products, and information on environmental variability to meet the agency's research and management needs. The objectives of ERD are to: (1) provide appropriate science-based environmental analyses, products, and knowledge to the SWFSC and its fishery scientists and managers; (2) enhance the stewardship of marine populations in the California Current ecosystem, and other relevant marine ecosystems, by understanding and describing environmental variability, the processes driving this variability, and its effects on the production of living marine resources, ecosystem structure, and ecosystem function; and (3) provide science-based environmental data and products for fisheries research and management, to a diverse customer base of researchers, decision-makers, and the public. ERD also contributes oceanographic expertise to the groundfish programs within the SWFSC, including planning surveys and sampling strategies, conducting analyses of oceanographic data, and cooperating in the development and testing of environmental and biological indices that can be useful in preparing stock assessments.

B. MULTISPECIES STUDIES

Research

Ichthyoplankton Surveys

The FRD, in collaboration with state and academic partners, supports and maintains the CalCOFI ichthyoplankton time series. The longest such time series in existence, this dataset extends from 1951 to the present and has been used to study distribution and abundance changes of many fish species in relation to climate and ecosystem change in the California Current region. CalCOFI data have been used in recent assessments of bocaccio rockfish, and are currently being used in a model of shortbelly rockfish. Since 2002, CalCOFI stations off central California, last routinely sampled in 1984, have been re-occupied during the winter and spring cruises in order to provide improved geographic coverage during the principal reproductive season for Pacific sardine and many of the groundfish species such as rockfishes, greenlings, cabezon, and various flatfishes whose spawning distributions extend well north of Point Conception or are centered north of Point Conception. Other recent ichthyoplankton surveys include the Southern California Nearshore Ichthyoplankton survey (2004-2005), the Cowcod Conservation Area high resolution ichthyoplankton and oceanographic surveys (2002-2005) and the Marine Ecological Reserves survey (1998-1999). These surveys provide an efficient and cost-effective means for monitoring abundance trends of cowcod, bocaccio, and other fishes.

Juvenile Surveys

Since 1983, the FED has conducted an annual survey of the distribution and abundance of pelagic juvenile rockfishes, with the goal of providing data for forecasting future recruitment to rockfish and other species, and to otherwise monitor the physical and biological environment. A number of west coast groundfish stock assessments (e.g., Pacific whiting, widow rockfish, and chilipepper rockfish) have used this pelagic juvenile index to estimate recruitment strength of year classes. In 2004, the geographic coverage of the pelagic juvenile rockfish mid-water trawl survey was expanded substantially, with the addition of new sample lines off of southern and northern California, from San Clemente Island to Point Delgada. This increased the effective latitudinal range of the survey from 180 to 800 km, representing a four-fold increase in coverage. In addition, for the last four years efforts to calibrate survey methods have been ongoing with the Pacific Whiting Conservation Cooperative (PWCC)/Northwest Fisheries Science Center (NWFSC) survey.

During 2005, pelagic juvenile rockfish catches in the core part of the survey area were at an all time low. However, with the new data available from the expanded survey coverage in 2005 (spanning San Diego, CA to Westport, WA when the PWCC/NWFSC data are included), two types of shifts in distribution were revealed. Specifically, species characterized by a more southerly geographic range (e.g., bocaccio, shortbelly, and squarespot rockfish) were caught in relatively large numbers south of Point Conception. Conversely, species with more northerly distributions (widow, canary, and yellowtail rockfish) were caught in moderate numbers north of Cape Mendocino. The near absence of fish in the core survey area then, seemed to be associated with a redistribution of fish, both to the north and the south, as well as overall lower abundances. This work, and greater comparisons of the SWFSC and PWCC/NWFSC paired tow survey results (with respect to catch rates, geographic distribution and species composition) will be reported in Sakuma et al. (in review).

In addition, FED is continuing a long-term monitoring survey of recently settled juvenile blue, yellowtail, and black rockfishes, using scuba in nearshore subtidal habitat off northern California for the last 21 years (Laidig et al. in press) and most recently off central California since 2001. While mean annual abundance is highly variable (0.01 - 181 fish/min), trends in the abundance index were similar for the three species, and sea level anomalies as well as nearshore temperatures had the strongest relationship with relative changes in abundance. The annual abundance index for juvenile yellowtail rockfish was also positively correlated with year-class strength of adult yellowtail rockfish, indicating the utility of juvenile abundance surveys for assessment and management purposes.

Deeper shelf substrates used as nursery habitat by age-0 rockfishes will be examined in a new project evaluating essential fish habitat for newly settled fishes. Methods of trapping, otter trawling, drop camera surveys, scuba diving censuses and ROV censuses will be employed in a two-year study starting in June, 2006. All habitat types within a depth zone of 20 to 100 m in Monterey Bay will be examined. Preliminary results from 2005 suggest clear depth and spatial patterns in habitat use, and additional differences between the distribution of age-0 and age-1 cohorts. Low relief mud/sand substrates appear to have nursery value for newly settled rockfishes of several species, with later migration to the high relief rocky substrates typically recognized as adult habitat.

Adult Surveys

The FRD's Advanced Sampling Technologies and In-Situ Survey groups are currently using three technologies combined with industry partnership to form a novel, non-lethal survey to better survey some rockfish species off southern California. Multi-beam sonar measurements are used for habitat characterization, multi-frequency echosounder measurements are used for mapping rockfish aggregations and facilitating remote species identification, and ROV video observations are used to validate the acoustical habitat classification and species identification. Rockfish and their habitats were mapped throughout the Southern California Bight from the NOAA Ship David Starr Jordan (Nov. 2004 and Feb. 2005) and the sportfishing vessel Outer Limits (Jan. and Mar. 2006). A cruise report from these efforts includes acoustic estimates of the habitats, and dispersions and relative abundances of some rockfish species in this area. Site fidelity, diel vertical migratory behavior, and temporal variations in biomass on inter-hourly, daily, weekly, and monthly scales were also documented. The frequency-specific sound scatter from six different rockfish species was measured in-situ and as a function of water depth. This will ultimately be used to acoustically discriminate among taxa, and to scale the total acoustic energy. David Demer presented the results of this investigation at the ICES Working Group on Fisheries Acoustics, Science and Technology in April 2006 in Hobart, Tasmania, and a manuscript is in preparation. Further development of survey methods, including the design of purpose-built small-craft, is ongoing.

In support of this work, efforts have been ongoing to improve the accuracy of target strength estimates that are used to convert integrated acoustic backscattering coefficient data to fish densities. Measurements of the sound scattering spectra from bocaccio rockfish were made at Hubbs SeaWorld Research Institute, and additional experimental measurements (including water pressure manipulation to simulate large depths) will soon be made using a new hyperbaric sound scattering chamber. The 1000-liter tank has been developed over the last year by the SWFSC. The tank will be used to make broad bandwidth measurements of the total sound scattering cross-sections of rockfish that can be used to better interpret survey data from multi-frequency echosounders. Sound signatures will improve the apportioning of total sound scatter to that from rockfish and other cohabitant species.

The FED has continued monthly industry-cooperative groundfish ecology surveys at numerous sites off central California, at depths 20 m to the continental slope. Both bottom trawl and longline gear are used from a commercial fishing vessel; these surveys began in late 2001, although coverage has been incomplete for much of 2005Fish count, size, sex, age, and reproductive state are recorded, along with depth and environmental variables. From these data, we estimate fecundity, spawning season, seasonal distributions, sex and size ratios within different areas, population age structure, and size frequencies. This life history information is being used to improve management of groundfish species (especially those for which we have little knowledge).

Economic Studies

The FED's Economics Team is developing a model of fishery dynamics using 1981-2005 vessel- and trip-specific data for all West coast commercial fisheries (including groundfish). The model is intended to: (1) analyze patterns of fishing behavior across space and time, (2) identify

biological, economic, regulatory and environmental factors underlying these behavioral changes, and (3) evaluate the cumulative effects of these changes on fishing communities.

Stock Assessment Support

Both the FRD and the FED regularly produce stock assessments of groundfish for the PFMC and support stock assessment science through the maintenance of data systems and the development of new analytical techniques. The FED works closely with the California Department of Fish and Game (CDFG) to coordinate port sampling efforts and to maintain the CALCOM database, which serves as the source of the data provided to PacFIN by the State of California. The system provides port sampling biologists with Internet access to the database, so that data are entered directly in real time.

Through our liaison with CDFG, the FED also recently acquired a massive amount of historical California landings data on microfiche and original paper. These data have immense value for stock assessment and habitat evaluation purposes, and the FED recently initiated a process of contracting for the digitization of these records, which will be done through the designated contractor for the NESDIS Climate Data Modernization Program. The microfiche contain information on monthly California catches by 10-minute block from 1931 to 1968. Previous work with the California Department of Fish and Game resulted in gaining access to similar data for 1969-1981, so that the final database (1931-present) created by this CDMP project will triple the length of the currently available historical catch time series (currently 1982-present).

The FED has also been involved in a simulation study to test how relative weighting among likelihood components affects assessment results. The simulation framework includes a population-fishery simulation model, an assessment model, and comparisons of assessment results between true and estimated biomass, depletion rates and recruitment parameters. In the assessment model, within-component likelihood weighting is used for age composition data and CPUE indices. The simulation results indicate that when equal weights are used for all likelihood components, the assessment models generally under-estimate depletion rates (the estimated current biomass was higher than the true biomass), under-estimated recruitment potentials (smaller h values than the true value), and have more variable population trajectories. The assessment results were much closer to the true values when the likelihood for age composition was down-weighted to about 10% of the original values.

C. BY SPECIES, BY AGENCY

Nearshore Rockfish

Research

The FED Early Life History Team continues to evaluate sources of variability in the fitness characteristics of individual larval rockfish, such as the initial size of larvae at parturition, bioenergetic condition as indexed by oil reserves, initial swimming capabilities, growth rates and mortality. The team has also conducted experiments testing for multiple paternity in rockfish broods. Maternal age appears to play an important role in larval success (growth and survival) for some species but not others. Age also appears to influence the timing of parturition,

suggesting that older mothers fertilize their eggs earlier than younger mothers. The strength of some of these maternal effects appears to be related to seasonal patterns of parturition timing.

Assessment

FED biologists were involved in supporting three assessments for nearshore rockfish performed in the 2005 PFMC stock assessment cycle, although all of these were led by authors from other agencies or entities. These include gopher rockfish (*Sebastes carnatus*, Key et al. 2005), California scorpionfish (*Scorpaena guttata*, Maunder et al. 2005) and kelp greenling (*Hexagrammos decagrammos*, Cope and MacCall 2005). The results from the gopher rockfish assessment (which was restricted to California waters north of Point Conception) was based on suggest that this stock is well above target biomass levels. California scorpionfish was assessed for the first time in 2005, and the assessment estimated the 2005 biomass to be at 80% of its unfished level. The status of kelp rockfish could not be ascertained in the southern (California) region due to a paucity of data and apparent inconsistencies in data that did exist, an assessment of the Oregon stock suggested that kelp greenling are close to target levels in that region.

Shelf Rockfish

Research

The SWFSC FRD Genetics team has pioneered the development of automated molecular ID of eggs and larvae from RFLPs to Multiplex PCR and finally gene arrays. Presently they have a 20+ species gene array that covers most species encountered in the CalCOFI grid. One new molecular genetic species identification method uses DNA-specific probes and optical detection to identify larval rockfish samples in real-time (hours, not months), at sea (Fig. 2). This method improves our observations by allowing for real-time adaptive sampling, and gives us a better understanding of the early life history of over-fished rockfish stocks. The FED is also involved in understanding temporal and genetic population structure in several rockfish species, and developing multilocus genotypes for the identification of northeastern Pacific rockfish.

The FED is currently developing a study in to estimate the spawning biomass of bocaccio in the southern California Bight based on larval production. In an effort to compliment the traditional stock assessment analysis, larval abundance data collected during routine CalCOFI surveys and enhanced ichthyoplankton sampling surveys in the Cowcod Conservation Area (CCA) were summarized. Bocaccio larvae were sub-sampled, aged, and a probability transition matrix developed to estimate age composition from the area-wide length composition. Spawning seasonality was estimated from long-term patterns of availability in the CalCOFI survey from 1950 to the present. Lastly, adult female weight-specific fecundity was estimated by sampling mature fish in 2002 from Ensenada (Mexico), which when combined with the larval production data, yielded estimates of total age-1+ biomass of bocaccio. Results from the larval production analysis are in general agreement with the traditional stock assessment, although uncertainty in estimates of weight-specific fecundity and the incidence of repeat spawning remain high.

The FED also developed a model of shortbelly rockfish, an essentially unexploited species due to small size and poor quality of flesh, for research purposes. Shortbelly rockfish are one of the most abundant rockfish species in the California Current, and are a key forage species for many piscivorous fish, birds, and marine mammals. Although catch data are extremely limited, other

sources of information suggest that the population has undergone significant fluctuations in abundance over the last several decades, presumably in response to variations in environmental conditions. As this stock might be considered the equivalent of a "control" rockfish population, the results may provide insight into the potential causes and consequences of natural population variability on both exploited and non-exploited rockfish populations throughout the California Current.

In cooperation with the NWFSC, the FRD has developed statistical techniques for analysis of bomb radiocarbon data and have completed several projects to assess ageing error of black and canary rockfish, using bomb radiocarbon and stable isotopes. Currently, these methods are being applied to other rockfish species.

The FED also is comparing results from direct-observation and video transects using an occupied submersible with those from bottom longline methods to determine abundance, size and species composition, catchability coefficients and selectivity, and appropriate conversion factors for relative and absolute abundance of groundfish shelf species off central California. Quantitative transect methods, collection of accurate visual observation and navigation data, database management and analysis follow protocols based on past experience with in situ methods. This study includes participation by a commercial longline fisherman. These results should contribute to improved assessments of groundfish stocks in untrawlable habitat off California.

Assessments

The FED conducted an update of the 2003 bocaccio rockfish assessment, which used the original Stock Synthesis model (MacCall 2005). In addition to new length frequency data, new data points were included from both the triennial survey and the CALCOFI larval abundance index, both of which suggested an increasing upwards trajectory for the stock. The estimated spawning output from the base model in 2005 was 10.7% of the estimated unfished level, and catches in recent years have been less than recent OY levels. The rebuilding analysis that followed the updated assessment found that the probability of further long term declines in bocaccio abundance were negligibly small, and that the expected (50% probability) year of rebuilding under status quo harvest rates was 2024.

The FED conducted a unique fishery-independent assessment of cowcod off southern California (Yoklavich et al. In Prep.). In 2002, cowcod were surveyed within the Cowcod Conservation Areas (CCAs) using non-extractive methodologies and direct observations during 95 dives from a research submersible over ten major offshore rocky banks (all longtime fishing sites). This survey was restricted to high and low relief rock substrata within a depth range of 75-300 m, which represented likely cowcod habitats. A line-transect analysis of the count of cowcods, their perpendicular distances from the track line, length of survey tracks, and area of each bank was used to estimate total number of fish in the study area. Several sources of uncertainty were evaluated and accounted for in the resulting estimates of abundance and biomass. This first ever fishery independent assessment for a rockfish species off southern California was well vetted by an independent CIE review panel and the PFMC cowcod STAR panel. It suggested that a time-series of results from such visual surveys is critical to evaluate a trend in cowcod biomass with respect to increased time of protection within the CCAs. Research is ongoing to assess the accuracy of visual underwater estimates of size and distance from submersibles; comparisons are

being made between actual measurements (from fish either caught on a longline or replicas placed on the seafloor) and those estimated using paired lasers on the submersible.

The FRD took the lead in conducting the 2005 cowcod stock assessment, which included only two primary data sources. These sources included a recreational CPUE time series and the direct-observation line transect survey conducted by researchers at FED (described above). The assessment estimated that the 2005 spawning biomass was 18% of unfished levels, within a range of 14 to 21% depending on the value assumed for steepness, a considerably more optimistic result than the 1999 assessment. The corresponding rebuilding analysis (Piner 2005b) also estimated that rebuilding to target levels could occur faster than earlier thought, although rebuilding times were still expected to last 60 to 80 years. However it was also noted that rebuilding scenarios are extremely uncertain for this data-poor species. Moreover, there is widespread concern about the ability to monitor the stock, and consequently to evaluate progress towards rebuilding in the future

The FED conducted a full assessment of widow rockfish in 2005 (He et al. 2005). In addition to including the new data from 2003 to 2004, this assessment added a new index of relative abundance based on the triennial survey. The base model estimated that spawning output in 2004 was 31% of the unexploited level, above the Council's overfished threshold. Further, spawning output in the base model was estimated to have never dropped below the 25% overfished threshold. Alternative model runs, which were considered to be only slightly less plausible than the base model, however, indicated that the stock could have been below B25%. The 2005 rebuilding analysis indicated that the stock was much closer to reaching a rebuilt biomass than previously estimated, with target dates of rebuilding within approximately 10 years (depending upon harvest rates).

The FED conducted an assessment for vermillion rockfish for the first time in 2005, with separate models for the stocks north and south of Point Conception. One consideration in this assessment was the building evidence from genetic research, which suggests that vermillion rockfish may be two species, as nothing is known about biological differences among the two species. The models suggested upward trends for vermillion rockfish since approximately 1990, with the depletion levels for both stocks generally above target levels for most model formulations. However, as the model exhibited high sensitivity to modest changes in data or assumptions, the assessment was not accepted by the Scientific and Statistical Committee (SSC) as being suitable for the provision of quantitative management advice.

Flatfish

Research

A paper on the growth and life history of sand sole is in preparation. Maturity, growth, and life history studies of starry flounder, rex sole and sanddabs are also ongoing, based primarily on data and specimens collected in the Central California Cooperative Groundfish Ecology Survey.

Assessment

The U.S. West Coast starry flounder stock was assessed for the first time in 2005 (Ralston 2006), with an assumption of separate biological populations north and south of the California/Oregon border. The assessment was based on catch data, relative abundance indices derived from trawl logbook data, and an index of age-1 abundance from trawl surveys in the San Francisco Bay and Sacramento-San Joaquin River estuary. Unlike most other groundfish stock assessments, no age- or length-composition data were available for use the assessment. Both the northern and southern populations are estimated to be above the target level of 40% of virgin spawning biomass (44% of SB0 in Washington-Oregon and 62% in California), although the paucity of data for this species contributes to substantial uncertainty around these levels. One of the most significant areas of uncertainty in the assessment is the estimate of natural mortality rate, which was quite high (0.30 yr-1 for females and 0.45 yr-1 for males).

D. OTHER RELATED STUDIES

Fish Culture and Enhancement

The SWFSC FRD has maintained over 10 species of rockfish in the experimental aquarium and has succeeded in getting some to mate, brood, and produce viable larvae. Larvae have been reared (not without difficulty) to the juvenile stage and papers describing larval and juvenile morphology have been produced. Collaborations with Hubbs-SeaWorld Research Institute and oil companies have resulted in establishment of captive brood stocks of bocaccio, vermillion, and cowcod. Currently, several species of rockfish are housed in the aquarium, although no experiments are associated with them at this time.

Trawl Location Mapping

The ERD has continued to develop a GIS demonstration of trawl location mapping with improved resolution. Trawl lines based on the start and endpoints of individual trawls from California logbook database were mapped for Central California for 1997-2002 and all of California for 2003 and 2004, and summarized with roughly 3 square km resolution. Associated information such as tow hours, date, and port was retained and integrated with pounds landed by species. Maps detailing the distribution of species and trawling effort are being analyzed to understand the effects of past regulatory actions, including the consequences of implementing rockfish conservation areas on the spatial distribution of fisheries effort.

Integration of Marine Protected Areas and Fisheries Science and Management

The Santa Cruz Laboratory and the National Marine Protected Areas Science Institute have continued their support of the Science Integration of Marine Protected Areas and Fishery Management Working Group through 2005 and into 2006. The entire working group has met twice, and the three principal working group teams have met frequently throughout the past year in working sessions to review progress and develop results. These groups include the MPA/ecosystem team, charged with using models and other means to identify and evaluate the trade-offs of different fishery management measures; the connectivity team, with a focus on the development of tools to identify connectivity patterns at the ecosystem scale and the natural

heritage team, with a focus on developing measurable objectives for the design and evaluation of MPAs implemented for natural heritage purposes.

SWFSC/Santa Cruz Lab Groundfish Habitat Ecology Program

The FED has an ongoing research program to implement legislative mandates with respect to Essential Fish Habitat (EFH) and Stock Assessment Improvement for West coast groundfish. This program uses a range of tools, including research submersibles, laser line scan system, and multibeam and side scan sonar. In addition to the Cowcod Conservation Area surveys and the gear intercalibration research described in the Assessments section for shelf rockfish, other ongoing projects include:. 1) an evaluation of patterns in groundfish distribution and abundance and seafloor habitats at a range of spatial scales, being conducted in collaboration with USGS (Anderson et al. 2005; Anderson and Yoklavich, In Prep.); 2) characterizing benthic invertebrates that form habitat on deep banks off southern and central California, with special reference to deep sea coral communities (Tissot et al. 2006); 3) an evaluation of the potential for laser line scan (LLS) systems to serve as a bridge between high resolution, limited coverage video survey tools (e.g., remotely-operated vehicle (ROV), occupied submersible, towed sled) and lower resolution, higher coverage acoustic technologies (e.g., multibeam and sidescan sonar) (Amend et al. In Press).

Groundfish Economics

The FED's Economics Team is conducting research to estimate technical efficiency in the West coast groundfish fishery. This research involves use of Bayesian methods to characterize a production function that accounts for both the highly stochastic environment of commercial fisheries and the effect of boat-specific unobservables such as skipper skill, and provides a framework for assessing the impact of regulations on vessel efficiency.

Concerns regarding overfished groundfish stocks have led to drastic regulatory changes, including highly restrictive OYs and vessel landings limits, an industry-funded buyback program, and sweeping closures on the continental shelf. The Economics Team is conducting a retrospective analysis of the effects of these regulations on trawlers who exited the fishery as well as those who continue to participate. This project is being conducted in collaboration with ERD, whose Trawl Location Mapping Study (D2 above) is well suited to exploring changes in fishing strategies and the spatial distribution in fishing activity over time.

GROUNDFISH PUBLICATIONS OF THE SWFSC, 2005 - PRESENT

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STATE OF ALASKA
GROUNDFISH FISHERIES

ASSOCIATED INVESTIGATIONS IN 2005

Prepared for the Forty Seventh Annual Meeting of the Technical Subcommittee of the Canada-United States Groundfish Committee

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STATE OF ALASKA GROUNDFISH FISHERIES AND ASSOCIATED INVESTIGATIONS IN 2005

REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT AND MANAGEMENT

A. Agency Overview

Description of the State of Alaska commercial groundfish fishery program:

The Alaska Department of Fish and Game (ADF&G) has jurisdiction over all commercial groundfish fisheries within the internal waters of the state and to three miles offshore along the outer coast. A provision in the federal, Gulf of Alaska (GOA) Groundfish Fishery Management Plan (FMP) gives the State of Alaska limited management authority for demersal shelf rockfish in federal waters east of 140^{o} W. longitude. North Pacific Fisheries Management Council (NPFMC) action in 1997 removed black and blue rockfish from the Gulf of Alaska FMP thus the state manages these species in both state and federal waters (of the GOA). The state also manages the lingcod resource in both state and federal waters of Alaska. Other groundfish fisheries in Alaskan waters are managed by the federal government, or in conjunction with federal management of the adjacent Exclusive Economic Zone (EEZ). The information related in this report is from the state-managed groundfish fisheries only.

The State of Alaska is divided into three maritime regions for marine commercial fisheries management. The Southeast Region extends from the Exclusive Economic Zone (Equi-distant line) boundary in Dixon Entrance north and westward to 144^{o} W. longitude and includes all of Yakutat Bay (Appendix II). The Central Region includes the inside and outside Districts of Prince William Sound (PWS), Cook Inlet including the North Gulf District off Kenai Peninsula, and Bristol Bay. The Westward Region includes all territorial waters of the Gulf of Alaska south and west of Cape Douglas and includes North Pacific Ocean waters adjacent to Kodiak, and the Aleutian Islands as well as all U.S. territorial waters of the Bering, Beaufort, and Chukchi Seas.

Southeast Region

The **Southeast Region** Commercial Fisheries Groundfish Project is based in Sitka with the groundfish project leader, assistant project leader and a port biologist located there. Seasonal technicians and port samplers are employed in Petersburg, Sitka, and Douglas. The project also received biometrics assistance from the regional office in Douglas.

The Southeast Region's groundfish project has responsibility for research and management of all commercial groundfish resources in the territorial waters of the Eastern Gulf of Alaska as well as black and blue rockfishes and lingcod in the EEZ. The project cooperates with the federal government for management of the waters of the adjacent EEZ. The project leader participates as a member of the North Pacific Fisheries Management Council's Gulf of Alaska Groundfish Plan Team and produces the annual stock assessment for demersal shelf rockfish for consideration by the North Pacific Fishery Management Council.

Project activities center around fisheries monitoring, resource assessment, and in-season management of the groundfish resources. In-season management decisions are based on data collected from the fisheries and resource assessment surveys. Primary tasks include fish ticket collection, editing, and data entry for both state and federal-managed fisheries; dockside sampling of sablefish, lingcod, Pacific cod, and rockfish landings; and skipper interview and logbook collection and data entry. Three resource assessment surveys were conducted during 2005. Funding for the Southeast Groundfish project comes from NOAA Grants NA17FN2591, NA04NMF4070163, and NA04NMF4370176.

Central Region

Central Region groundfish staff is headquartered in Homer and is comprised of a regional groundfish management biologist, a regional shellfish/groundfish research project leader, a groundfish sampling coordinator, a groundfish fish ticket entry position, two marine research biologists, and one seasonal commercial catch sampler. An area management biologist and a seasonal commercial catch sampler are also located in Cordova and regional support comes from Anchorage. The research project leader also functions as a member of the North Pacific Fishery Management Council's Gulf of Alaska Groundfish Plan Team. The R/V *Pandalus*, home ported in Homer, and the R/V *Solstice,* home ported in Cordova, conduct a variety of groundfish-related activities in Central Region waters.

Groundfish responsibilities in Central Region include research and management of most groundfish species harvested in territorial waters of Central Region. Within Central Region, groundfish species of primary interest include sablefish, rockfish, pollock, Pacific cod, lingcod, sharks, and skates. Stock assessment data are collected through port sampling, and through ADF&G trawl, longline, jig, scuba, and remotely operated vehicle (ROV) surveys. Commercial harvest data (fish tickets) are processed in Homer for state and federal fisheries landings in Central Region ports.

Westward Region

The **Westward Region** Groundfish management and research staff is located in Kodiak and Dutch Harbor. Kodiak staff is comprised of a regional groundfish management biologist, an area groundfish management biologist, an assistant area groundfish management biologist, a groundfish research project leader, a groundfish research project assistant biologist, a groundfish dockside sampling coordinator, a seasonal age-determination unit biologist, two seasonal fish ticket processing technicians, and a seasonal dockside sampler. A full-time assistant area groundfish management biologist, a seasonal fish ticket processing technician, and a seasonal dockside sampler are located in the Dutch Harbor office. Seasonal dockside sampling also occurs in Chignik, Sand Point, King Cove, and Adak. The R/V *Resolution*, R/V *K-Hi-C*, and R/V *Instar* are home ported in Kodiak and conduct a variety of groundfish related activities in the waters around Kodiak, the south side of the Alaska Peninsula, and in the eastern Aleutian Islands.

Major groundfish activities include: fish ticket editing and entry for approximately 11,000 tickets from both state and federal fisheries, analysis of data collected on an annual multi-species trawl survey encompassing the waters adjacent to the Kodiak archipelago, Alaska Peninsula and Eastern Aleutians, management of black rockfish, state-waters Pacific cod, lingcod, and Aleutian Island state-waters sablefish fisheries, conducting dockside interview and biological data collections from commercial groundfish landings, and a number of research projects. In addition, the Westward Region has a member on the North Pacific Fisheries Management Council's Bering Sea/Aleutian Island Groundfish Plan Team (Ivan Vining) and the Gulf of Alaska Groundfish Plan Team (Nick Sagalkin).

Headquarters

The Alaska Fisheries Information Network (AKFIN) project began in 1997 in response to the 1996 Magnuson-Stevens Act. The Alaska Department of Fish and Game (ADF&G) entered into a contract with the Pacific States Marine Fisheries Commission to expand data collection and management duties previously carried out under PACFIN. The purpose of the AKFIN program is to collect and make available the fishery catch information from Alaska's marine fisheries. This includes the major federal and state groundfish fisheries as well as the Bering Sea and Aleutian Island crab fisheries. The AKFIN project provides accurate and timely fishery data that has been essential for management, pursuant to the biological conservation, economic and social, and research and management objectives of the fishery management plans for groundfish and crab resources.

The Alaska Fisheries Information Network also:

1. Provides a forum for agencies to develop coordinated relational data/information systems encompassing State of Alaska and Federal fisheries data for use by fishery managers, associated agencies and the public.
2. Provides data management consultation and technical advice to participating agencies upon request.
3. Promotes the efficiency, effectiveness and timeliness of data acquisition and delivery with a minimum of duplication.
4. Maintains the AKFIN Support Center which conducts such projects set forth in the AKFIN work plan to insure that all available data are accessible to fishery managers, the North Pacific Fishery Management Council and its Plan Development Teams and Scientific and Statistical Committee, and each participating agency to meet respective fisheries management responsibilities.
5. Facilitates and support a comprehensive and coordinated program to collect, record, store, and make available social and economic data relating to fisheries and fishing communities.
6. Provides support for the acquisition, maintenance, and analysis of fishery dependent data (including but not limited to GIS-based fishing locations, otolith-based age determination, and port sampling) for inclusion in agency databases as appropriate.

The foundation of the state's AKFIN project is an extensive port sampling system for collection and editing fish ticket data from virtually all of the major ports of landing from Ketchikan to

Adak and the Pribilof Islands, with major emphasis on Sitka, Homer, Kodiak, and Dutch Harbor. The port sampling program includes collection of harvest data, such as catch and effort, and also the collection of biological data on the fish and crab species landed, and age determination based on samples of age structures collected from landed catches. ADF&G personnel continued to collect, review, edit and amend, data capture, and archive all ADF&G fish tickets submitted to local offices. These fish tickets include those required as well as tickets voluntarily submitted by EEZ operators.

The state's AKFIN program is supported by a strong commitment to development and maintenance of a computer database system designed for efficient storage and retrieval of the catch and production data on a wide area network. It supports the enhancement of the fish ticket information collection effort including; regional fishery monitoring and data management, GIS database development and fishery data analysis, catch and production database development and access, the age determination unit laboratory, database management and administration, Bering sea crab data collection and reporting, various fishery economic projects, and fisheries information services.

Local ADF&G personnel in nine locations throughout the state of Alaska (Craig, Ketchikan, Petersburg, Sitka, Juneau, Seward, Homer, Cordova, Kodiak, and Dutch Harbor) maintain close contact with fishers, processors and enforcement to maintain a high quality of accuracy in the submitted fish ticket records. Following processing, the data is electronically transferred to Headquarters. The research analyst working with this project works as part of a team to maintain a master statewide groundfish fish ticket database. Data feeds to Headquarters are merged to this master database. Data is routinely reviewed for accuracy with corrections applied as required. Within the confines of confidentiality agreements, raw data is distributed to the National Marine Fishery Service (both NMFS-ARO and NMFS-AFSC), the North Pacific Fishery Management Council (NPFMC), the Commercial Fisheries Entry Commission (CFEC), the Pacific States Fisheries Information Network (PACFIN) and the AKFIN Support Center on a regularly scheduled basis. Summary groundfish catch information is also provided back to regional ADF&G offices as well as to the State of Alaska Board of Fisheries, NMFS, NPFMC and the AKFIN Support Center (Contact Lee Hulbert).

Electronic Fish Ticket System (contact Gail Smith)

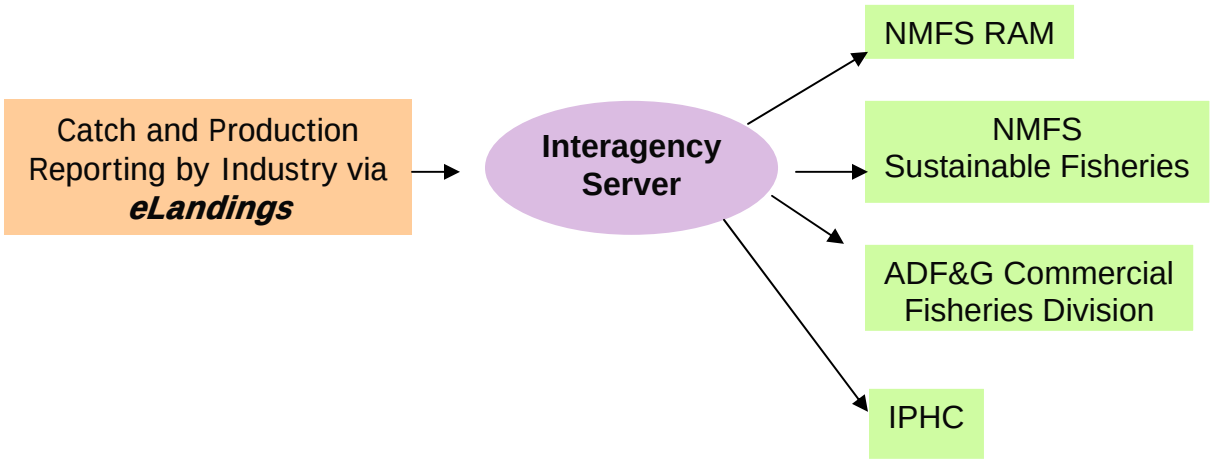
The Alaska Department of Fish and Game maintains a commercial harvest database, based on landing report receipts – fish tickets. These data are comprehensive for all commercial salmon, herring, shellfish, and groundfish from 1969 to present. Data is stored in an Oracle relational database and available to regional staff via the State of Alaska network.

AKFIN funded ADF&G personnel are cooperating with an Interagency Steering Committee to develop and implement an online electronic catch and production reporting program for the rationalized crab fishery. The features implemented include electronic landing and production reports, real time quota monitoring, immediate data validation, and printable (.pdf) fish ticket reports. The goal is to move to statewide implementation of electronic reporting in all groundfish fisheries by January of 2006.

The three resource management agencies tasked with commercial fisheries management in Alaska are the Alaska Department of Fish and Game (ADF&G), the International Pacific Halibut Commission (IPHC), and the National Marine Fisheries Service – Alaska Region (NMFS-AK). Since 2001, these agencies have been working to develop consolidated landing, production, and IFQ reporting from a sole source. This collaborative effort, the Interagency Electronic Reporting System, was developed with funding provided through the Pacific States Marine Fisheries Commission. The web-based reporting component of this system is ***eLandings***. An additional application was developed, designed to be installed on local computers for the at-sea, catcher processor fleet.

The web-based application provides the seafood industry with the ability to submit landing reports (fish tickets), IFQ fisher/processor quota harvest, and processor production information from a single location. The information submitted via the web application, ***eLandings***, is stored in a single repository database. The ADF&G, the IPHC, and the NMFS-AK copy data submitted by industry to their individual data systems.

DATA FLOW MODEL



This new commercial harvest reporting provides several benefits for fisheries management agencies and industry, when compared to current recordkeeping and reporting. The most obvious benefit is a sole source reporting site for landing and production data. Fisheries managers, individual processing facilities, and the parent company will have the ability to obtain landing report catch and production information immediately. Additional benefits include:

- Significant reduction of redundant reporting to management agencies.
- Immediate data validation when the landing, IFQ, or production report is submitted.
- Real time harvest data availability to management agencies.
- Staged reporting to accommodate the work flow of industry.
- Application function to allow processors to import or export the catch and production information they submit, facilitating one time data entry for processors.

The eLandings applications were deployed initially with the Rationalized Crab fisheries of the Bering Sea and Aleutian Islands. The implementation for statewide groundfish will begin on May 15, 2006.

Local ADF&G personnel in six locations throughout the state of Alaska (Petersburg, Sitka, Juneau, Homer, Kodiak and Dutch Harbor) maintain close contact with groundfish fishers, processors and state/federal enforcement to maintain a high quality of accuracy in the submitted fish ticket records. The Interagency Electronic Reporting System – eLandings applications, with immediate data validation and business rules, should continue to improve data quality and allow personnel to function at a higher level while review of submitted data.

Landing and production data are submitted to a central database, housed in Juneau, validated and reviewed, and pulled to the individual agency databases. Landing data is available to agency personnel within seconds of submission of the report. Printable documentation of the landing report and the Individual Fishery Quota debit are created within the applications. Signed fish tickets will continue to be submitted to local offices of ADF&G for additional review and comparison to other data collection documents. These documents include vessel/fisher logbooks, agency observer datasets, and dockside interviews with skippers.

Within the confines of confidentiality agreements, raw data is distributed to the State of Alaska Commercial Fisheries Entry Commission (CFEC) daily and to the National Marine Fishery Service NMFS-ARO and AKFIN Support Center on a monthly schedule. The CFEC merges the ADF&G fish ticket data with fisher permit and vessel permit data. This dataset is then provided to the AKFIN Support Center, which distributes the data to the professional staff of the North Pacific Fishery Management Council (NPFMC) and summarized data to the Pacific States Fisheries Information Network (PACFIN). Summary groundfish catch information is also posted on the ADF&G Commercial Fisheries website:
http://www.cf.adfg.state.ak.us/geninfo/finfish/grndfish/grndhome.php.
Summarized data is provided to the State of Alaska Board of Fisheries, the North Pacific Fisheries Management Council, and to the State of Alaska legislature as requested.

Gene Conservation Laboratory

The ADF&G Gene Conservation Laboratory continued studies on genetic diversity and gene flow for a variety of groundfish species in 2002. Efforts focused on black rockfish, light and dark dusky rockfish, and pollock (a list of *Sebastes* tissue samples stored at ADF&G's Gene Conservation Laboratory can be found in Appendix III).

Age Determination Unit (contact Kristine Munk)

The ADFG's centralized statewide age reading program at the Age Determination Unit (ADU) in Juneau continued to provide age data to ADFG regional managers in 2005. Age structures from approximately 8,882 groundfish, representing 14 species, were received through statewide commercial and survey harvest sampling efforts and 9,559 age data were released back to managers. Additional age data were produced through training and precision testing. A total of 16,047 otoliths were measured. The majority (74%) of funding for this project is through the Alaska Fisheries Information Network (federal), approximately 24% from the Fisheries Management Plan Early Jurisdiction (Project 15; federal), and ~1% of general funding (state) or outside contract. Seven people were employed for approximately 43 work months to age groundfish age structures or conduct associated work (sample preparation, data entry, archiving, otolith measurements, and project work). Only one employee was full-time and funded year round. Other individuals were seasonal, employed for 1-11 months duration.

Quality of age data is routinely assessed through second-reading at least 15% of the sample, either by the initial-reader or by a reader with equal or greater experience. Species-specific control limits are imposed and further guide release of age data; transgression of control limits direct reviewing of some or the entire sample.

In 2005, the ADU was in production status for all species received. Effort continues toward increasing objective information (age structure measurements) to strengthen foundation of pattern interpretation for all species.

The ADU Oracle database AegIS, Age Information System, was used for simple importing and exporting of data throughout 2005. In late 2005, AegIS began a 3 phase redevelopment with the first of three phases being completed: reprogramming of the initial shell to increase user success and incorporating data validation. Phase II (early 2006) will completely rewrite AegIS in Java programming language, and, incorporate biological measurements such as fish and age structure dimensions. Phase III (late 2006?) will increase interactivity and automated reporting capability of AegIS. Programming work is conducted by 2 non-ADU personnel and funding sources. Limited refinements to the ADU website (http://tagotoweb.adfg.state.ak.us/ADU/) were made.

Description of the State of Alaska Recreational groundfish fishery program (Sport Fish Division)

ADF&G has jurisdiction over all recreational groundfish fisheries within the internal waters of the state, in coastal waters out to three miles offshore, and throughout the EEZ. The Alaska Board of Fisheries extended existing state regulations governing the sport fishery for all marine species into the waters of the EEZ off Alaska in 1998. This was done under provisions of the Magnuson-Stevens Fishery Conservation and Management Act, which stipulate that states may regulate fisheries that are not regulated under a federal fishery management plan or other applicable federal regulations.

Most management and research efforts are directed at halibut, rockfish, and lingcod, the primary species targeted by the recreational fishery. Statewide data collection programs include an

annual mail survey to estimate overall harvest (in number) of halibut, rockfish, lingcod, and sharks, and a mandatory logbook to assess harvest of the same species in the charterboat fishery. The Deputy Director of the Division of Sport Fish (Rob Bentz), located in Juneau, takes the statewide lead in federal-state jurisdictional management issues.

Regional programs with varying objectives address estimation of recreational fishery statistics including harvest and release magnitude and biological characteristics such as species, age, size, and sex composition. Research is funded through the Federal Aid in Sport Fish Restoration program and through a NOAA grant administered by NMFS. There are essentially two maritime regions for marine sport fishery management in Alaska. The Southeast Region extends from the Exclusive Economic Zone (Equi-distant line) boundary in Dixon Entrance north and westward to Cape Suckling, at approximately 144^{o} W. longitude. The Southcentral Region includes state and federal waters from Cape Suckling to Cape Newenham, including Prince William Sound (PWS), Cook Inlet, Kodiak, the Alaska Peninsula, the Aleutian Islands, and Bristol Bay.

Southeast Region Sport Fish

Regional staff in Douglas coordinates a data collection program for halibut and groundfish in conjunction with a region wide Chinook salmon harvest studies project. The project leader is Mike Jaenicke while assistant project biologists were also located in Ketchikan (Kathleen Wendt) and in Juneau (Diana Tersteeg). The project biometrician (Steve Fleischman) is located in Anchorage. A total of 21 technicians work at the major ports in the Southeast region, where they interview both anglers and charter operators and then collect data from sport harvests of halibut and groundfish while also collecting data on sport harvests of salmon. Data collected on groundfish are limited to species composition, length of halibut and lingcod, and sex of lingcod; no otoliths or other age structures are collected. Data are provided to the Alaska Board of Fisheries, other ADF&G staff, the public, and a variety of other agencies such as the NPFMC and the IPHC.

Area management biologists in Yakutat, Haines, Sitka, Juneau, Petersburg, Klawock, and Ketchikan are responsible for groundfish management in those local areas. In general, sport fisheries for groundfish are not actively managed inseason.

Southcentral Region Sport Fish

The **Southcentral Region** groundfish staff consisted of the area management biologists and assistants for the following areas: (1) PWS and the North Gulf areas, (2) Lower Cook Inlet, and (3) Kodiak, Alaska Peninsula, and the Aleutian Islands. In addition, a region-wide harvest assessment project was based in the Homer office, consisting of a project leader, field supervisor, and six technicians. The research project biometrician was located in Anchorage. Ongoing assessment of sport harvest and fishery characteristics at major ports throughout the region is the primary activity. Data are collected from harvested halibut, rockfishes, lingcod, and sharks, and anglers and charter boat operators are interviewed for fishery performance information. All age reading is done in Homer, and the staff are active participants in the Committee of Age Reading Experts (CARE). Seasonal technicians collected data from the sport harvest at seven major ports in the region, and two of them read all rockfish and lingcod age structures. Halibut otoliths were

collected from the harvest and will be forwarded to the International Pacific Halibut Commission for age reading.

Southcentral region staff is responsible for management of groundfish fisheries in state and federal waters. For all species, the lack of stock assessment information has precluded development of abundance-based fishery objectives. As a result, management is based on building a regulatory framework specifying bag and possession limits, seasons, and methods and means that provides for sustained yield over the long term. Inseason management action has generally been unnecessary, but increasing harvests of some species will eventually necessitate development of a well-defined harvest strategy.

Typical duties also include providing sport halibut harvest statistics to the International Pacific Halibut Commission (IPHC) and NPFMC, assisting in development and analysis of the statewide charter logbook program and statewide harvest survey, working with Alaska Board of Fisheries, advisory committees, and local fishing groups to develop local area management plans (LAMPs), drafting and reviewing proposals for recreational groundfish regulations, and dissemination of information to the public.

B. By Species

Pacific Cod

Catch rate and biological information is gathered from fish ticket records, port sampling programs, a tagging program, and during stock assessment surveys for other species. A mandatory logbook program was initiated in 1997 for the state waters of Southeast Alaska. Commercial landings in Southeast, Central Region and the Westward Region are sampled for length, weight, age, sex, and stage of maturity.

Research

The **Westward Region** has continued the cod-tagging program that was initiated in 1997 in the Central and Western Gulf of Alaska. Approximately 350 fish were tagged in 2005, bringing the total number of tags released to 13,150. By year's end, 713 tags had been recovered, 518 of them with useable recovery location information. Results to date show that while the vast majority of Pacific cod are recovered within 15 km of their tagging location, much longer recapture distances are possible. Several fish were recaptured more than 500 km from their tagging location. The relatively small number of long distance recaptures show movement of cod is occurring from the Shumagin Islands into the Bering Sea, the Alaska Peninsula to Kodiak waters, and several fish tagged in Kodiak waters were recovered in Southeast Alaska.

Stock Assessment

No stock assessment programs were active for Pacific cod during 2004.

Management

Regulations adopted by the Alaska Board of Fisheries during November 1993 established a guideline harvest range (GHR) of 340 to 567 mt for Pacific cod in the internal waters of **Southeast Alaska**. The GHR was based on average historic harvest levels rather than on a biomass-based ABC estimate. Pacific cod along the outer coast are managed in conjunction with the Total Allowable Catch (TAC) levels set by the federal government for the adjacent EEZ.

In 1996, the Alaska Board of Fisheries adopted Pacific cod Management Plans for fisheries in 5 groundfish areas, **Prince William Sound**, Cook Inlet, Kodiak, Chignik and South Alaska Peninsula. The plans did not restrict participation to vessels qualified under the federal moratorium program. Included within the plans were season, gear and harvest specifications. Fishing seasons begin seven days after the close of the initial federal season in all areas except Cook Inlet, which begins 24 hours after the closure and Chignik, which has a regulatory opening date of March 1. The BOF restricted the state waters fisheries to pot or jig gear in an effort to minimize halibut bycatch and avoid the need to require onboard observers in the fishery. The guideline harvest levels (GHL) are allocated by gear type. The annual GHL's are based on the estimate of allowable biological catch (ABC) of Pacific cod as established by the NPFMC. Current GHLs are set at 25% of the Western Gulf ABC to be reserved for the South Alaska Peninsula Area, 25% of the Central Gulf ABC to be apportioned between the Kodiak, Chignik and Cook Inlet Areas and 25% of the Eastern Gulf ABC for the Prince William Sound Area. Action by the BOF in 2004 reduced the GHL in Prince William Sound to 10% of the Eastern Gulf ABC with a provision to increase subsequent GHLs to 25% if the GHL is achieved in a year.

Additional regulations include a 58’ vessel size limit in the Chignik and South Alaska Peninsula Areas and allocations between gear types in Kodiak, Cook Inlet and Prince William Sound. The fishery management plans also provided for removal of restrictions on exclusive area registrations, vessel size and gear limits after October 31 to increase late season production to promote achievement of the GHL.

Efforts have increased to collect biological data through port sampling. In addition, observers are used on day-trips to document catches and at-sea discards in the nearshore pot fisheries.

There is no bag, possession, or size limit for Pacific cod in the recreational fisheries in Alaska. Pacific cod harvest and release information is not collected in the creel surveys and port sampling of the recreational fisheries in Southcentral or Southeast Alaska.

Fisheries

Most of the Pacific cod harvested in Southeast Alaska are taken by longline gear in NSEI during the winter months. Pots have been the dominant gear in both the Cook Inlet and Prince William Sound areas. Overall Pacific cod harvest from the Cook Inlet and PWS areas during the parallel season has declined in recent years. In the Westward Region, trawl gear takes over 60% of the harvest, with the remainder split between longline, jig, and pot gear. Prior to 1993 much of the cod taken in Southeast was utilized as bait in fisheries for other species. Pacific cod harvested since that time is roughly evenly divided between bait use and human consumption. In other areas of the state, Pacific cod are harvested in both state and federal waters and utilized primarily as food fish. Harvests of Pacific cod totaled 213 mt in the Southeast state-managed fishery during 2005, up slightly from the 2004 catch. The 2005 GHL's for the state-managed Pacific cod seasons in the **Central** Region were set at 1,243 mt and 407 mt, respectively. Due to the low number of vessels making landings from the PWS Area in 2005 harvest figures remain confidential. Harvest from the Cook Inlet Area state-managed Pacific cod fishery totaled 1,052 mt. Harvest from the 2005 state managed fishery in the Kodiak Area totaled 3,877 mt, while 2,625 mt of cod were harvested in the Chignik Area, and the South Alaska Peninsula Area harvest totaled 5,192 mt. The Kodiak and South Alaska Peninsula Areas obtained their maximum GHL 'step up' provisions for 2000 and all subsequent years. The Kodiak Area will receive 12.5% of the Central Gulf ABC and the South Alaska Peninsula will receive 25% of the Western Gulf ABC in all future years. The Chignik Area achieved its maximum GHL 'step' up in 2003. The Chignik Area will receive 8.75% of the Central Gulf ABC in 2004 and all future years. Action by the Alaska Board of Fisheries during 2004 increased the Pacific cod allocation in the Cook Inlet Area from 3% to 3.75% of the Central Gulf ABC, the maximum allowed under regulation.

Rockfishes

Rockfishes are managed under three assemblages: demersal shelf (DSR), pelagic shelf (PSR), and slope rockfish. Demersal Shelf Rockfish include the following species: yelloweye, quillback, china, copper, rosethorn, canary, and tiger. Pelagic shelf rockfish (PSR) include black, blue, dusky, yellowtail, and widow. Black and blue rockfish were removed from the PSR assemblage in the federal fisheries management plan and placed totally under state management in 1998. Slope rockfish contain all other *Sebastes* and *Sebastolobus* species.

Research

Detecting spatial structure in the genetic variation of some marine fishes is challenging as populations are often closely related through high gene flow and the relationships between populations may change over years. However, recent advances in molecular markers provide a large array of potentially valuable approaches to address these questions. The Alaska Department of Fish and Game Gene Conservation Laboratory is currently conducting studies of spatial and temporal variation in black rockfishes using analyses of microsatellite DNA.

Studies of black rockfish are investigating the spatial structure throughout the range of the species from the Pacific Northwest through the Bering Sea. Sample collection efforts were

largely completed in 2001. Sites range from Oregon through the Alaska Peninsula. Ten individual collections were analyzed for eight microsatellite loci derived from black and quillback rockfishes. Loci were highly variable with an average heterozygosity of 0.748. Preliminary statistical analyses indicate small but significant differences among collections. F_{st} values by locus varied from 0.001 to 0.020. A manuscript and final report are in preparation (Contact Lisa Seeb).

In the **Southeast Region,** port sampling and the mandatory logbook program for rockfish fisheries continued in 2005. The logbook and interview programs are designed to furnish detailed catch and effort information, to estimate at-sea discards, and to obtain more detailed information regarding specific harvest location. The port-sampling program provides species composition from the landed catch and an opportunity to collect biological samples. Otoliths were obtained from principal demersal shelf rockfish species and black rockfish and sent to the age-reading laboratory in Juneau for age determination. Data from these programs is entered into a regional database. Closures in the 2005 directed fishery for demersal shelf rockfish in CSEO and SSEO significantly reduced the sampling opportunity for these species. In 2005, 459 yelloweye and 63 black rockfish were sampled for age, weight, length, sex, and maturity (Contact Mike Vaughn).

Rockfish habitat mapping projects continue in the Southeast Region. The objective of this project is to continue a bottom-mapping project of the Eastern Gulf of Alaska to provide detail on habitat characterization in this important fishing ground. To date, ADF&G has mapped approximately 2100 km^2 of seafloor. This represents over 7% of the total habitat inside the 100-fm contour along the outer coast of Southeast. More importantly, over 980 km^2 of rocky habitat has been mapped, approximately 32% of what is estimated to occur. The goal of this project is to produce a GIS compatible sun-illuminated multibeam mosaic of these areas complete with bathymetric contour mosaics and a geological habitat interpretation of the mosaics. Quantification of rockfish habitat based on the geological interpretation of multibeam data is subcontracted to Moss Landing Marine Laboratories.

Beginning in 2004, we contracted Fugro Pelagos to post process multibeam data that was collected by NOAA for the purpose of updating the nautical charts for the areas close to Sitka Sound. Our hope is that data collected by NOAA will be useful to us and save us the cost of mobilizing surveys of our own. The NOAA survey Fugro Pelagos is post processing is from the south end of Kruzof Island and approximately half of it was collected in a manner that will result in maps that will be useful for the delineation of rocky habitat in that area.

Skipper interviews and port sampling of commercial rockfish deliveries in **Central Region** during 2005 occurred in Homer, Seward, Whittier, Anchorage and Cordova. Efforts during the first half of the year primarily sampled rockfish delivered as bycatch in other groundfish fisheries, primarily slope and demersal shelf species. During the last half of the year, sampling focused primarily on the directed jig fishery that targets pelagic rockfish. Additional sampling occurred during the Cook Inlet and PWS trawl and sablefish longline surveys. Sample data collected included date and location of harvest, species, length, weight, sex, and gonad condition. Otoliths were collected from most sampled fish. Homer office staff determined ages of pelagic

and demersal rockfish otoliths. Otoliths from all other rockfish species were sent to the Age Determination Unit (Contact Willy Dunne).

In 2000, **Central Region** staff initiated a three-year project to evaluate sampling approaches for estimating black rockfish (*Sebastes melanops*) abundance in specific nearshore habitats of Southcentral Alaska along the Northern Gulf of Alaska. Harvest guidelines are currently based on long-term harvest levels of all rockfish species in aggregate and have not been established to reflect changes either in the abundance of individual species or in fishing patterns. Black rockfish comprise the largest component of state waters rockfish harvest along the northern Gulf of Alaska. This project attempts to use in-situ scuba diver observations and mark-recapture to obtain black rockfish abundance and density estimates and will assess the use of these and other methods as indices of relative abundance. In addition, protocols are being developed for diver observations of habitat type to aid in elucidating black rockfish habitat associations. A second project initiated in 2001 involves the use of an ROV for the purpose of habitat and stock assessment of a variety of marine species, including rockfish. This three-year project will focus on equipment purchase and the development of proficiency with the ROV (Contact Ken Goldman).

The **Westward Region** continued its port sampling of the commercial rockfish and Pacific cod harvests in 2004. Rockfish sampling consisted mainly of black rockfish with opportunistic sampling of light duskies, dark duskies, and other miscellaneous *Sebastes* species. Skippers were interviewed for information on effort, location, and bycatch. Length, weight, gonadal maturity, and otolith samples were collected (contact Kally Spalinger or Carrie Worton). Staff from the Kodiak office has completed aging black rockfish otoliths through the 2005 season while a number of Pacific cod ototlihs remain to be read.

The Westward Region also continued several studies on Western Gulf of Alaska black rockfish. Monthly gonad collections continued through June 2005 in an effort to determine reproductive seasonality and size of maturity. This completed the collections for that project and the results are being compiled. In addition, monthly samples were started for dark rockfish from both male and female fish. Beach seining was conducted in August and September in the Kodiak area to collect juvenile black rockfish and determine their habitat preferences and early life history parameters (Contact Carrie Worton).

The **Division of Sport Fish—Southeast Region** continued to collect catch and harvest data from rockfish as part of a marine harvest onsite survey program with rockfish harvests tabulated back to 1978 in some selected ports. Data collected in the program include statistics on effort, catch, and harvest of the primary rockfish species commonly taken by Southeast Alaska anglers. Ports sampled in 2005 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove, Ketchikan, and Yakutat. Primary species harvested in Southeast Alaska included yelloweye, black, and quillback rockfish (Contact Mike Jaenicke).

The **Division of Sport Fish—Southcentral Region** continued collection of harvest and fishery information on rockfish as part of the harvest assessment program. Rockfish objectives included estimation of: 1) species composition, 2) age, sex, and length composition, and 3) the

geographic distribution of harvest by the fleets by port. Approximately 2,284 rockfish were sampled at Seward, Valdez, Whittier, Kodiak, and Homer in 2005 (Contact Scott Meyer).

Stock Assessment

The **Southeast Region** uses line-transect methods, conducted from the submersible "Delta", to collect density estimates of yelloweye rockfish. Biomass is the product of density, average weight, and area of rock habitat.

New density surveys were conducted during 2005 in SSEO. Yelloweye rockfish density for this stock assessment is based on the last best estimate by management area. The EYKT and CSEO areas were last surveyed in 2003 and NSEO was surveyed in 2001. Density estimates by area range from 1,420 to 3,557 adult yelloweye per km^2 . The density estimate for SSEO in 2005 was 2,196 adult yelloweye/km^2 (CV=17.16%). This is higher than the previous estimate obtained in 1999 of 1,879 adult yelloweye/km^2 (CV=17.11%), however the difference is not significant. The model is a hazard rate model with 11 cutpoints ending at a width of 28 ft (Contact Tory O'Connell).

In the **Southeast Region,** no black rockfish surveys were conducted in 2005.

Beginning in 2000, **Central Region** groundfish staff initiated a three-year project designed to develop and implement a sampling approach for estimating black rockfish abundance in specific nearshore habitats of Southcentral Alaska along the Northern Gulf of Alaska. Harvest guidelines are currently based on long-term harvest patterns of all rockfish species in aggregate and have not been established to reflect changes either in the abundance of individual species or in fishing patterns. Black rockfish comprises the largest component of rockfish harvests along the northern Gulf of Alaska. This project used tagging and SCUBA to explore habitat-based assessment of black rockfish. In 2004, an additional project with funding for two seasons began, this project compares scuba and acoustic-based rockfish indices to catch indices from a commercial jig vessel. Rockfish are also tagged during these cruises (Contact Ken Goldman).

In the **Westward Region,** hydroacoustic equipment was deployed in a preliminary effort at stock assessment of black rockfish. Surveyed areas included the eastern Aleutians and Shumagin Islands. The **Westward Region** also coordinated with the **Central Region** in a project using divers, jig machines, and hydroacoustics to develop protocols for the surveying of black rockfish (Contact Dan Urban or Mike Byerly).

Management

Management of DSR is based upon a combination of guideline harvest ranges, seasons, gear restrictions, and trip limits. The state has management authority for demersal shelf rockfish in both state and federal waters of **Southeast Alaska**.

Directed harvest of demersal shelf rockfish is restricted to hook-and-line gear. Directed fishing quotas are set for the 4 outside water management areas (SEO) individually and are based on the poundage remaining after assigning a 2% harvest rate to the adult yelloweye biomass estimate

and estimating bycatch (reported and nonreported) mortality. Directed fishery quotas for the two internal water management areas are set at 25 mt annually. Regulations adopted in 1994 include trip limits (within any 5 day period) of 6,000 pounds per vessel (12,000 pounds in EYKT), and added a requirement that logbook pages must be submitted with fish tickets for each fishing trip. The directed DSR fishery quota is now allocated with 2/3 of the quota apportioned to the January 1- March 15 season and 1/3 of the quota apportioned to the November 16- December 31 season. The 2005 TAC for DSR in SEO was 410 mt. A significant portion of the total harvest is taken as bycatch mortality during the halibut fishery, estimated at 328 mt for 2005. In 2005, the directed DSR fishery in SEO was opened in the EYKT area only. The CSEO and SSEO fisheries were not opened in 2005. Prior to 2005, sport fish catch data was not available for DSR and had not been considered in estimating total mortality. In late fall of 2004, the 2003 sport fish data was tabulated and it was determined that the combined harvest of DSR in the halibut fishery, directed commercial fishery, and the sport fish fishery would result in over-harvest in the SSEO and CSEO areas. The directed commercial fishery was closed in these two areas (Contact Tory O'Connell).

Management of black rockfish is based upon a combination of guideline harvest limits and gear restrictions. The state has management authority for black rockfish in both state and federal waters of Southeast Alaska. Directed fishery guideline harvest limits are set by management area, and range from 11.3 mt in IBS to 57 mt in SSEO, totaling 136 mt. A series of open and closed areas was also created so managers could better understand the effect a directed fishery has on black rockfish stocks. Halibut and groundfish fishermen are required to retain and report all black rockfish caught. The directed fishery for black rockfish had very little participation in 2005, with less than 5 mt landed in directed and bycatch fisheries combined.

Shortspine thornyhead, shortraker rockfish, rougheye rockfish and redbanded rockfish may be taken as bycatch only (no directed fishing). A total of 117 mt of slope rockfish were landed in NSEI and SSEI during 2005.

Rockfish in **Central Region's** Cook Inlet and PWS areas are managed under their respective Rockfish Management Plans. Plan elements include a fishery GHL of 68 mt for each area and 5-day trip limits of 0.5 mt in the Cook Inlet District, 1.8 mt in the North Gulf District, and 1.4 mt in PWS. Rockfish regulations underwent significant change beginning in 1996 when the Alaska Board of Fisheries formalized the GHL into a 68 mt harvest cap for all rockfish species in Cook Inlet and PWS and a 5% rockfish bycatch limit for jig gear during the state waters Pacific cod season. In 1998, the board adopted a directed rockfish season opening date of July 1 for the Cook Inlet Area and restricted legal gear to jigs, primarily because the fishery typically targets pelagic rockfish species. At the spring 2000 meeting, the board closed directed rockfish fishing in the PWS area and established a bycatch-only fishery with mandatory full retention of all incidentally harvested rockfish. In November 2004, the board also adopted a full retention requirement for rockfish in the Cook Inlet Area and restricted the directed harvest to pelagic shelf rockfish. Rockfish bycatch levels were also set at 20% during sablefish and 10% during other directed fisheries. Proceeds from rockfish landed in excess of allowable bycatch levels are surrendered to the State of Alaska. (Contact Charlie Trowbridge)

The **Westward Region** has attempted to conservatively manage black rockfish since 1997, when management control was relinquished to the State of Alaska. Area guideline harvest levels were set at 75% of the average production from 1978-1995 and sections were created to further distribute effort and thereby lessen the potential for localized depletion. Since 1997, section GHL's have been reduced in some areas that have received large amounts of effort.

In the Kodiak Area, vessels may not possess or land more than 5,000 pounds of black rockfish in a 5-day period. Additionally, vessel operators are required to register for a single groundfish fishery at a time. A registration requirement also exists for the Chingik Area; that area was also designated as super-exclusive for the black rockfish fishery beginning in 2003.

In 2005, 102 mt of black rockfish were harvested from six sections in the Kodiak Area. Effort and harvest decreased in 2005 compared to 2004. Guideline harvest levels were attained in four sections. The 2005 black rockfish harvest in the Chignik Area totaled 22 mt and totaled 26 mt in the South Alaska Peninsula Area. The staff of the Westward region is currently seeking an economically feasible and statistically valid means to conduct stock assessments on the rockfish resources of the region. A voluntary logbook program was initiated in 2000 in the hope of obtaining CPUE estimates as well as more detailed harvest locations; the logbook program was made mandatory in 2005. (Contact: Nick Sagalkin).

State wide, the majority of sport caught rockfish are taken incidental to recreational fisheries for halibut or while trolling for salmon. In **Southeast Alaska, sport** bag limits consist of 5 pelagic rockfish and 5 non-pelagic rockfish per day of which only 2 may be yelloweye rockfish. In addition, bag limits in areas near Ketchikan and Sitka are limited to 3 non-pelagic rockfish, only 1 of which may be a yelloweye rockfish (Contact Mike Jaenicke).

In most of the fisheries in **Southcentral Alaska**, bag limits in most areas have been designed to discourage targeting of rockfish yet allow for retention of incidental harvest. Bag limits in Prince William Sound, the North Gulf, and Cook Inlet are five rockfish daily, with no more than one or two being non-pelagic (DSR and slope) rockfish. The Alaska Board of Fisheries has allowed a 10-rockfish bag limit in the Kodiak and Alaska Peninsula areas because of lower levels of effort and predominance of pelagic species in the catch.

Given the lack of quantitative stock assessment information for much of Alaska, sport fish managers have established conservative harvest strategies for recreational rockfish fisheries. Recreational seasons and bag and possession limits for rockfish in Alaska are among the most restrictive on the West Coast.

Fisheries

Reported harvest of rockfishes, from commercial fisheries in **Southeast,** totaled 809 mt in 2004, 198 mt of which was the directed DSR fishery and 17 mt the directed black rockfish fishery. The majority (23%) of the remaining rockfish taken in the Southeast district were DSR bycatch made in conjunction with the IFQ halibut fishery. All rockfish harvested in state-managed fisheries in Southeast is taken by hook-and-line gear either in directed fisheries or incidental to fisheries for other species.

The 2005 **Cook Inlet Area** directed rockfish fishery opened July 1 and closed December 31 with a total harvest of 30 mt, primarily pelagic rockfish. This was the sixth year that the jig-only gear restriction was in place. Total rockfish harvest for the PWS Area rockfish bycatch-only fishery was 27 mt. This included a 3.8 mt incidental catch of slope rockfish from the walleye pollock trawl fishery and a 22.9 mt incidental harvest of demersal and slope rockfish from the sablefish and halibut longline fisheries.

Estimates of **sport harvest** are obtained by three methods – the Statewide Harvest Survey (SWHS), charter vessel logbooks, and, in major ports, creel survey dockside sampling. Harvest reporting areas for these programs are different than commercial reporting areas making direct comparisons difficult. Additionally, species-specific data is available only from creel surveys.

The SWHS reports harvest for the general category of "rockfish", and the charter vessel logbook records rockfish harvest in two categories: "non-pelagic" and "pelagic". DSR are part of the "non-pelagic" category. Recreational rockfish harvest is typically estimated in numbers of fish. Estimates of the 2005 harvest are not yet available from the statewide harvest survey, but the 2004 estimates were 87,700 fish in Southeast and 92,500 fish in Southcentral Alaska. There were historic highs for each region. The average estimated annual harvest for the most recent five-year period (200-2004) was 63,900 rockfish (all species) in Southeast Alaska and 69,600 fish in Southcentral Alaska.

Creel survey data for Sitka indicates that 12,847 individual yelloweye (approximately 36 mt) were retained by anglers in an area roughly equivalent to the CSEO in 2005. This is a 43% increase in the harvest of yelloweye since 2001. Creel and SWHS data for SWHS Area B (Prince of Wales Island) indicates that 4,000 yelloweye (approximately 13 mt) were retained in 2004. This area includes the SSEO and a portion of the SSEI. Given the restrictive bag limit for yelloweye (1 or 2 depending on area) it is likely that these numbers underestimate total sportfish induced mortality. These numbers do not include harvest of other species of DSR.

Sablefish

Research

In 2005, sablefish longline surveys were conducted for the NSEI area. These surveys are designed to measure trends in relative abundance and biological characteristics of the sablefish population. Biological data collected in these surveys include length, weight, sex and maturity stage. Otoliths are collected and sent to the ADF&G age determination unit in Juneau for age

reading. The cost of these surveys is offset by the sale of the fish landed. Because of a restriction on testfish revenues in FY05 the longline survey for SSEI had to be canceled for 2005.

In the NSEI survey, the 2005 overall CPUE (kg/hook) was 1.09, up slightly from 2004 (0.96) and similar to 2003 (1.09). Thornyhead rockfish dominated the bycatch in all areas except the northern-most statistical area.

The on-going mandatory logbook program in the sablefish fisheries provides catch and effort data by date, location, and set. In the SSEI sablefish fishery, overall CPUE (adjusted for hook spacing) increased in 2005 to 0.24 kg lbs/hook compared to 0.18 rd. kg/hook in 2004. The lack of longline survey removals in 2005 may have had a positive effect on CPUE. In the NSEI fishery, the overall CPUE adjusted for hook spacing, in round kg/hook for vessels, was 0.32, identical to 2004.

In 2005, ADF&G continued a mark/recapture study in NSEI, tagging and releasing 7,119 sablefish using pot gear to capture the fish 1.5 months prior to the start of the fishery (August 15, 2005). Fish were caught with pot gear to minimize the apparent "hook shyness" pattern of tag returns observed in 1997, 1998 and 1999 when longline gear was use to catch fish for tagging.

Within **Central Region,** ADF&G initiated a limited mark-recapture study in 1999 within PWS using the biennial bottom trawl survey as the capture vehicle. Tagging was continued in the 2003 PWS bottom trawl survey. Fewer than ten tagged fish have been recovered to date (Contact Ken Goldman).

Skipper interviews and port sampling occurred in Whittier, Cordova and Seward for the PWS Area fishery and in Seward and Homer for the Cook Inlet Area fishery. Data obtained included date and location of harvest, length, weight, sex, and gonad condition. Otoliths were removed and sent to the Age Determination Unit (Contact Willy Dunne).

Stock Assessment

In **Southeast**, the department is using mark-recapture methods with tags and fin clips to estimate abundance and exploitation rates for sablefish in the NSEI Subdistrict. Sablefish are captured with pot gear in mid-summer, marked with a tag and a fin clip then released. Tags are recovered from the fishery and fish are counted at the processing plants and observed for fin-clips. Based on Chapman's modification of the Petersen estimator, there were an estimated 2,675,118 sablefish in NSEI at the time of the 2004 fishery (Chapman 1948). The 90% confidence interval for the 2004 sablefish abundance estimate was 2,501,350 – 2,872,325 sablefish. Decrementing this estimate to account for natural mortality, and forecasting the exploitable numbers, the lower 90% confidence interval forecast for 2005 was 2,276,411 sablefish and 17,403,486 pounds of sablefish. In addition to the mark-recapture work, annual longline surveys are conducted in both NSEI and SSEI to provide biological data as well as relative abundance information (Contact Sherri Dressel).

A longline survey, using ADF&G vessels, has been conducted in **Prince William Sound** annually since 1996. Mean CPUE has ranged from 0.07 fish/hook in 1997 to 0.13 fish/hook in 2000. Longline survey effort was recently extended into the North Gulf District in 1999, 2000 and 2002. The 2001 PWS survey focused on the northwest and southwest PWS, and was limited to the northwest area in 2002 and 2003. Relative to recent surveys, sablefish catch rates (not weighted for available depth strata) increased from 2002 to 2003, but remained below rates in 2001. Survey costs are partially offset by the sale of the fish (Contact Ken Goldman).

Management

There are three separate internal water areas in Alaska which have state-managed sablefish fisheries. The Northern Southeast Inside Subdistrict (NSEI), the Southern Southeast Inside Subdistrict (SSEI), and the Prince William Sound District each have separate seasons and guideline harvest ranges.

In the **Southeast Region,** both the SSEI and NSEI sablefish fisheries have been managed under a license limitation program since 1984. In 1994 the BOF adopted regulations implementing an equal share quota system where the annual guideline harvest level was divided equally between permit holders and the season was extended to allow for a more orderly fishery. In 199, the BOF adopted this equal share system as a permanent management measure for both the NSEI and SSEI sablefish fisheries.

Due to declines in fishery CPUE and preliminary results from our mark-recapture work, ADF&G reduced the NSEI quota 35% in 1999 to 1,415 mt where it remained through 2000. Beginning in 2001 a biomass estimate was available and the NSEI area total allowable catch (TAC) set using an $F_{40\%}$ applied to the lower 90% confidence limit of the estimate of biomass. The TAC is then decremented by estimated mortality in other fisheries before the directed fishery quota is set. The quota was decreased in 2001 to 990 mt and to 909 mt for 2002 and 2003. In 2004 the quota was increased to 1,018 mt. The 2005 directed fishery quota was 931 mt with 106 permit holders (longline). The SSEI quota was set at 316 mt in 2000, and has remained the same thru 2005 with 28 permit holders (4 pot gear, 24 longline).

During the January 2003 Alaska Board of Fisheries (BOF) meeting, the BOF made several major changes in regulations affecting the NSEI and SSEI sablefish fisheries: The opening date for the NSEI fishery was changed from September 1 to August 15; permit holders are allowed to release healthy sablefish and are required to document the number of fish released in their logbook (all injured or dead sablefish must be retained); the retention of sablefish for use as bait is prohibited in state waters; permit holders are allowed to carry-over up to 5% of their annual equal quota share as an overage or underage or transfer up to 5% of their legal harvest to another permit holder; and if requested by ADF&G permit holders may fish outside of the regular season if they carry a state observer on board.

During 2004 and 2005, ADF&G issues permits to allow permit holders to fish outside of the regular season. Vessels participating in this program were required to take an ADF&G biologist on the trip and data regarding catch rates, bycatch, and biological samples were taken. In 2004, one vessel fished in early February and 5 vessels (7 permits) fished in late April. In 2005, 3

vessels fished in mid-February, 2 vessels (3 permits) fished in mid March, and 5 vessels (6 permits) fished in late April. In general, catch rates were low in February and there were very high bycatch rates of dogfish. The CPUE improved by mid-March and was strong in April as well.

Sablefish fisheries in outer coastal state waters (0-3 miles) have been managed in conjunction with the federal-managed fishery in the EEZ. There is no open-access sablefish fishery in the Southeast Outside District as there are limited areas that are deep enough to support sablefish populations inside state waters. In some areas of the Gulf, the state opens the fishery concurrent with the EEZ opening. These fisheries, which occur in the North Gulf District of Cook Inlet and the Aleutian Island District, are open access in state waters, as the state cannot legally implement IFQ management at this time. The quotas are based on historic catch averages and closed once these have been reached.

The GHL for the North Gulf District is set using an historic baseline harvest level adjusted annually by the same relative reduction to the TAC in the Central Gulf Area. The 2005 fishery GHL was 40 mt. In 2004, the BOF adopted sablefish fishery-specific registration and logbook requirements and a 48-hours trip limit of 1.3 mt. For PWS, a limited entry program that included gear restrictions and established vessel size classes was adopted in 1996. Additionally a commissioner's permit, which stipulates logbook and catch reporting requirements, must be obtained prior to participation in the fishery. The fishery GHL is set at 110 mt, which is the midpoint of the harvest range set by a habitat-based estimate. Fishery management continued to develop through access limitation and then into a quota share system wherein permit holders are allocated shares of the harvest guideline. Shares are equal within each of four vessel size classes, but differ between size classes. Central Region staff annually conducts dockside interviews and sample landings in the ports of Cordova, Whittier, and Seward.

There is no bag, possession, or size limit for sablefish in the recreational fisheries in Alaska. Sablefish harvest and release information is not collected in the creel surveys and port sampling of the recreational fisheries in Southcentral or Southeast Alaska.

Fisheries

In the **Southeast Region,** the 2005 NSEI sablefish fishery opened August 15 and closed November 15. The 106 permit holders landed a total of 918 mt of sablefish. The fishery is managed by equal quota share; each permit holder was allowed 8.8 mt. The 2005 SSEI sablefish fishery opened June 1 and closed November 15. Twenty-eight permit holders landed a total of 290 mt of sablefish, each with an equal quota share of 11.3 mt (Contact Tory O'Connell).

In the **Central Region,** the 2004 open access sablefish fishery in the North Gulf District opened for 24 hours beginning noon July 15 and closed 3 PM on July 23. Ten vessels harvested 38 mt. In the Prince William Sound area, a "shared quota" system was adopted by the Board of Fish and instituted during the 2003 season. Season dates for 2005 were March 15 - May 15 and August 1 – 21. The system allocates half of the 110 mt GHL equally among all registered participants with the balance of the GHL allocated between each vessel size class based on historic harvest within each class resulting in the following percentages: Classes A and B (90 and 60 feet maximum length = 18.53%; Class C (50 feet maximum length) vessels = 70.33% and Class D (35 feet

maximum length) vessels = 11.14%. All sablefish landed in excess of an individual's quota are sold and the proceeds go to the State of Alaska. Skipper interviews and biological sampling were conducted in-season which gathered effort and location information as well as age, length, weight, sex and gonad condition data (Contact Charlie Trowbridge).

Within the **Westward Region**, only the Aleutian Islands have sufficient habitat to support mature sablefish populations of sufficient magnitude to permit commercial fishing. All other sections within the region are closed by regulation to avoid the potential for localized depletion from the small amounts of habitat within the jurisdiction of the state. Bycatch from the areas closed to directed fishing is limited to 1%. The 2004 Aleutian Island fishery opened on May 15, 2005. Additional requirements for the fishery include registration and logbook requirements. The GHL was set at 249 mt for the state managed fishery. The preliminary harvest from the 2005 Aleutian Islands sablefish fishery was 92 mt. The season remained open until the November 15 closure date (Contact Barbi Failor-Rounds).

Flatfish

Research

There was no research on flatfish during 2005.

Stock Assessment

There are no stock assessments for flatfish.

Management

Trawl fisheries for flatfish are allowed in three small areas in the internal waters of **Southeast Alaska** under a special permit issued by the department. The permits are generally issued for no more than a month at a time and specify the area fished and other requirements. Trawl gear is limited to beam trawls, and mandatory logbooks are required, observers can be required, and there is a 20,000 pound weekly trip limit.

Fisheries

There has been almost no effort in the **Southeast** fishery for the past five years, with no harvest reported for the 2004-2005 season. The Southeast flatfish trawl areas are also the sites of a shrimp beam trawl fishery. Most of the Southeast harvest is starry flounder. NMFS manages the flatfish fishery and harvest in the state waters of **Westward Region**.

Pollock

State-managed pollock is limited to the Central Region

Research

Pollock continue to be a dominant species in the **Central Region** ecosystem. Due to uncertainty about the appropriate harvest level for the PWS pollock fishery, assessment in 2005 included commercial fishery catch sampling and bottom trawl surveys of the summer (post-spawning) population. Skipper interviews and port sampling of **Central Region** commercial pollock deliveries during 2005 occurred in Kodiak. Additional sampling occurred during the Cook Inlet and PWS trawl and sablefish longline survey. Sample data collected included date and location of harvest, species, length, weight, sex, and gonad condition. Otoliths were collected from most sampled fish. Homer office staff determined ages of pollock otoliths (Contact Willy Dunne).

In 1996, interactions between pollock, herring, and juvenile salmon were also examined as part of Sound Ecosystem Assessment (SEA) funded by the *EXXON Valdez* Oil Spill Restoration.

In Pollock, we are testing for spatial patterns of genetic variation in six population samples from three regions: North America – Gulf of Alaska; North America – Bering Sea; Asia – East Kamchatka. We tested for annual stability of the genetic signal in replicate samples from three of the North American populations. These studies, begun in 1998 and 1999, continued into 2000. A manuscript documenting the findings is under internal review. Allozyme and mtDNA markers provide concordant estimates of spatial and temporal genetic variation. These data show significant genetic variation between North American and Asian pollock as well as evidence that spawning aggregations in the Gulf of Alaska, such as Prince William Sound, are genetically distinct and may merit management as distinct stocks. These data also provide evidence of inter-annual genetic variation in two of three North American populations. Gene diversity values show this inter-annual variation is of similar magnitude to the spatial variation among North American populations, suggesting the rate and direction of gene flow among some spawning aggregations is highly variable (Contact Lisa Seeb).

Stock Assessment

Hydroacoustic surveys, with sample collection by mid-water trawl, were conducted in PWS in the winters of 1995, 1997, 1998, 2000, 2001, and 2002 by the Prince William Sound Science Center in cooperation with ADF&G. Biomass estimates of prespawning pollock aggregations have been relatively stable, except for 1998, with a slight decline indicated in more recent years. The department also conducts a biennial bottom trawl survey during the summer in PWS, and develops a pollock biomass estimate used to establish the harvest guideline for the winter commercial fishery. This approach is justified, despite the belief that a significant portion of the spawning population targeted by the winter fishery immigrated from federal waters, because the summer population is not assessed by the NMFS summer survey. Survey biomass estimates from the biennial bottom trawl survey have declined in recent years, and the fishery harvest level has been reduced accordingly (Contact Ken Goldman).

Management

Prince William Sound pollock fishery regulations include a commissioner's permit and a registration deadline of January 13. The permit stipulates logbooks, catch reporting, and accommodation of a department observer upon request. Vessels are required to check in and check out of the area and fishery as well as contact the department daily to report catch, effort, and fishing location. In 2001, new regulations were adopted dividing the PWS Inside District into three sections (Port Bainbridge, Knight Island, and Hinchinbrook) and limiting harvest to a maximum of 40% of the GHL from any section (Contact Bob Berceli).

Fisheries

The 2005 fishery opened on January 20 with a GHL of 923 mt. Catch and effort remained low until late February when aggregations of pollock in the Hinchinbrook section increased resulting in achievement of the 40% harvest level for that section. The section closed by emergency order on March 5. Subsequently, fishing improved in the Knight Island and Bainbridge sections, which closed on March 9 due to concerns over increased bycatch. Total pollock harvest for all sections combined was 761 mt. As in past years, fishery bycatch was dominated by squid (2.7 mt), sharks (5.2 mt), and rockfish (3.8 mt).

Sharks

Research

In the **Central Region,** Spiny dogfish and Pacific sleeper sharks have been tagged annually since 1997 as part of the PWS longline survey for sablefish, and since 2000 during bottom trawl surveys in Cook Inlet and PWS. Through 2003, over 400 each of spiny dogfish and Pacific sleeper sharks have been tagged. To date, ten tagged sleeper sharks have been recovered from PWS; maximum time-at-large was 1,259 days and most sharks moved less than 20 km between tagging and recapture locations. No spiny dogfish have been recovered. In 2003, 340 spiny dogfish were sacrificed and the posterior dorsal spine removed for age determination. In addition, 10-15 sleeper sharks have been sacrificed annually during 2000 to 2003 for parasite and contaminant analysis (Contact Ken Goldman).

In recent years, a small **recreational** fishery targeting salmon sharks has developed in the Gulf of Alaska and Prince William Sound. Little information is available to assess the status or structures of targeted stocks. The Division of Sport Fish initiated a modest cooperative tagging program with a few charterboat operators in 1998 and continues to collect biological data on all sharks harvested in the sport fishery through the port-sampling program.

Stock Assessment

Among **Central** Region assessment projects, sharks are caught in the trawl surveys and the PWS longline survey. Catch per unit effort for Pacific sleeper shark ranged from 1.1 fish/set in 1996 to 4.3 fish/set in 1999. Spiny dogfish CPUE has ranged from 0.9 to 9.2 fish/set except for a

dramatic increase to 51.3 fish per set in 1998. The high catch rates of spiny dogfish in 1998 appear to have been an anomaly (Contact Ted Otis).

The **Division of Sport Fish—Southcentral Region** collected harvest and fishery information on sharks through the groundfish harvest assessment program although no specific research objectives were identified. Shark harvest is still at a relatively low level, but it is hoped that size and age composition of the harvest can be estimated using multiple years of data. In 2005, 44 salmon sharks and 12 spiny dogfish were sampled for length, sex, and age structures from the sport harvest throughout the region (Contact Scott Meyer).

Management

The Alaska Board of Fisheries prohibited all directed commercial fisheries for sharks in 1998. In 2000, the BOF increased the bycatch allowance in **Southeast Region** for dogfish taken while longlining for other species to 35% round weight of the target species and also allowed full retention of dogfish bycatch in the salmon setnet fishery in Yakutat. This action was an effort to minimize waste of dogfish in these two fisheries and to encourage sale of bycatch. In **Central Region**, bycatch is set by regulation at 20% of the round weight of the directed species on board.

Recreational fishing for sharks is allowed under the statewide Sport Shark Fishery Management Plan adopted by the BOF in 1998. The plan recognizes the lack of stock assessment information, the potential for rapid growth of the fishery, and the potential for overharvest, and sets a statewide daily bag limit of one shark and a season limit of two sharks of any species. Recreational demand for spiny dogfish remains low and they are widely considered a nuisance species. There is, however, a small directed charter boat fishery for salmon sharks in Southcentral Alaska, primarily at Seward and in Prince William Sound. Pacific sleeper sharks are occasionally caught but rarely retained.

In 2000, the BOF prohibited the practice of "finning", requiring that all shark retained must be sold or utilized and have fins, head, and tail attached at the time of landing. "Utilize" means use of the flesh of the shark for human consumption, for reduction to meal for production of food for animals or fish, for bait, or for scientific, display, or educational purposes.

Fisheries

Regulations adopted by the Alaska Board of Fisheries in 1998 restricted all commercial shark fisheries to bycatch-only. However in 2004, the BOF amended regulations to provide fro a directed fishery for spiny dogfish in the Cook Inlet area under terms of a permit issued by the commissioner. No permits were requested in 2005.

Estimates of **recreational shark harvest** in 2005 are not yet available, but in 2004 an estimated 243 sharks of all species were harvested in Southeast Alaska, and 502 were harvested in Southcentral Alaska. The statewide charter logbook program also requires reporting of the number of salmon sharks kept and released in the charter fishery. Charter anglers account for the vast majority of the recreational salmon shark harvest. In 2004, charter operators reported harvesting 30 salmon sharks in Southeast Alaska and 111 salmon sharks in Southcentral Alaska.

Lingcod

Research

Over the past nine years 8,787 lingcod have been tagged and 345 fish recovered. Opportunistic tagging of 287 young lingcod in Sitka Sound occurred during 2005. Length, sex and tagging location were recorded for all tagged fish (Contact Cleo Brylinsky).

In the **Central Region**, skipper interviews and port sampling were conducted in Cordova, Whittier, Seward and Homer. Data obtained included date and location of harvest, length, weight, sex and age. Gonad condition was generally not determined as nearly all fish delivered were already gutted (Contact Willy Dunne).

The **Division of Sport Fish—Southeast Region** continued to collect catch, harvest, and biological data from lingcod as part of a marine harvest survey program with lingcod harvests tabulated back to 1987 in some selected ports. Data collected in the program include statistics on effort, catch, and harvest of lingcod taken by Southeast Alaska sport anglers. Ports sampled in 2005 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove, Yakutat, and Ketchikan. Length and sex data were collected from 1,644 lingcod in 2005, primarily from the ports of Sitka, Ketchikan, Craig, Gustavus, Elfin Cove, and Yakutat (Contact Mike Jaenicke).

The **Division of Sport Fish—Southcentral Region** continued collection of harvest and fishery information on lingcod through the groundfish harvest assessment program. Lingcod objectives include estimation of 1) the age, sex, and length composition of lingcod harvests by ports and 2) the geographic distribution of harvest by each fleet. A total of 674 lingcod were sampled from sport harvest at Seward, Valdez, Whittier, Kodiak, and Homer in 2005. These ports accounted for the majority of recreational lingcod harvest in Southcentral Alaska (Contact Scott Meyer).

Stock Assessment

The **Southeast Region** is not currently able to reliably estimate lingcod biomass or abundance. Lacking abundance estimates, and given the complex life history and behavior of lingcod, impacts to lingcod populations from fishing are difficult to assess. Analysis of catch per unit effort data (CPUE), in terms of fish per hook-hour for 1988–1998, showed that CPUE had declined between 21 to 62% in areas where a directed fishery and increased recreational catch had developed. Consequently the quota for lingcod was reduced in all areas in 1999. Commercial logbook data for the period 1999-2005 shows a recent increasing trend in CSEO and NSEO beginning in 2000. CPUE increased in EYKT in 2001 and has remained level. There is also a level trend in the NSEO area.

The Sport Fish Division, Southcentral Region, is continuing efforts toward a lingcod stock assessment. Initial work focused on compiling data from sport and commercial fisheries, mining existing survey data from other agencies, estimating natural mortality from age data, and

estimating length-weight and growth parameters. Some of the next steps include standardization and comparison of CPUE indices and compilation of spatial data.

Management

Management of lingcod in **Southeast Alaska** is based upon a combination of guideline harvest ranges, season and gear restrictions. The state has management authority for lingcod in both state and federal waters. Regulations include a winter closure for all users except longliners between December 1 and May 15 to protect nest-guarding males. Guideline harvest limits were greatly reduced in 2000 in all areas and allocations made between directed commercial fishery, sport fishery, longline fisheries, and salmon troll fisheries. This was the first time sport catch was included in a quota allocation. The 27" minimum commercial size limit remains in effect and fishermen must keep their lingcod with the head on, and proof of gender to facilitate biological sampling of the commercial catch. Vessel registration and trip limits are allowed when needed to stay within allocations. The directed fishery is limited to jig or dinglebar troll gear. In 2003, the Board of Fish established a super-exclusive directed fishery for lingcod in the IBS Subdistrict.

Regulations for the **Central Region** lingcod fishery include open season dates of July 1 to December 31 and a minimum size limit of 35 inches (89 cm) overall or 28 inches (71 cm) from the front of the dorsal fin to the tip of the tail. In 1997, the BOF adopted a jig only gear requirement for the directed lingcod fishery in the Cook Inlet Area. Beginning in 1997, the department set commercial lingcod fishery GHLs for the Central Region at 50% of the average harvest for the period 1987 to 1996. However, GHLs were increased to 75% of this average in 2001 for PWS and in 2003 in Cook Inlet.

In **Southeast Alaska**, the sport fishery for lingcod is open from May 16 through November 30. The regionwide bag and possession limits are two per day, four in possession, with no size limit. However, the bag and possession limits in two areas near Sitka and Ketchikan are one per day, two in possession, and the Pinnacles area near Sitka is closed to sport fishing year-round for all groundfish.

In 2000, sport harvests of lingcod in Southeast Alaska were incorporated into a region wide lingcod management plan, which reduced GHL's for all fisheries (combined) in seven management areas, and allocated a portion of the GHL for each area to the sport fishery. Since 2000, harvest limits reductions, size limits, and mid-season closures have been implemented by emergency order in various management areas to ensure sport harvests do not exceed allocations.

In 2005, lingcod bag limits were reduced from 2 to 1 fish per day region wide, slot limits were imposed for guided and nonresident anglers in all management areas except Southern Southeast Inside near Ketchikan, and the season was closed in northern Southeast management areas (NSI, CSO, and NSO) from June 16 through August 15 (Contact Charlie Swanton).

Conservative harvest strategies have been established for recreational lingcod fisheries in **Southcentral Alaska** in light of the lack of quantitative stock assessment information.

Resurrection Bay is closed to lingcod fishing year-round to rebuild the population, although no formal rebuilding plan is in place. The season is closed region-wide from January 1 through June 30 to protect spawning and nest guarding lingcod. Daily bag limits are 2 fish in all areas except the North Gulf, where the daily bag limit is one fish. All areas except Kodiak have a minimum size limit of 35 inches to protect spawning females (Contact Scott Meyer).

Fisheries

Lingcod are the target of a "dinglebar" troll fishery in **Southeast Alaska**. Dinglebar troll gear is power troll gear modified to fish for groundfish. Additionally lingcod are landed as significant bycatch in the DSR longline fishery (35% limit), as bycatch in the halibut fishery (5% limit), and as bycatch in the salmon troll fishery. The directed fishery landed 81 mt of lingcod in 2005 and an additional 78 mt was landed as bycatch in other fisheries. The halibut longline fishery accounted for roughly 68% of lingcod bycatch in the Southeast Region and the salmon troll fishery accounted for 15%.

Central Region lingcod harvests have primarily occurred in the North Gulf District of Cook Inlet and the Outside District of PWS. In 2005, the Cook Inlet GHL was 24 mt and the PWS GHL was 11 mt. Lingcod harvests in 2005 totaled 9.4 mt in Cook Inlet and 11.8 mt in PWS. The majority Cook Inlet Area lingcod harvest was by directed jig fishing, while the PWS harvest was mainly from longline bycatch to other (primarily halibut) fisheries.

Limited directed effort occurred for lingcod in the **Westward Region** during 2004. Incidental harvest in other fisheries totaled 23 mt for the year. The majority of the harvest occurred in the Kodiak Area with a minor amount occurring in the Chignik Area.

Recreational lingcod harvest is estimated in numbers of fish. Estimates of the 2005 harvest are not yet available from the statewide mail survey, but in 2004 an estimated 16,100 lingcod were harvested in Southeast Alaska while 11,800 lingcod were taken in Southcentral Alaska. The average estimated annual harvest for the most recent five-year period (2000-2004) was 15,070 fish in Southeast Alaska and 11,874 fish in Southcentral Alaska.

Other species

In 1997, the BOF based a new policy that would strictly limit the development of fisheries for other groundfish species in Southeast. Fishermen are required to apply for a “permit for miscellaneous groundfish” for all fisheries that do not already have specific regulations and permits do not have to be issued if there are management and conservation concerns. At this time, that includes all species except sablefish, rockfish, lingcod, flatfish, and Pacific cod. At this time, most other groundfish species taken in state waters are taken as bycatch in fisheries for other groundfish and halibut. The State also has a regulation that requires that the bycatch rate of groundfish be set annually for each fishery by emergency order unless otherwise specified in regulation.

A commissioner’s permit is required before a directed fishery may be prosecuted for skates and rays. This permit may restrict depth, dates, area, and gear, establish minimum size limits, and

require logbooks and/or observers, or any other condition determined by the commissioner to be necessary for conservation and management purposes. In 2005, interest continued for a skate fishery in the Cook Inlet and Kodiak Areas. In the Cook Inlet Area, harvest information is confidential due to limited participation. In the Kodiak Area, twenty-one vessels obtained commissioner's permits and prosecuted target fisheries for skates in state-waters; several additional vessels participated exclusively in federal waters. The majority of these vessels targeted the big skate *Raja binoculata* and Longnose skate *Raja rhina.* The 2004 harvest from state waters was 86 mt. In addition to the permit requirements listed above, vessel operators were required to notify ADF&G of deliveries. This was done to ensure that ample opportunity occurred to collect biological data from the landed catch. Dockside samplers performed species identification and obtained sexed lengths from the catch. In addition, vertebrae were collected for age analysis. A commissioner's permit is also required before any trawl fishery besides the existing beam trawl fishery for flatfish may be prosecuted in the Southeast District.

As part of a cooperative research study, tissue samples were collected from approximately 40 longnose skates in Prince William Sound for contaminant analysis.

Work on a "Developing Fisheries" policy, intended to reduce the potential for a fishery to escalate beyond management control, has been halted at present.

The recreational halibut fishery is the focus of a statewide research and management effort. Data on the recreational fishery and harvest are collected through port sampling effort in Southcentral Alaska and creel surveys and port sampling in Southeast Alaska. These data are provided annually to the International Pacific Halibut Commission for use in an annual stock assessment, and to the North Pacific Fishery Management Council. The Council has used the information in the design and analysis of regulations governing the sport charter fishery.

As stated earlier in this report, the BOF took action in 2000 prohibiting the development of a live fish fishery for groundfish in the Southeast District.

C. Other Related Studies

Beginning in 1999, representatives of the Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service – Alaska Region (NMFS) met to address fishery data acquisition issues. As a result of this meeting, the NMFS and the ADF&G agreed to pursue the development of a single reporting system for Alaska fisheries. To meet the goal of single source reporting of landings data, the International Pacific Halibut Commission was invited to join this initiative. A cooperative interagency electronic fisheries data collection steering committee was formed and funding was secured from the Pacific States Marine Fishery Commission.

This is a complex and ambitious project that requires careful planning, design, and staged implementation to succeed. Consolidated reporting has required an analysis of all data elements collected. An interagency database is in the final stages of development to meet the projected needs of all agencies. The primary focus on the interagency electronic reporting project goes beyond front-end application development. A substantial portion of the work on this project has

been directed at consolidated reporting, data storage, and data interface with each agency. At each stage of the implementation, the system requires additional analysis and functionality.

Full implementation is scheduled to be finalized at the end of Fiscal Yr 2007. Upon full implementation specifications will be developed for private software developers (Contact Gail Smith).

Staff in the **Central Region** has implemented a multi-year study to explore the utility of a remotely operated vehicle (ROV) as a stock assessment tool for a variety of groundfish resources. Initial efforts are focusing on identification of suitable rockfish and lingcod habitat along the northern Gulf of Alaska, and comparing ROV study results with habitat available in a GIS format form NOAA (Contact Mike Byerly).

The Department of Fish and Game manages state groundfish fisheries under regulations set triennially by the Board of Fisheries. The department announces the open and closed fishing periods consistent with the established regulations, and has authority to close fisheries at any time for justifiable conservation reasons. The department also cooperates with NMFS in regulating fisheries in the offshore waters.

By regulation, fish tickets are required for all shore-based landings in Alaskan ports and for all landings from state-managed fisheries. The catch data from the fish tickets is used as the primary means of tracking the in-season harvest levels. Groundfish fish tickets are collected from as many as thirty or more processors within the state. The fish tickets are edited for accuracy and the data is entered on microcomputers in Petersburg, Douglas, Sitka, Homer, Kodiak, and Dutch Harbor. Because of the intensity of many of the groundfish fisheries, a "soft data" accounting system using processor contacts is also utilized, when necessary, to track landings during a fishery.

In 1997, at the Southeast Groundfish meeting, the Board of Fisheries adopted a regulation that requires all groundfish fishermen to complete mandatory logbook pages while fishing. These logbook pages must be submitted as part of their landing record and attached to their fish ticket at delivery. The Board also requires that fishermen obtain a conditional use permit when fishing for any species for which specific regulatory language is not in effect. This will allow ADF&G to deny permits for some species and allow exploratory or controlled fishing for others.

Dixon Entrance Area

Total removals from the Dixon Entrance area (Alaska statistical areas 325431, 315431, 325401, and 315401) have declined in recent years, due mostly to reductions in sablefish quotas and the prohibition on directed fishing for slope rockfishes. The table below lists the catch by species group from 1988 through 2005 rounded to the nearest mt.

Year	# Permits	# Landings	DSR	Other Rock	Sablefish	Other	Total
1988	20	25	3	3	82	3	91
1989	8	7	1	1	20	0	22
1990	16	17	3	5	182	1	191
1991	24	21	6	12	150	2	170
1992	19	19	3	5	150	1	159
1993	27	26	6	14	232	1	253
1994	27	26	1	20	216	2	239
1995	21	18	0	20	137	0	157
1996	16	14	1	12	83	0	96
1997	37	30	1	18	103	0	122
1998	26	23	1	8	95	0	104
1999	23	24	0	7	71	0	78
2000	27	22	0	14	49	0	63
2001	23	29	1	14	86	0	101
2002	30	46	1	11	106	0	118
2003	29	44	8	12	89	2	111
2004	23	33	5	9	114	2	130
2005	10	24	tr	6	84	tr	91

Marine Reserves

In September of 1997, the ADF&G submitted proposals to both the BOF and the NPFMC requesting that they implement a small no-take marine reserve in **Southeast**. The purpose of these proposals was to permanently close a 3.2 sq. mile area off Cape Edgecumbe to all bottomfish and halibut fishing (including commercial, sport, charter, bycatch and subsistence) and anchoring to prevent over-fishing and to create a groundfish refuge. Two large volcanic pinnacles that have a diversity and density of fishes not seen in surrounding areas dominate the Edgecumbe Pinnacles Marine Reserve. The pinnacles rise abruptly from the seafloor and sit at the mouth of Sitka Sound where ocean currents and tidal rips create massive water flows over this habitat. These two pinnacles provide a very unique habitat of rock boulders, encrusted with *Metridium*, bryazoans and other fragile invertebrate communities, which attracts and shelters an extremely high density of juvenile rockfishes. The area is used seasonally by lingcod for spawning, nest-guarding, and post-nesting feeding. Yelloweye rockfish and pelagic rockfish species as well as large numbers of prowfish and Puget Sound rockfish also densely inhabit the pinnacles. This closure protects the fragile nature of this rare habitat, and prevents the harvest or bycatch of these species during critical portions of their life history. In February 1998, the BOF approved of the reserve and the NPFMC approved of the reserve at their June 1998 meeting. The NPFMC recommended to the BOF that they consider closure of the area to salmon trolling which would make the area a complete-no take zone. In February 2000 the BOF rejected closing the area to salmon trolling. The area is an important "turn-around" area for commercial trollers

and the BOF did not believe there was sufficient conservation benefit to warrant closing the area to salmon fishing.

In 2004, a short movie of the Edgecumbe Pinnacles Marine Reserve was created because of increased public interest in our work, and to give others an opportunity to learn about, and view the pinnacles from below the waters surface. This movie is available in either VHS or DVD format for schools or non-profit organizations through the Sitka office of the Alaska Department of Fish and Game.

User Pay/ Test Fish Programs

The Alaska Department of Fish and Game receives receipt authority from the state legislature that allows us to conduct stock assessment surveys by recovering costs through sale of fish taken during the surveys. Receipt authority varies by region. In **Southeast Alaska,** we have several projects that are funded through test fish funds (total allocation approximately 400k), notably the sablefish longline assessments, the king crab survey, and the herring fishery and dive surveys. Also in 1995, the Southeast Region was given a separate receipt authority for $250,000 to conduct sea urchin research using test fish funds. In the case of sea urchins the industry placed bids on the right to harvest and market sea urchins. The low bidder was responsible for paying for the department's expenses in research and management of this fishery and was limited to a 12% profit after state expenses were paid.

GIS

The ADF&G Division of Commercial Fisheries Headquarters Office is using ArcGIS 9.0 for general map production, project planning and spatial analysis. Basemaps are maintained in ArcGIS format. Statistical area charts are currently being updated using ArcGIS 9.0 and the NAD83 datum. All data and maps requests are made in NAD83 (the State of Alaska standard) or will be converted into NAD83, if possible. Final output and all metadata will be in NAD83. Some users in other divisional offices use ArcGIS 8 and ArcView 3.x for their GIS work. The Headquarters Office has reduced its GIS staff to one cartographer.

Hardcopy and digital groundfish and shellfish statistical area charts are available. Digital are available in Abode PDF and can be viewed or downloaded at http://www.cf.adfg.state.ak.us/geninfo/statmaps/charts.htm or in ArcGIS format at http://maps.cf.adfg.state.ak.us. The ADF&G Commercial Fisheries GIS Maps and Data Server will be home for all publicly available GIS maps developed by the division in the future. The server will also feature online maps using ArcIMS (Internet Map Server) software (contact Evelyn Russell).

Logbooks

In 1997, logbooks became mandatory for all state-managed commercial fisheries in Southeast Alaska. Logbooks for rockfish and lingcod had been mandatory for a number of years. All usable longline and jig logbook data through 2005 has been entered.

Number of commercial fishery logbooks collected by fishery, target species, and year.

SE	Longline				Jig/dinglebar			
Year	DSR	Pacific cod	Slope Rock	Sablefish (includes pot gear)	Lingcod	Black rockfish	DSR	PSR
1986	21	1						
1987	25							
1988	20							
1989	19							
1990	50	1	2					
1991	232	8	1					
1992	259	7						
1993	190	8						
1994	197	9	3		108			
1995	140	13			215			
1996	261	8			252	31	6	
1997	204	98	4	466	177	64	8	1
1998	177	135	15	552	153	70	3	4
1999	165	223	9	405	89	21	1	1
2000	153	97	4	421	153	30		
2001	128	48	2	332	44	2	2	
2002	143	27	5	276	53	31	4	0
2003	115	53	closed	298	54	37	2	closed
2004	96	55	closed	229	40	23	3	closed
2005	14	53	closed	240	52	23	1	closed

Since 1998, marine recreational charter operators have been required to log port of landing, effort and harvest, and ADF&G statistical area for every charter trip made. The 2005 logbook was similar to the 2004 logbook format. Data collected for each vessel trip included port of landing, location(s) fished, effort for salmon and bottomfish, and harvest and/or release (in numbers) of Chinook, Coho, sockeye, pink, and chum salmon, pelagic rockfish, other rockfish, lingcod, and salmon sharks. In 2001, the **Sport Fish Division** conducted an initial evaluation of the 1998-2000 charter logbook data, including comparisons of data from the logbook, the statewide mail survey, and on-site interviews.

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News Releases: http://www.adfg.state.ak.us/news/dept_news.php
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http://www.sf.adfg.state.ak.us/statewide/sf_home.cfm
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http://www.sf.adfg.state.ak.us/region2/groundfish/gfhome.cfm
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Region II Groundfish Home Page:
http://www.cf.adfg.state.ak.us/region1/finfish/grndfish/grndhom2.php
ADF&G Groundfish Overview Page:
http://www.cf.adfg.state.ak.us/geninfo/finfish/grndfish/grndhome.php.
Commercial Fisheries Entry Commission: http://www.cfec.state.ak.us/
State of Alaska home page: http://www.state.ak.us/
Gene Conservation Laboratory Home Page:
http://www.cf.adfg.state.ak.us/geninfo/research/genetics/genetics.php
Adobe PDF versions of groundfish charts can be viewed or downloaded at
http://www.cf.adfg.state.ak.us/geninfo/statmaps/charts.php
ArcView- and MapInfo-compatible charts can be downloaded from the ADF&G CF GIS Maps and Data Server at http://maps.cf.adfg.state.ak.us/. This server will be the home for all publicly available GIS maps developed by the division. In the future this server will also feature online maps using ESRI's ArcIMS (Internet Map Server) software (Contact Evelyn Russell).

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APPENDIX I. ALASKA DEPARTMENT OF FISH AND GAME PERMANENT FULL-TIME GROUNDFISH STAFF DURING 2004.

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AKFIN Program Coordinator Lee Holbert (907) 465-6109	Age Determination Unit Kristen Munk Box 25526 Juneau, AK 99802 (907) 465-3054	

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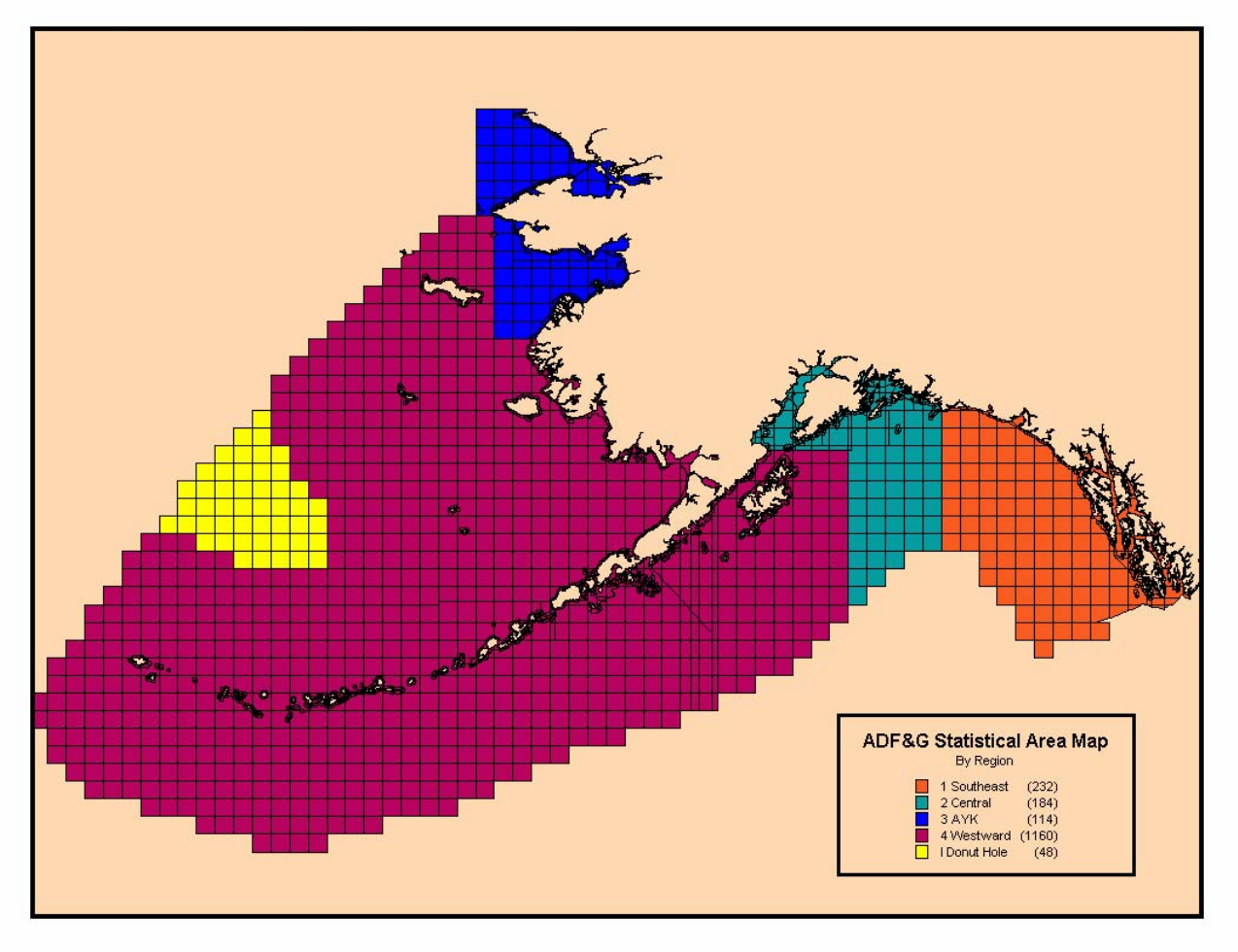
Appendix II. Map Depicting State of Alaska Management Regions.



Appendix III. Tissue samples of *Sebastes* species collected for genetic analyses and stored at Alaska Department Fish and Game, Gene Conservation Laboratory, Anchorage. Species, sampling location and collection ID, year collected, sample size, and tissue type are given.

Species	Silly Name - Location	Year	Size	Tissue Type
Yelloweye Rockfish	YERFLAM98 - Flamingo, British Columbia.	1998	46	fin clips; larvae
S. ruberrimus	YERTASU98 - Tasu, British Columbia.	1998	50	fin clips
	YERTOPK98 - Topknot, British Columbia.	1998	49	fin clips
	YERTRI98 - Triangle, British Columbia.	1998	63	fin clips; larvae
	YERSE298 - Sitka	1998	49	fin clips
	YRSE99 - Stat areas 355601, 365701	1999	100	fin clips
	YERYAK99 - Fairweather grounds	1999	100	fin clips
	YEPW91 – Prince William Sound; Gravina, Danger, Herring	1991	27	muscle, liver, eye
	YERGA98 – Prince William Sound, Knight Is./Naked Islands area	1998	100	fin clips
	YERPWS100 - Whittier	2000	97	fin clips
	YERPWS200 - Whittier	2000	50	fin clips
	YERRES99 – Resurrection Bay	1999	100	fin clips
	YERKACH99 - Kachemak Bay	1999	58	fin clips
	YERKOD99 – Kodiak Island	1999	115	fin clips
Black Rockfish	BRORE99 – Pacific Northwest; Oregon	1999	50	muscle, liver, heart
S. melanops	BRWASH98 - 47°08' / 124°37'; Washington	1998	20	fin clips
	BRSIT98 - Sitka	1998	50	fin clips
	BRSIT99T - Sitka Sound	1999	200	fin clips
	BRSIT99 – Sitka	1999	83	fin clips
	BRPWS100 - Valdez	2000	13	fin clips
	BRPWS200 - Whittier	2000	16	fin clips
	BRRESB97 - Resurrection Bay	1997	82	muscle,liver,heart,eye,fin
	BRRESB98 – Resurrection, North Fox Island	1998	24	fin clips
	BRKOD96 - Kodiak Island	1996	2	muscle, liver, heart, eye
	BRKOD197 - Ugak Bay	1997	100	muscle,liver,heart,eye,fin
	BRKOD398 - Westside Kodiak Island	1998	114	fin clips
	BRKOD198 - Eastside Kodiak Island	1998	100	fin clips
	BRKOD298 - Southwest side Kodiak Island	1998	86	fin clips
	BRSAND98 - Carpa Island near Sand Point	1998	40	fin clips
	BRSAND99 - Castle Rock near Sand Point	1999	60	fin clips
	BRKOD00 - Chignik	2000	100	fin clips
	BRBERS99- Akutan	1999	100	fin clips
	BRDUTS00 - Dutch Harbor	2000	6	fin clips
	BRYAKU03- Yakutat	2003	130	fin clips

OREGON'S GROUNDFISH FISHERIES AND INVESTIGATIONS IN 2005

OREGON DEPARTMENT OF FISH AND WILDLIFE

2005 AGENCY REPORT
PREPARED FOR THE MAY 2-3, 2006 MEETING OF THE TECHNICAL SUB-COMMITTEE OF THE CANADA-UNITED STATES GROUNDFISH COMMITTEE

Edited by

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Contributions by

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Oregon Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
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April 2006

OREGON DEPARTMENT OF FISH AND WILDLIFE

A. AGENCY OVERVIEW – MARINE RESOURCES PROGRAM

MRP Program Manager	Dr. Patricia M. Burke
Resource Assessment and Analysis	Dave Fox
Management and Monitoring	Maggie Sommer
Data Services	Bill Herber

The Marine Resources Program (MRP) is within the Oregon Department of Fish and Wildlife (ODFW) and has jurisdiction over fish, wildlife, and habitat issues coast-wide. MRP is headquartered at Newport in the Hatfield Marine Science Center, with field stations at the coastal ports of Astoria, Tillamook, Charleston, Gold Beach, Brookings, and Corvallis. It is tasked with the responsibility for assessment, management, and sustainability of Oregon's marine habitat, biological resources and fisheries. In addition to direct responsibilities in state waters (from shore to three miles seaward), MRP provides technical support and policy recommendations to state, federal, regional, and international decision-makers who develop management strategies that affect Oregon fish and shellfish stocks, fisheries, and coastal communities. Staffing consists of approximately 50 permanent and more than 70 seasonal or temporary positions. The program budget is approximately $5 million yearly, with about 50% of funding from federal sources and the remainder from various state sources.

B. MULTISPECIES STUDIES

Sport Fisheries Project

Sampling of the ocean boat sport fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2005. Based on the results of year round sampling in 1999-2000, less than 5 percent of the annual fishing effort and catch occurred during the winter period (Nov - Feb). Oregon plans to continue sampling the March through October period during 2006.

Black rockfish remains the dominant species caught in the ocean boat fishery. Lingcod, several other rockfish species (blue rockfish, china rockfish and other nearshore species), cabezon and greenling are also commonly landed. Oregon's fishery for Pacific halibut continues to be a very popular, high profile fishery requiring International Pacific Halibut Commission (IPHC), federal, and state technical and management consideration and management.

The ORBS expanded its species composition and biological sampling of groundfish species at Oregon coastal ports during 2005. As in prior years, black rockfish and blue rockfish otoliths were gathered, in addition to lingcod fin rays, for ageing studies. Age structure sampling was expanded in 2005 to include many additional nearshore species. ORBS continued collecting of length and weight data from all groundfish species.

From April through September, a portion of sport charter vessels were sampled at sea for species composition, discard rates and sizes, location, depth and catch per angler (CPUE) using ride-along samplers.

Starting in 2004, the harvest of several species was monitored inseason for quota tracking purposes. Inseason action was taken in 2005 to close cabezon (mid-August) and the nearshore fishery out to 40-fathoms (mid-October) due to harvest cap attainment of black rockfish. The shore fishery remained open.

Other ODFW management activities included participation in the U.S. West Coast Recreational Fish International Network (RecFIN) process, data analysis and sponsoring public hearings to discuss changes to the management of Pacific halibut, groundfish fisheries.

Starting July 2005, sampling of the shore and estuary fishery was discontinued due to a lack of funding. Black rockfish make up the largest component of the estuary boat groundfish and surfperch made up the majority of shore-based catch by weight. Salmon dominate estuary boat landings by weight. Pacific herring made up the majority of both shore-based and estuary boat landings by number of fish.

ODFW discontinued the project to determine if phone angler surveys for effort and trip type from shore and estuaries can be estimated based on an angler license frame due to funding constraints.

Weekly harvest in the sport and commercial halibut fisheries were monitored for quota tracking purposes. The majority of recreational caught halibut continue to be landed in the central coast sub-area (Newport and Garibaldi). In 2005, the directed sport fishery was open for 60 days, which was an increase over recent years. The commercial directed fishery was open for four 10-hour periods as in 2004. In 2005, as in recent years, the sport and commercial halibut fisheries received equal allocations.

Contact: Don Bodenmiller (541) 867-0300 ext. 223, Don.G.Bodenmiller@state.or.us

Maturity Studies

We continued research begun several years ago to gather female maturity data from a variety of species for which such data is unavailable, outdated or only available for areas far from Oregon. This work continued in 2005, with a focus on nearshore rockfish, other nearshore species and poorly known slope rockfish species (aurora, POP, redbanded). We used the Port Liaison Project, through OSU extension to fund collection of aurora and redbanded rockfish from commercial catches that would have been discarded at sea. This study also utilizes histology to validate maturity status on uncertain ovaries. This work will continue in 2006.

Contact: Bob Hannah at (541) 867-0300 ext. 231, bob.hannah@oregonstate.edu

Development and Testing of a Selective Flatfish Trawl

The selective flatfish trawl became required fishing gear for all U.S. groundfish trawling shoreward of the Rockfish Conservation Area on January 1, 2005. The only problem noted with these trawls to date is that catch efficiency drops off when water clarity declines severely, for example during strong upwelling-driven plankton blooms. Work in 2005 with the selective flatfish trawl focused on using an imaging sonar to study fish behavior inside and ahead of the trawl to try and understand the factors that result in either capture or escapement. This is a cooperative project with NMFS, Northwest Science Center, and will continue into 2006. To date, we have successfully attached a DIDSON sonar to a bottom trawl, imaging fish in front of the footrope and out along the wings. Specifically, we are trying to understand how different species react to and possibly escape the selective flatfish trawl. Halibut may go over the tops of the wings instead of herding. Others may rise over the headrope or go under the footrope. More work in deeper water and more encounters with various species are needed. We will also try several new views, looking down and backwards toward the footrope and possible from the footrope up towards the cutback headrope of the selective flatfish trawl.

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Nearshore Reef Habitat Studies

ODFW contracted with a local hydrographer to conduct a multibeam mapping project off Seal Rock, just south of Newport. The area mapped was 3 km wide and 15 km long, positioned just off the coastline from 9-40 m. The 2-m horizontal resolution map was used to provide context for the black rockfish telemetry study.

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Developmental Fisheries Project

The ODFW Developmental Fisheries Program was created in 1993 to allow for controlled development of new species and fisheries. Each year, the Developmental Fishery Board recommends to the Oregon Fish and Wildlife Commission a list of food fish species that are considered to be developmental and a harvest program that includes a limited entry system. The Developmental Fishery Board is made up of members from a broad range of fishing interests (harvesters, processors, and state agencies).

In 2005, a total of 83 permits were issued for all species; 45 permits for finfish species; similar to the number of permits issued in 2004. The main finfish of interest were-sardines, for which there were 20 permits issued. Other finfish species for which we issued permits were hagfish (10), anchovy/herring (13), blue shark (1), and swordfish (1).

Market samples of sardines were collected for length, weight, maturity, and age data. See section 6 under “By Species: Sardines” for details.

Contact: Brett Wiedoff (541-867-4741), Brett.L.Wiedoff@state.or.us

Marine Finfish Ageing Unit

The untimely death of our principal age-reader, Bob Mikus, in the summer of 2005 brought our ageing work to an abrupt halt. We did accomplish some ageing work on otoliths of nearshore and slope rockfish as part of our maturity study by bringing Bill Barss out of retirement in a temporary appointment. In 2006, Josie Thompson was hired to replace Bob and will be re-evaluating our ageing project and setting goals for the next several years when she starts in the near future.

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C. BY SPECIES

Nearshore Rockfish

Black rockfish PIT tagging

Oregon's primary recreational groundfish fishery targets the nearshore species, black rockfish (*Sebastes melanops*). Previous assessments relied on the relative CPUE trends derived from recreational fishery sampling programs. These data are not robust to problems of sampling bias or changes in fishing distribution, and can result in errors in the trend of relative population abundance. The need to independently estimate exploitation rates for black rockfish off Oregon prompted us to investigate the use of passive integrated transponder (PIT) tags for a mark-recapture program. Because PIT tags are invisible to anglers, there is no tag non-reporting problem, and tag detection rates can be estimated directly. We tagged 2,550 fish in 2002, 3,000 fish in 2003, 3,013 in 2004, and 2,882 in 2005 with PIT tags (12mm x 2mm) during 20 days of fishing each year near Newport, Oregon. Tags were injected in the hypaxial musculature below the gill arches, determined to be the best site by a previous PIT tag retention study. At tagging, categorical barotrauma symptoms were noted and fish with significant barotrauma symptoms were recompressed by immediate submersion in a cage and release at depth. During the fishing seasons (May – October), carcasses of almost all black rockfish landed by charter vessels in Newport and Depoe Bay were counted by samplers and electronically scanned for tags. We have had good recoveries each year and exploitation rates are within expected assessment values of approximately 5%. This program design will integrate well with the current tagging program used by Washington state and may result in a valuable abundance index for a combined Oregon – Washington assessment. We have begun the fifth year of tagging and will likely continue the project for the next several years.

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Barotrauma in rockfishes

We have built three pressurized aquaria that can hold up to 6 rockfish each and simulate depths of up to 30 m. In 2005, a new PhD student (Alena Pribyl) began work on identifying the actual tissue level effects of barotrauma in different rockfish species using these tanks. Her project will

use histology to evaluate embolism in various susceptible tissues, examine survival and recovery rates in several ecologically different rockfishes, and also utilize new genetic microarray techniques to compare gene expression in different tissues both as a direct response to barotrauma and throughout the healing process. Ultimately this may show when a fish has "recovered" using gene expression in control fish as "normal".

Work examining barotrauma and discard mortality is hampered by difficulties in capturing numbers of target rockfish species, and if captured, transporting them to lab facilities with low mortality. However, our work with recompression with black rockfish and with cage cam (see below) indicates that several species in deeper water at least orient and swim towards the bottom when released at > 20m depth. We captured 6 yelloweye rockfish off Stonewall Bank in 60 meters depth, attached an external transmitter, and recompressed the fish with a video release cage. We then monitored the horizontal and vertical movements of the fish with moored receivers for 4 months. Utilizing vertical movements to indicate they were alive, we concluded that 3 of the 6 fish were alive at 21 days post release. Two others were likely alive but data was not complete enough to confirm movement. Only one fish definitely died within 5 days of release. All fish exhibited severe barotrauma on capture. One interesting observation was dramatic (>40m) vertical movements shown by 5 of 6 fish after release. This entailed rapid movement from 60 m to10-20m and back. In one fish this was observed continuously every night. All fish showed more vertical activity during darkness.

We continued work with a "camera cage" in 2005 using a low-light underwater video camera to observe recompression and release at depth of 9 species of rockfish captured at depths up to 60m. Observations showed that many rockfish that appear dead at surface pressure are immobilized from gas expansion and show substantial recovery of normal behavior and appearance upon rapid recompression, generally appearing competent at release (properly oriented, swimming towards bottom). Species differed in the percentage that appeared competent at release, with blue rockfish showing the poorest rate of recovery, despite appearing lively at the surface. Some species that have a reputation for surviving poorly at surface pressures (e.g. canary rockfish) appeared to fair better upon recompression. A decline in behavioral scores with increasing depth of capture was observed, with poor ability to orient vertically and sluggishness the principal symptoms of lingering effects from barotrauma.

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Black rockfish telemetry

We studied the movement patterns of black rockfish (*Sebastes melanops*) along the open Oregon coast to estimate home range over short to annual time scales, describe the frequency and range of vertical movements, and evaluate the influence of environmental variation on behavior. We moored 18 acoustic receivers in a 3x5 km grid south of Newport, OR at depths from 9 – 36 m. We then surgically implanted black rockfish (34 – 40 cm) with coded, pressure transmitters with a lifespan of about 6 months. Fish were tagged in August (n = 6), September (14), October (7), and February (8, + 8 coded only). We recorded over 2.8 million detections, and documented home range sizes from 3-271 ha, with a mean of 55 ha. We also documented longer absences from the area by females during winter months, suggesting that there may be reproductive-based

movements. The scale of these movements remains unknown, but fish were only absent for a week on average. Some were absent for up to a month. We also examined vertical movement patterns. We observed patterns of strong diurnal vertical migration, but shallower at night and during the day. We also observed periods of continuous large vertical movements, and also period of little activity. There were seasonal patterns the prevalence of vertical movement behavior categories. We saw no correlation of vertical movements with environmental variables such as lunar phase, cloud cover, or temperature. 2005 was an atypical year with regard to upwelling pattern, which complicated analysis of behavior with respect to upwelling conditions.

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Shelf

Petrale sole

ODFW, in collaboration with Steve Berkeley at UCSC, is conducted a feasibility experiment to capture flatfish (specifically Petrale sole) using a fish trap. If feasible, the use of a Petrale pot may allow more productive flatfish stocks to be accessed in areas closed to trawling due to rockfish conservation efforts. Initial experiments at UCSC determined that Petrale sole are attracted to dead bait and will pass through a tunnel to access squid and sardines. Commercial sized traps were designed by modifying Alaskan snow crab pots to have a long wide entrance at the bottom on three sides, and varying the mesh materials. Initial field trials were conducted in the fall of 2004. Following the cruise, the pots were refitted with better mesh and tunnels were reconfigured to three different types allow easier access for flatfish yet prevent lingcod and halibut from entering. We conducted more trials in August of 2005. The presence of Petrale in the area was confirmed by several bottom trawlers fishing nearby at the same time. We found poor catch rates in all pots, due mainly we think, to excessive Dungeness crab catch. All of the tunnel designs we tested were vulnerable to Dungeness crab invasion, and any flatfish entering the pot were usually damaged or killed by the crabs. We could not find an area where there were Petrale sole, but not Dungeness. Another try may occur using slightly different tunnel designs off central California, but the feasibility based on work to date is not encouraging.
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Pacific Hake

The PFMC's U.S. optimum yield (OY) increased from 250,000 mt to 269,069 mt in 2005. This OY was limited due to bycatch concerns for widow rockfish and estimated canary rockfish bycatch. The directed season for mothership and catcher/processor at-sea processing (north of 42^{o} N) began on the 15^{th} of May 2004. The 2004 directed shoreside hake fishery began on 01 April 2004 off California (south of 42^{o} N), and on 15 June 2004 off Oregon and Washington (north of 42^{o} N). To avoid pre-empting more northerly segments of the fishery, the California component of the hake fishery is limited to 5% of the total shoreside allocation until the northern component of the shoreside fishery begins. No landings were made in California after June 15^{th}.

Surprisingly, the primary issue in the 2005 fishery was salmon bycatch. The entire fishery operates under an 11,000 Chinook, which was exceeded by almost 1,000 fish. This was especially controversial because the salmon troll fishery was severely restricted due to Klamath River concerns. Exceeding the cap requires re-initiation of Section 7 ESA consultation, which

may trigger further restrictions to reduce Chinook catch. Bycatch of other species of rockfish increased, often at a rate greater than the increase in hake quota. This may create concerns in the future, as these rockfish species are under strict constraints (namely Canary, widow and darkblotched rockfish).

Yellowtail rockfish otoliths and length-frequency information are provided to Sandra Rosenfeld at the Department of Fisheries Marine Fish & Shellfish Division in Olympia, Washington for future stock assessments on this species. Biological samples of Pacific mackerel are provided to the CDFG for their stock assessment work on this species. Biological samples of widow rockfish are sent to Don Pearson NMFS in Santa Cruz, California. Sablefish, jack and pacific mackerel, darkblotched, bocaccio and canary rockfish have been retained at ODFW and are available for future assessment efforts. Past shoreside hake observation reports are available on the internet at http://hmsc.oregonstate.edu/ odfw/reports/whiting.html

Contact: Steve Parker at 541-867-4741 Steve.parker@oregonstate.edu

Pacific Sardine

In 2005, landings for sardine continued to increase. Twenty vessels landed 99.4 million pounds (45,110 mt); a 25 % increase from 2004. Most of the sardine catch was by seine gear (99 %), and most fish were landed into Astoria and processed as bait for a Japanese longline fishery. Incidental landings of mackerel accounted for approximately 0.7 % of the catch. We were, again, unable to hire a seasonal worker to conduct ride-along trips to observe by-catch, but staff made a few observed trips. From logbook data, bycatch consisted of sharks and some salmon. Salmon averaged 0.5 per trip, with 70 % being released alive. Market samples were collected for length, weight, maturity, and age data. The average length and weight for all samples was 174 mm (standard length) and 87 gm. The size of sardines off Oregon in 2005 was considerably smaller (length and weight) than in 2004 due to an influx of smaller, and presumably younger, fish. The abundance of small fish caused problems for harvesters and processors as established markets were geared toward the larger sized fish.

Contact: Brett Wiedoff (541-867-4741), Brett.L.Wiedoff@state.or.us

Angling Selectivity Studies

In 2005, we began work on some small scale experiments to determine the potential for using changes in terminal tackle to reduce bycatch in recreational hook and line fisheries. Results to date simply demonstrated that these kind of studies were feasible, but were complicated by choice of fishing location and seasonal variations in species abundance. In 2006, these small scale studies will continue and will examine potential bycatch reduction techniques for yelloweye rockfish and canary rockfish.

Contact: Bob Hannah at 541-867-4741, bob.w.hannah@state.or.us

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Hannah, R. W. and S. A. Jones. 2005. A Survey Evaluating Shrimp Abundance, Sex Composition, Bycatch and Trawl Gear Performance on the Northern Oregon Shrimp Grounds – Fall 2004. Oregon Department of Fish Wildlife, Information Report Series, No. 2005-01. 33p.

Projects planned for year 2005

Barotrauma in rockfishes: We plan to continue the telemetry work described above with black rockfish, yelloweye rockfish and other species such as canary rockfish, china rockfish or quillback rockfish. The work will be conducted off Siletz reef, with the hope of encountering fish in shallower water to remove some of the barotrauma. We will also displace some of the fish approximately 10 km to examine homing ability. We will deploy approximately 30 acoustically tagged fish.

In a related project, we will have an undergraduate intern collect rockfish condition information from the recreational fishery to determine the percentage of fish caught in the fishery that have specific injuries, such as a ruptured swimbladder, bruised organs, exopthalmia etc… This

student will also demonstrate the use of recompression devices to the charter fleet and collect information on what techniques are being used by the fleet for release of rockfishes.

Contact: Steve Parker at 541-867-4741, Steve.parker@oregonstate.edu

Nearshore Management Strategy: In December 2006, Marine Resources Program staff completed *Oregon's Nearshore Marine Resources Management Strategy* (Nearshore Strategy). The Nearshore Strategy's 16 recommendations will guide future management decisions affecting Oregon's nearshore marine resources and direct managers' attention and resources to priority areas where they can have the most positive impact on nearshore fish and wildlife. Implementation of the Nearshore Strategy will begin with establishment of a Nearshore Advisory Committee (NAC) that will provide advice to ODFW staff during implementation of Strategy recommendations. ODFW staff will focus on inter-agency management coordination, nearshore habitat surveys at Port Orford Reef, a revision of the Interim Management Plan for Oregon's Commercial Nearshore Fishery, and expanded outreach including revisions to the ODFW/MRP website (http://www.dfw.state.or.us/MRP/). ODFW will review the Nearshore Strategy for consistency with current resource issues, state policies, scientific information and public interest approximately every five years.

Contact: Hal Weeks at (541) 867-0300, ext 279, Hal.Weeks@state.or.us

Washington Contribution to the 2006 Meeting of the Technical Sub-Committee (TSC) of the Canada-US Groundfish Committee

Compiled by:

Thomas Jagielo
Senior Research Scientist
Washington Department of Fish and Wildlife

May 2-3, 2006

Review of Agency Groundfish Research, Assessment, and Management

A. Puget Sound Area Activities

Research on Cowsharks in Washington *Contact: Greg Bargmann (360) 902-2825)*

The Department of Fish and Wildlife, in collaboration with the National Marine Fisheries Service, has been conducting research on sixgill sharks (*Hexanchus griseus*) in Puget Sound and sevengill sharks (*Notoytnchus maculatus*) in coastal estuaries. Longline fishing gear was deployed from chartered vessels to capture, measure and tag the animals. Both visual external tags and internal acoustical (VEMCO) tags have been used.

The sixgill sharks caught in Puget Sound have all been juveniles, despite extensive efforts to locate mature fish. The acoustical tags reveal a pattern of residency in a small area within Puget Sound for months.

Sevengills have been caught and tagged in Willapa Bay in 2003 and 2005, and in Gray's Harbor in 2005. Both immature and mature fish have been caught. The results from the acoustical tagging indicate some movement between the two coastal estuaries. Tagged fish seemed to be resident in the estuaries through the summer and early fall then left in a sudden movement out of the bay. Tagged fish have been detected off of Oregon and California and in Puget Sound. We plan to resume the tagging for one final year in 2006.

Detection of movement patterns has been hampered by the lack of access to detections made by the POST system.

Puget Sound Groundfish Monitoring, Research, and Assessment *(Contributed by Wayne Palsson, Marine Fish Science Unit (425) 379-2313, palsswap@dfw.wa.gov)*

Staff of the Puget Sound Marine Fish Science Unit include Wayne Palsson, Robert Pacunski, Tony Parra, Jim Beam, and Ocean Eveningsong. Their tasks are primarily supported by supplemental funds from the Washington State Legislature for the recovery of Puget Sound bottomfish populations. Most of the work of the staff is associated with the Puget Sound Assessment and Monitoring Program (PSAMP) and is tasked by the Puget Sound Action Team. The main activities of the unit include the assessment of bottomfish populations in Puget Sound and the evaluation of bottomfish in marine reserves. This year, additional grants and contracts were received for special studies regarding marine fish habitat modifications and marine reserves in Puget Sound.

A major effort was undertaken this year to assess the status and biology of rockfishes in Puget Sound. A draft document was nearing completion in the spring of 2006 that included the results of most sampling programs reviewed below.

Puget Sound Marine Habitat Studies

Wayne Palsson and Robert Pacunski collaborated with Professors Don Gunderson of the University of Washington and Gary Greene of Moss Landing Marine Labs in a Washington Sea Grant study. They examined the distribution of marine fishes in relation to the distribution of different sea floor habitats in the San Juan Archipelago that were mapped by Dr. Greene through the NOAA/CCS and other grants. San Juan Channel was mapped with a high-resolution multi-beam echosounder that collected detailed bathymetric and back-scatter information (Figure 1). This mulitbeam bathymetry and bottom type information provided the survey frame for the Sea Grant study. During the 2004 field season, we used a Phantom 2+2HD ROV to survey the diversity of rocky, coarse, and fine sediment habitats in San Juan Channel. We found strong community associations with each substrate type. As expected, rockfish and lingcod were almost exclusively associated with rocky habitats. During the second year of study in 2005, we conducted 87 ROV transects in San Juan Channel and focused exclusively on rocky habitats to tease apart exactly how rockfish and lingcod are associated with different rocky habitat features. As in 2004, we were successful in deploying the ROV with a depressor weight and conducting transects as deep as 500 feet and in current speeds of 1.5 knots. Both seasons' data are being analyzed and written up for peer-reviewed publications.

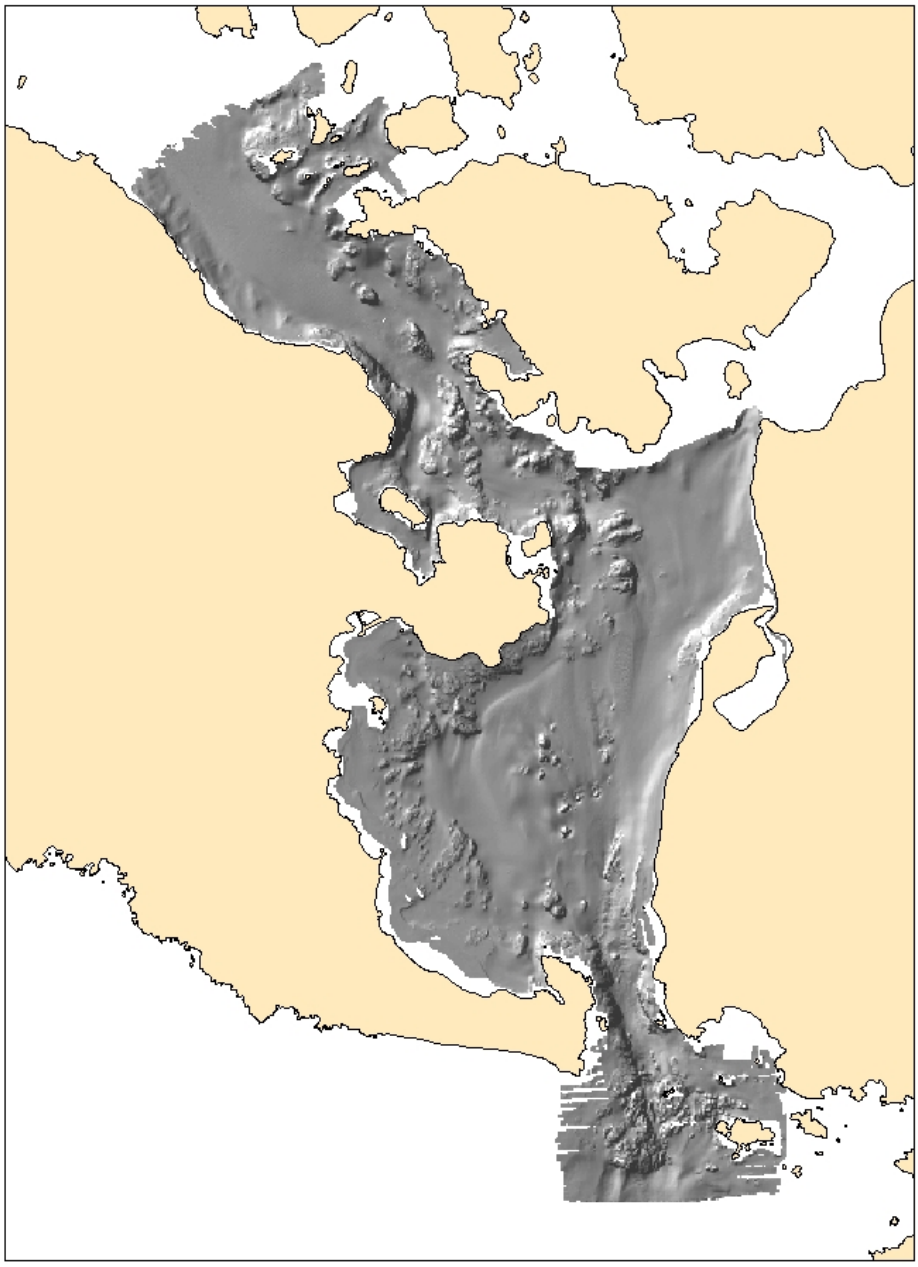

Figure 1. Hillshaded bathymetry of San Juan Channel.

Evaluation of No-Take Refuges for Rocky Habitat Fishes

WDFW has developed a system of 18 fully and partially protected marine reserves in Puget Sound (Figure 2). As the system has expanded, MFSU staff has developed a plan to monitor a core series of the marine reserves on a frequent basis and visit other subtidal reserves on a periodic basis. This plan builds upon field research at many of these sites that were begun as early as 1986. The field work primarily consists of scuba divers conducting visual censuses along strip transects. Along with estimating fish density, divers measure individual fish, and in the case of lingcod, quantify nesting activity.

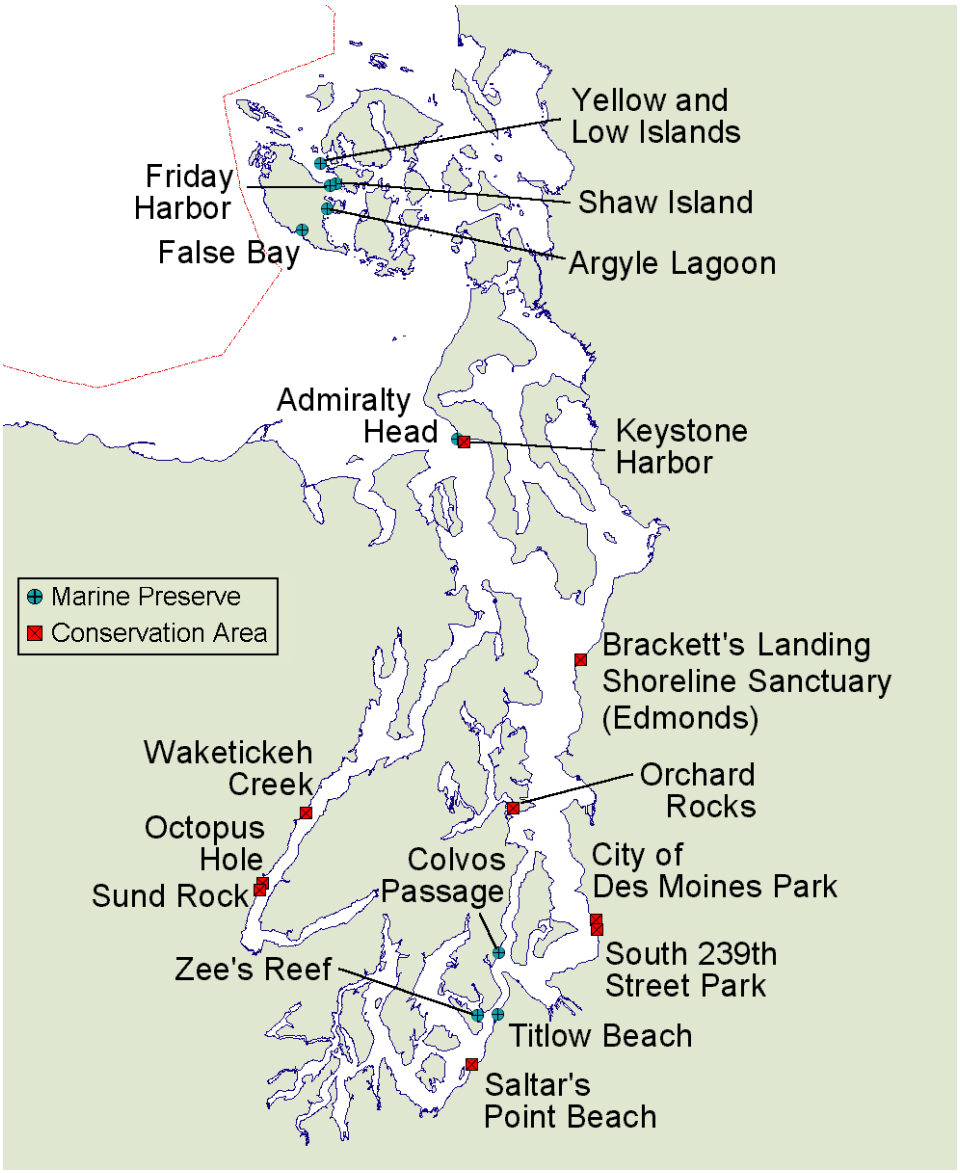

Figure 2. WDFW non-tribal marine reserves in Puget Sound. Conservation Areas are fully-protected, Marine Preserves are partially-protected.

Specific monitoring activities in 2005 included surveying many of the Puget Sound reserves and comparable fished sites. Several reserves in central Puget Sound were visited six times during 2005 as an extension of a study initiated in 1999 that takes advantage of the previous information collected at Orchard Rocks. This site was declared as a fully-protected reserve in 199, but was a fished site monitored in 1986, 1987, and from 1995-1997. With the addition of a new fished site treatment at Point Glover, the newly created refuge in a formerly monitored fished area is an excellent opportunity to evaluate the before and after impacts of refuge creation with a comparable fished site treatment. WDFW also created several new reserves in 2002. These included subtidal reserves at Admiralty Head and Keystone Jetty in Admiralty Inlet and Zee's Reef in Southern Puget Sound. Monitoring was initiated at Zee's Reef in 2002 with six surveys conducted again in 2004. The reserve at Colvos Passage was also monitored during the same survey series.

We have not subjected the 2004-5 marine reserve data to detailed analysis, but the observations will likely corroborate earlier analyses showing that lingcod have dramatically increased in many of the marine reserves and that rockfish have either declined or showed little improvement over time. The increase in lingcod abundance may be best demonstrated by the long-term reserve study in the San Juan Archipelago where lingcod densities are twice as dense inside marine reserves as in comparable fished areas (Figure 3). While the density continues to increase inside the marine reserves, densities have decreased in the fished areas after a multi-year pattern of increase.

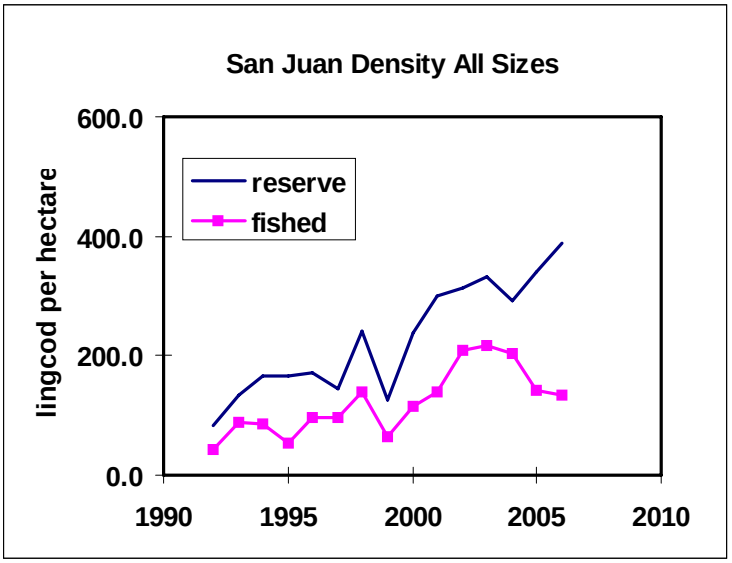

Figure 3. Winter scuba density estimates from two reserved and fished area transects in San Juan Channel.

Low Dissolved Oxygen Conditions at Sund Rocks Marine Reserve

Hood Canal is a fjord connected to Puget Sound in the north and extending 100 km to the south (Figure 1). The steep sides of the canal extend to depths of 180 m in the north and range to depths of over 125 m for most of the water body. Hood Canal is one of the water bodies identified in the Pew Ocean Commission report as a hypoxic dead zone. Dissolved oxygen (DO) concentrations of less than 2 mg/l have been observed for decades in deep and shallow waters in

the southern portion of the canal (Warner et al. 2002; Collias 1974), and these low concentrations have been attributed to naturally poor circulation resulting from low estuarine flow and bottom water replacement. In recent years, low DO concentrations have become chronic, extending into nearshore waters and possibly becoming worse due to eutrophication (J. Newton, Wash. Dept. of Ecology, pers. comm). Mass mortality events of fishes and invertebrates (Fish Kills) in 1926 and 1963 likely have resulted from poor water quality. Beginning in 2001, WDFW began surveying marine fishes with respect to depth at the Sund Rocks Reserve. Two discrete and prominent rocky habitats located north and south of each other were surveyed independently. A team of three divers conducted the visual surveys. One diver swam the 9 m isobath and oriented the two recording divers along the longitudinal axis of each survey area. The two divers swam along predetermined depth zones and identified, counted, and measured key fish species along the rocky outcropping. The divers swam close together to coordinate their observations and not double count fishes. Total length measurements to the nearest 10 cm were made with the aid of a graduated plastic rod.

DO concentrations were obtained from the Washington Department of Ecology's Marine Water Monitoring group, the University of Washington's PRISM program, and citizen monitors with the Hood Canal Salmon Enhancement Group. The data were collected by calibrated continuous oxygen sensors or with water samples and subsequent laboratory titration.
Dive surveys at both the North and South Sund Rocks sites in November 2001 found that copper rockfish were distributed evenly from a depth of 5 m to a depth of 20 m and were generally not present in depths of less than 5 m. Monthly monitoring by WDOE revealed that DO concentrations were at least 3 mg/l in waters shallower than 20 m. In October 2002, we found rockfish were almost exclusively concentrated in depths of less than 7 m during a period when DO concentrations were greater than 4 mg/l in shallow water and less than 2 mg/l at greater depths. Rockfish were distributed evenly to 20 m in depth again by November 2002 when rains restored circulation and DO concentrations were once again greater than 4 mg/l in the nearshore zone.

During the 2002 and 2004 low DO events, dead fish were not observed. On October 10, 2003, a fish kill was observed along the western edge of southern Hood Canal. WDFW divers observed dozens of dead copper rockfish, 24 other fish species, and many invertebrates along the shore and during census dives. Eighty dead copper rockfish were measured and they tended to be smaller than the live fish observed during the survey dives. The dive surveys also revealed that only half of the previous counts of copper rockfish were present. These numbers remained low during the subsequent November survey.
These field observations revealed that copper rockfish are hypoxia intolerant and cannot tolerate DO concentrations below 2 mg/l. The observed avoidance behavior is similar to the response of other marine fishes to low dissolved oxygen in Chesapeake Bay and other coastal waters where low dissolved oxygen limits the amount of available habitat (Breitburg 2002). The widespread occurrence of poor water quality in southern Hood Canal has many ramifications for sustainable fisheries pursued by tribal and recreational fishers and for the location and design of marine reserves in the area. Further work is planned for determining the causes of worsening water quality and the impact on marine resources.

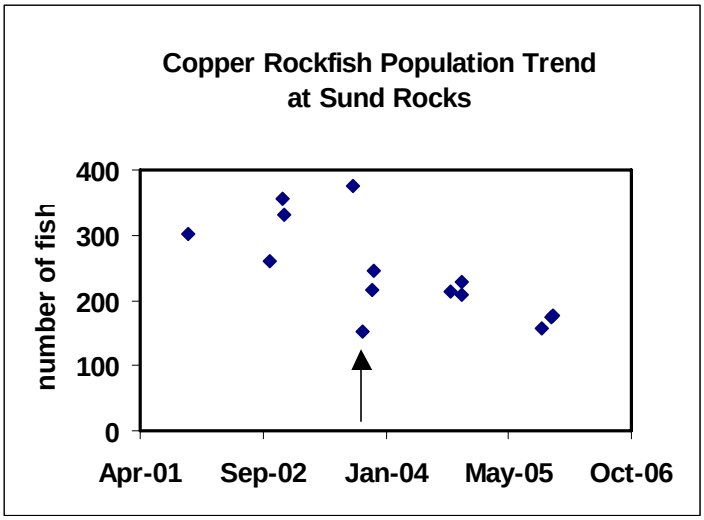

Figure 4. Scuba counts of copper rockfish at Sund Rocks prior to, during, and after the October 2003 fish kill.

Second Tacoma Narrows Bridge Mitigation Study

In March 2003, the Washington Department of Transportation (WSDOT) and the Washington Department of Fish and Wildlife (WDFW) established a contract to fulfill part of the terms of the mitigation agreement for the construction of a second bridge at Tacoma Narrows, connecting Tacoma with the Kitsap Peninsula across Puget Sound. The contract establishes that staff from WDFW will conduct sampling at the bridge site to determine the impacts of the disruptive activities associated with the construction of the bridge upon marine fish communities at the bridge site. Primary areas of interest include the two caisson and pier sites, the proposed anchor sites, and the rip-rap fields that will be placed at the footings of the existing and new tower piers. As part of the mitigation, a new artificial habitat was created at Toliva Shoal in spring 2005 that tested the effectiveness of adding small, quarried rock on or near existing artificial habitat composed of large boulders and concrete deployed for attracting adult rockfish (Figure 5).

Monitoring at the bridge site included conducting scuba transects in the shallow waters (<100 ft) at planned anchor sites and conducting towed video transects at planned anchor, rip-rap, and bridge tower locations. Pre-construction surveys revealed that most rockfish and lingcod were distributed along old bridge rubble and natural hardpan habitats on the eastern side of the Narrows. Now that the towers have been erected and the anchors removed, after-construction comparisons will be made from transects conducted during early 2006.

Pre-construction scuba transects at Toliva Shoal, found that most rockfish and lingcod were sparsely distributed on previously deployed, large-rock artificial habitats composed of concrete and quarried boulders. Initial surveys after deployment of small, quarried rock found sub-adult rockfish sparsely distributed on newly created habitat in greater numbers than on comparable transects that were not affected by new construction. Extensive surveys will continue for the next two years to determine the effectiveness of creating a small rock habitat for rockfishes on top of or away from an existing artificial habitat composed of large rocks targeting adult rockfish and lingcod.

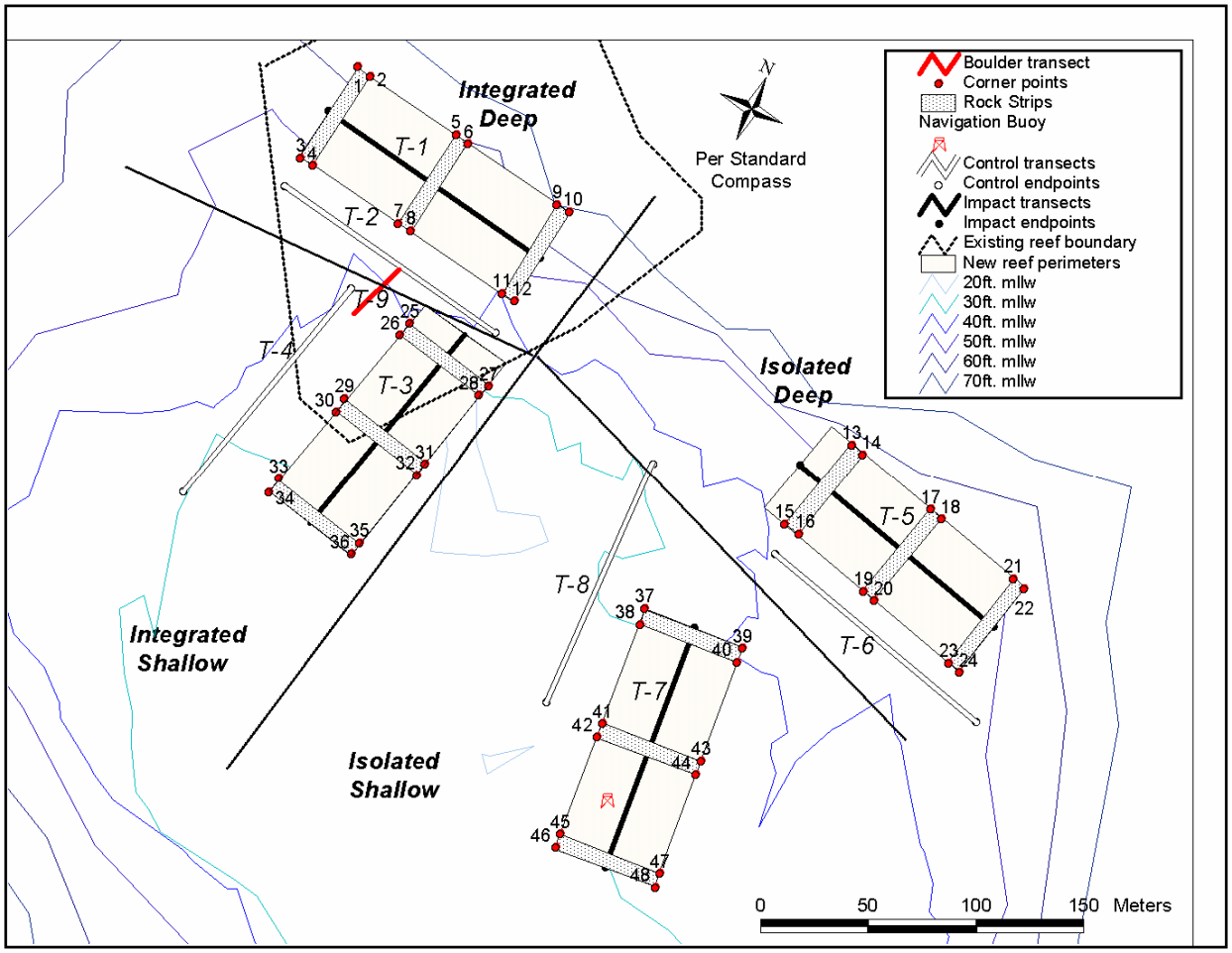

Figure 5. Deployed quarry rock for juvenile rockfishes at Toliva Shoal.

2004 Bottom Trawl Survey of Northern Puget Sound

In 2005, WDFW conducted a synoptic bottom trawl survey in the waters south of Port Townsend including central and southern Puget Sound, the Whidbey Basin, and Hood Canal. The goals and objectives of this survey were to estimate the abundance and describe the distribution of recreational and commercial groundfish and macro-invertebrate species, collect biological information from key species, and evaluate the relationship of abundance and distribution of key species to oceanographic features and the need for transboundary management

The chartered *F.V. Chasina* was used as the sampling vessel which towed a 400 mesh Eastern net fitted with a 3 cm codend liner. Stations were selected with a stratified random approach based upon four depth zones for each of the subregions. The area sampled at each station was measured with differential GPS and known net width openings. The catch from each trawl was identified, weighed, and enumerated, and the weights and numbers of each species were divided by the area sampled to estimate species densities. Abundance will be estimated by averaging station densities within each stratum and multiplying these by the stratum area. A total of 168 of 170 planned trawl stations were occupied and completed.

The trawl surveys conducted at irregular intervals since 1987 have provided the basis to compare population trends in the inland marine waters over the past two decades. Statistical analysis has shown that fish communities sharply differ between the inland waters north of Port Townsend from those south of Port Townsend. In North Puget Sound, total biomass has not changed dramatically since 1987 (Figure 6), but the species composition has changed from having fewer dogfish and other species and having higher proportions of flatfishes. In South Sound, total biomass was substantially reduced during 1989-91, but increased to levels comparable to 1987 afterwards (Figure 7). Spotted ratfish have been increasing, seemingly at the expense of codfishes and dogfish.

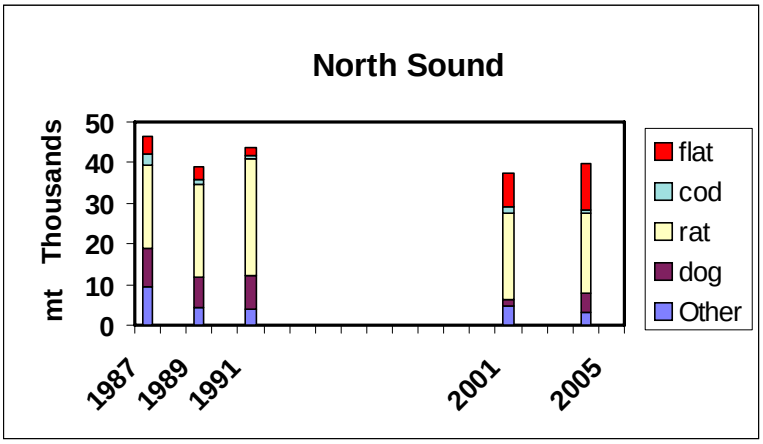

Figure 6. Estimated biomass (metric tons) of flatfishes, codfishes, ratfish, dogfish, and other groundfish in North Puget Sound resulting from bottom trawl surveys.

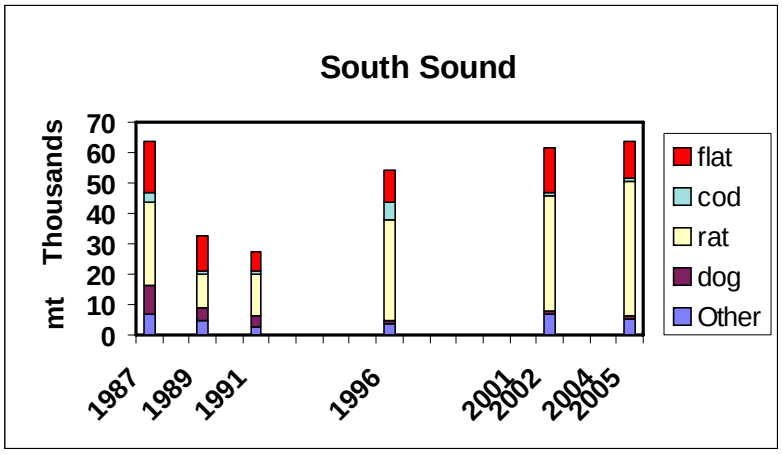

Figure 7. Estimated biomass (metric tons) of flatfishes, codfishes, ratfish, dogfish, and other groundfish in South Puget Sound resulting from bottom trawl surveys.

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Herring Stock Assessment *Contact: Kurt Stick (360) 466-4345 ext 243)*

Annual herring spawning biomass is estimated for known herring populations in Washington waters using spawn deposition and/or acoustic-trawl surveys. The Washington Department of Fish and Wildlife recognizes nineteen different herring stocks in Puget Sound and two coastal stocks, based primarily on timing and location of spawning activity. Estimates were made for all recognized stocks in 2005. Stock assessment activities for the 2006 spawning season are in progress.

The herring spawning biomass estimate for all Puget Sound stocks combined in 2005 is 11,321 tons (Table 1 and Figure 8). The cumulative abundance of spawning herring in Puget Sound has decreased since 2002, when it totaled 17,721 tons. The Puget Sound total reflects the recent trend exhibited by the combined biomass of south/central Puget Sound herring stocks; an increase from 1997 to 2002, followed by a decrease through 2005.

Cumulative biomass of North Puget Sound stocks has remained at a low level of abundance, primarily due to the continued critical status of the Cherry Point herring stock. The Cherry Point stock increased slightly in 2005 to 2,010 tons, continuing an observed annual increase since a low of 808 tons in 2000. The Cherry Point stock ranged from 3,100 to nearly 15,000 tons between 1973 and 1995. Recent research has suggested that the Cherry Point stock is genetically distinct from other Puget Sound and British Columbia herring stocks. However, it did not meet the Endangered Species Act criteria in a 2005 review by NOAA for protection as a Distinct Population Segment.

Herring spawning biomass for the Strait of Juan de Fuca region is also at a very low level of abundance. The Discovery Bay herring stock is the primary component of this region and has decreased dramatically and steadily since the late 1980's, after a peak estimate of 3,200 tons in 1980. However, surveys to date in 2006 indicate a significant increase in spawning biomass for this stock.

Estimated herring spawning biomass for 2005 for coastal stocks (Willapa Bay and Grays Harbor) was higher than that estimated for 2004, but abundance is relatively low compared to previous years (Table 1).

Additional information about herring management and stock status is available the WDFW web site at: http://wdfw.wa.gov/fish/papers/herring_status_report/index.htm

Table 1. **Washington state herring spawning biomass estimates by stock and region, 1996-2005.**

HERRING SPAWNING BIOMASS ESTIMATES (SHORT TONS) BY STOCK AND REGION, 1996-2005.
(blanks indicate no surveys done that year)

	YEAR									
	2005	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**
Squaxin Pass	436	828	2201	3150	1597	371	474	68	149	374
Wollochet Bay	67	52	152	106	133	142				
Quartermaster Harbor	756	727	930	416	1320	743	1257	947	1402	805
Port Orchard-Port Madison	1958	700	1085	878	2007	1756	2006	489	360	806
South Hood Canal	210	176	207	166	187	140	516	101	226	239
Quilcene Bay	1125	2342	916	2585	2091	2426	2464	1152	465	328
Port Gamble	1372	1257	1064	1812	1779	2459	1664	971	1419	2058
Kilisut Harbor	170	184	448	774	612	107	802	311	307	380
Port Susan	157	429	450	775	587	785	545	2084	828	110
Holmes Harbor	498	673	678	573	275	281	175	464	530	336
Skagit Bay	1169	1245	2983	2215	2170	646	905	209	893	736
South-Central Puget Sound Total	7918	8613	11114	13450	12758	9856	10808	6796	6579	6172
Fidalgo Bay	231	339	569	865	944	737	1005	844	929	590
Samish/Portage Bay	218	351	299	496	470	196	555	643	509	636
Int. San Juan Is.	41	67	72	158	219	128	197		30	277
N.W. San Juan Is.	0	0	13	131	62	90		107	79	53
Semiahmoo Bay	870	629	1087	1012	1098	926	868	919	621	1219
Cherry Point	2010	1734	1611	1330	1241	808	1266	1322	1574	3095
North Puget Sound Total	3370	3120	3651	3992	4034	2885	3891	3835	3742	5870
Discovery Bay	33	252	207	148	137	159	307	0	199	747
Dungeness/Sequim Bay	0	22	44	131	93	138	352	112	158	180
Strait of Juan de Fuca Total	33	274	251	279	230	297	659	112	357	927
Puget Sound Total	11321	12007	15016	17721	17022	13038	15358	10743	10678	12969
Grays Harbor	15	33	129	87	77	166	297	77		
Willapa Bay	145	0*	398	389	150	345	397	57	144	
*partial survey coverage										
Coast Total	160	33	527	476	227	511	694	134	144	

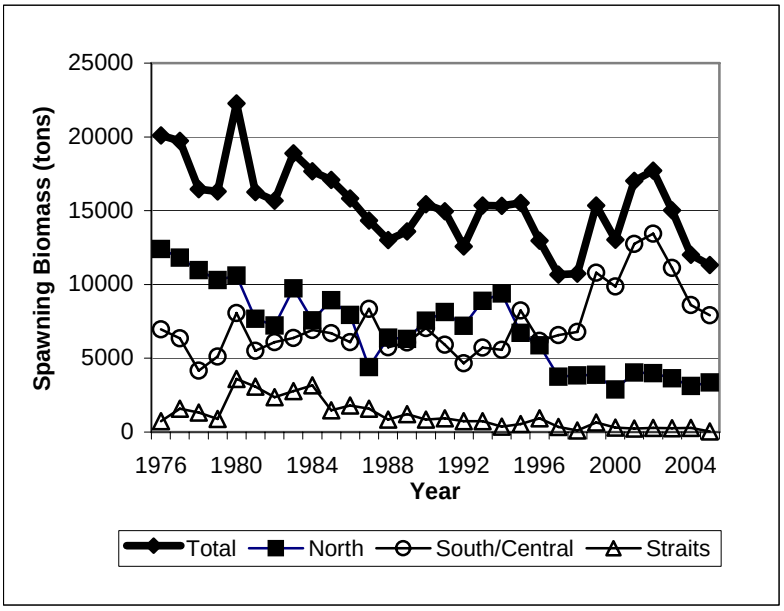

Figure 8. **Estimated Puget Sound herring spawning biomass, 1976-2005**

Puget Sound Ambient Monitoring Program (PSAMP) *Contact: Sandie O'Neill (360) 902-2843*

The Washington Department of Fish and Wildlife continues to be a key component of the Puget Sound Ambient Monitoring Program Project (PSAMP), a multi-agency effort to assess the health of Puget Sound. To assess how the health of the Sound is affected by chemical contamination of its fish, the PSAMP Fish Component monitors "legacy" pollutants like PCBs and DDTs that persist in the ecosystem despite restrictions in their use; PAHs, which are compounds associated with petroleum and with combustion, heavy metals; and emerging toxics like PBDEs that are used as flame retardants.

Puget Sound Marine Fish Research *Contact Larry LeClair (360) 902-2767*

Trans-generational Marking of Viviparous Marine Fish in Puget Sound, Washington
(Contact: Larry LeClair, Marine Fish Science, 360 902-2767, leclalll@dfw.wa.gov)

Investigators at the Washington Department of Fish and Wildlife continued experimenting with the use of elemental strontium as a means to mark the otoliths of viviparous marine fish larvae prior to birth. Laboratory trials with captive perch and rockfish have shown that a single intramuscular injection of strontium into gestating adults is sufficient to produce a lifelong strontium mark in the otoliths of larvae prior to parturition, thus providing a potential method for directly estimating retention and dispersion rates from local populations.

The first field trials are now underway at Point Heyer, Washington with brown rockfish (*Sebastes auriculatus*). To date, over 80 gestating females have been injected and released *in situ*, and 150 injection cohort juveniles have been recovered and assayed for the presence of elevated Sr. A single marked otolith was found among the 150 juveniles captured.

Use of Microsatellite DNA and Pedigree Analysis to Test For Self-recruitment in an Isolated Population of Brown Rockfish in Puget Sound, Washington
(Contact: Larry LeClair, Marine Fish Science, 360 902-2767, leclalll@dfw.wa.gov)

This collaborative study between the Washington Department of Fish and Wildlife and the University of Washington is aimed at using genetic markers to identify progeny of resident adult brown rockfish among juveniles sampled at an isolated reef near Point Heyer, Washington. Non-lethal *in situ* sampling using tissue clipped from the dorsal lobe of the caudal fin are being used to genotype individuals at 12 microsatellite loci. To date, 137 adults, estimated to be about one third of the total adult population, have been sampled and genotyped. Genotypes from 118 juveniles have been obtained. Preliminary results using a maximum likelihood estimation approach indicate self-recruitment to be about 15%; however, low genetic variability and higher than expected genotyping error has lead to some ambiguity in assigning parent-offspring-sib relationships. Additional marker loci with greater allelic richness and reduced genotyping error were developed in 2005 and will be used to assay existing and future collections from Point Heyer and adjacent areas. Results are expected to be directly applicable to the design and placement of MPAs in Puget Sound and elsewhere.

Allozyme and Microsatellite DNA Analysis of Lingcod From Puget Sound, Washington, and Adjoining Waters
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Allozymes and microsatellite DNA were used to examine genetic connectivity among lingcod populations in Puget Sound and between Puget Sound and the outer coast. No significant differences in allele frequencies were detected, though multidimensional ordination suggested minor differences between Puget Sound and the outer coast. A manuscript was submitted to the Transactions of the American Fisheries Society is currently under revision.

B. Coastal Area Activities

Coastal Groundfish Management *(Contact Michele Culver, (360) 249-1211 or Brian Culver, (360) 249-1205)*

Council Activities
The Department contributes technical support for coastal groundfish management issues via participation on the Groundfish Management Team (GMT), the Scientific and Statistical Committee (SSC), and the Habitat Steering Group (HSG) of the Pacific Fishery Management Council (PFMC). The Department is also represented on the Scientific and Statistical Committee and Groundfish Plan Teams of the North Pacific Fishery Management Council. Landings and fishery management descriptions for PFMC-managed groundfish are summarized annually by the GMT in the Stock Assessment and Fishery Evaluation (SAFE) document.

Coastal Groundfish Monitoring, Research, and Assessment

Black Rockfish Tagging Study *Contact: Eric Eisenhardt (360) 249-1208*
In 1998, WDFW began a multi-year mark-recapture survey near Westport Washington, the principal location of recreational landings of black rockfish along the Washington coast. The survey design involves annual releases of coded wire tagged (CWT) fish and recovery of tagged carcasses from the recreational fishery, both of which are currently on going. From 1998 to 2001, WDFW's R/V Corliss was used to capture, tag and release 2,622, 3,478, 2,779 and 3,200 black rockfish annually. Since 2002, commercial charter vessels have been used, including F/V Hula Girl, F/V Slammer and F/V Tequila Too. A total of 4,089 black rockfish were caught, tagged and released in 2002, 6,744 in 2003, 5,981 in 2004, and 3,716 in 2005. In 2004, passive integrated transponder (PIT) tags were used to reduce the labor need to read and match recovered tags. In 2005, all tagged fish released were tagged with both CWTs and PIT tags, which will allow estimation of PIT tag loss rates (since CWT loss rates are already known).

Fish are released on pinnacles distributed throughout the area fished by the Westport charter fishing fleet. Each CWT-tagged fish had two tags placed in the opercular musculature: one on each side of each fish's head. The tags were marked to allow for identification of specific individuals upon subsequent recapture. No tag shedding or tag related mortality was observed during holding experiments during 1998, 1999 and 2003. PIT tags are injected into the throat

patch musculature, and appear to have excellent retention and very low to non-existent shedding rates.

On an annual basis, roughly 40% of the total Westport recreational black rockfish catch is sampled for tags by passing fish carcasses through a metal detector tube (Northwest Marine Technologies R8000).

Yelloweye Rockfish Stock Assessment for PFMC *Contact: Farron Wallace (360) 249-4628*
A stock assessment was prepared reporting the status of the yelloweye rockfish (*Sebastes ruberrimus*) resource off the west coast of the United States, from the Mexican border to Canadian border. This stock is treated as a single coastwide population as in the previous two assessments (Wallace *et al*. 2005, Methot *et al*. 2002) and as separate sub-populations in area models for Washington, Oregon and California.

Catches – NMFS and State personnel expended a significant amount of effort to provide the best possible historical accounting of landings prior to 1983. These estimates are considered to be a significant improvement over previous catch time series for California, Oregon and Washington. This resulted in decreasing total catch between 1955-2005 for the coastwide recreational fishery by 667 mt and increasing the commercial landings by 1,674 mt (compared to the 2005 assessment). Discard was assumed to have not occurred prior to enactment of strict harvest policies beginning in 2002 and is currently estimated from a variety of sources. By 2004, all three States instituted regulations that did not allow yelloweye retention in the recreational fishery and most commercial fisheries. Discard between 2002 and 2004 may not be well estimated due to an overall lack of sampling coverage during establishment of restrictions to decrease catch.

Data and assessment – The first and second full assessments for yelloweye rockfish were conducted in 2001 (Wallace 2001) and 2002 (Methot *et al*. 2002), respectively. Both assessments were length-based models and used an earlier version of the Stock Synthesis program (Methot 1989). Wallace (2001) conducted separate area assessments for the Northern California and Oregon areas. Methot *et al*. (2002) incorporated Washington catch, recreational abundance indices, and age data, and treated the stock as one single assemblage of the W-O-C coast. The 2005 assessment (Wallace *et al*. 2005) provided an update of the 2002 assessment incorporating a revised catch time series and employed the Stock Synthesis 2 (SS2) modeling framework to estimate model parameters and management quantities. Abundance indices were not revisited and little new composition data were available. All of the assessments concluded that ending spawning biomass was less than 25% of unfished.

This current (2006) assessment reevaluated all of the available coast-wide catch and effort information, and reformulates all of the indices of abundance. The IPHC survey index of abundance, a revised historical catch time series from 1955-1982 and new age, length and size composition data were also incorporated. The SS2 modeling framework is again used to estimate model parameters for a coastwide model and for separate area models for W-O-C. Additionally, natural mortality was estimated within the coastwide model to be 0.036 and was assumed to be 0.036 in all area specific models. This compares to natural mortality estimates of

0.02 and 0.033 (in development) used in the SE Alaska, U.S. and British Columbia, Ca, respectively. Natural mortality was assumed to be 0.045 in the previous two assessments.

Since natural mortality is confounded with selectivity in age-structured models we explored the trade-off between natural mortality and selectivity relative to our ability to estimate selectivity parameters. Because of the lack of age and length composition information especially for older, larger individuals we concluded that we did not have sufficient data to allow us to satisfactorily estimate the descending limb of a double logistic selectivity curve and chose to assume a logistic form for all models. This model form assumes that all ages and sizes of fish are available to the fishery with no refugia for the largest individuals in the population.

In agreement with previous assessment(s), yelloweye rockfish biomass is considered to be at historic low levels with spawning biomass less than 25% of unfished in all models.

Unresolved problems and major uncertainties – As in the previous assessments, the sparseness of the size and age composition data and the lack of a relevant fishery-independent survey have limited the model's ability to properly assess the status of the resource. This is especially apparent in the Washington model where the wholesale lack of data resulted in our inability to obtain a converged model without placing significant restraints and assumptions within the model relative to the area-specific models for California and Oregon. Further, due to catch restrictions since 2002, catch-per-unit-effort (CPUE) data no longer reflect the real changes in population abundance, and discard estimates are highly uncertain.

Research and Data Needs – Additional effort to collect age and maturity data is essential for improved population assessment. Collection of these data can only be accomplished through research studies and/or by onboard observers because this species is now prohibited. In 2006, IPHC and WDFW scientists are conducting a study to increase our knowledge of current stock biomass off Washington coast. Loss of the study due to declining OY will have significant detrimental effects on our ability to adequately assess this stock in the future. We strongly urge Management to make this study the highest priority. Increased effort toward habitat mapping and in-situ observation of behavior will provide information on the essential habitat and distribution for this species.

An alternative survey such as the in-situ 2002 US Vancouver submersible survey in untrawlable habitat is required for future assessment of yelloweye rebuilding status. This study has demonstrated that submersible visual transect surveys can provide a unique alternative method for estimating demersal fish biomass in habitats not accessible to conventional survey tools. For example, because of the low frequency of yelloweye rockfish encountered in the NMFS shelf trawl survey tows, those data were not considered a reliable indicator of abundance and were not used in the 2002 yelloweye stock assessment for PFMC (Methot *et al.* 2002). Results from this study support this conclusion and illustrate the need for large-scale surveys to assess bottomfish densities in habitats that are not accessible to trawl survey gear. Further, stratified random sampling designs should be employed with sample sizes sufficient to ensure acceptable levels of statistical power (Jagielo *et al.* 2003). At present, the in-situ visual transect submersible survey method appears to be a useful tool for this purpose, and the utility of this method will likely

improve further with technological advances such as the 3-Beam Quantitative Measurement System (QMS).

Lingcod Stock Assessment for PFMC *Contact: Tom Jagielo (360) 791-9089*
A stock assessment was conducted for lingcod (*Ophiodon elongatus*) in the full Pacific Fishery Management Council (PFMC) management zone (the US-Vancouver, Columbia, Eureka, Monterey, and Conception INPFC areas). Separate assessment models were constructed to describe population trends in the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

Commercial Landings – Commercial lingcod catch history in California waters is available beginning with the year 1916 (personal communication Brenda Erwin, PSMFC) and averaged 428 mt between 1916 and 1955. Commercial lingcod landings in Oregon were first reported in 1950 (Mark Freeman, personal communication) and averaged 264 mt between 1950 and 1953. Washington commercial lingcod landings were first reported in 1937 (anonymous, 1956, WDFW report) and averaged 106 mt until 1955.

Commercial landings peaked in 1985 at 3,129 mt in northern waters (Columbia and Vancouver INPFC areas) and in 1974 at 1,735 mt in southern waters (Eureka, Monterey and Conception INPFC Areas). Average catch between 1990-1997 declined 40 % and 35% since the 1980s in northern and southern waters, respectively. Under rebuilding management, commercial fishery restrictions in recent years (1998-present) reduced coastwide catches to an annual average of less than 225 mt.

From 1981-1997, trawl gear has made up the majority of commercial landings for the northern (83%) and southern (63%) coast. In recent years (1998-2004), commercial fishery restrictions constrained the trawl portion of the commercial catch to 65% and 40% for the northern and southern coast, respectively. In 2004, coastwide commercial landings totaled 174 mt and were distributed as follows by INPFC area: U.S.-Vancouver (41.7 mt), Columbia (44.6 mt) , Eureka 39.5 mt), Monterey (33.2 mt), Conception (14.8 mt).

Recreational Landings – Recreational fishers in California have targeted lingcod since the early 1940s. Catch averaged 65.3 mt annually between 1947-1954 (Leet et al., 1992). Recreational lingcod catch information is not available until 1977 for Oregon waters and averaged 52.3 mt annually between 1977 and 1979. Recreational lingcod catch in Washington was first estimated in 1967 to be 25.3 mt and annual catch estimates have been provided since 1975.

Recreational catch estimates were extracted from the RecFIN database for years 1980–1989 and 1993 to present for California waters. California recreational catch estimates for all other years were previously compiled in the 2000 lingcod assessment (Jagielo et al., 2000). Oregon recreational catch data were provided by ODFW (Don Bodenmiller personal communication). The recreational catch in Washington was provided by the WDFW Ocean Sampling Program.

Recreational catch in southern waters has declined since catch peaked in 1980 at 2,226 mt (Table 5, Figure 4). In contrast, recreational catch in northern waters peaked at 236 mt in 1994.

Estimated coastwide recreational landings averaged 500 mt. from 1998-2004 and were 1175 mt. and 316 mt. in 2003 and 2004, respectively.

Historically, recreational landings have comprised a larger proportion of the total landings for the southern area, compared to the northern area. In recent years, the recreational portion of the total landings has increased substantially in both the southern and northern areas. In 2004, recreational fisheries harvested 65% of the total lingcod catch coastwide.

Modeling Approach and Assessment Program – The 2006 assessment updated the previous coastwide assessment (Jagielo et al. 2003) and is implemented in Stock Synthesis II using the executable code SS2 version 1.19d (Methot 2005).
As in the previous assessment, separate age structured models were constructed to analyze stock dynamics for the northern (LCN: US-Vancouver, Columbia) and southern (LCS: Eureka, Monterey, Conception) areas.

Unresolved Problems and Major Uncertainties – At the STAR Panel review (August 15-19, 2005), concern was raised regarding the apparent lack of evidence in the data for the northern (LCN) model estimates of high 1999 and 2000 year class strength. In particular, doubts were raised concerning the reliability of the 2001 and 2004 NMFS triennial survey estimates, in which these two year classes were abundant. Furthermore, the STAR Panel did not find compelling evidence from the fishery age composition data to corroborate the high year classes seen in those two surveys. As a result of these uncertainties, the lingcod assessment was recommended for further review at the follow-up STAR Panel meeting (September 26-30, 2005).

At the follow-up STAR Panel meeting, additional analyses and information were provided to document the LCN model estimates of high 1999 and 2000 year class strength. Additional model runs with sequential removal of the 2001 and 2004 NMFS trawl surveys, and age compositions from the commercial and recreational fisheries from 2000-2004 indicated that both survey and commercial data supported the two strong year classes. As a result, the STAT Team recommended and the STAR Panel approved the base LCN model for management.

The STAT team additionally notes that:

1) Uncertainty regarding stock status is higher for the southern area relative to the northern area, primarily because historical data from the southern area were sparse relative to the northern area. The time series of fishery age data available for the southern (LCS) model is short and samples sizes are small, resulting in greater uncertainty in the estimation of assessment parameters and stock productivity for the southern area. Age data for the NMFS trawl survey were sparse for both regions in early years, but particularly for the southern region. Recreational fishery catch at age data were not available for the southern region in 2003.

2) Management-implemented minimum size limits have resulted in limiting the utility of fishery information for estimation of recent stock recruitment in both regions, and fishery trip limits have compromised the utility of recent fishery CPUE data as viable indices of abundance.

Management Reference Points – The estimates of unfished spawning biomass (Bzero) were determined as the product of mean recruitment from 1956-2005 and the estimated Spawners Per Recruit. On a coastwide basis, the lingcod population is fully rebuilt; estimated spawning biomass was 34,017 mt in 2005, which is 0.60 of the unfished spawning biomass estimate (52,850 mt). The estimated ratio of 2005 spawning biomass to unfished spawning biomass is higher in the north (0.87) compared to the south (0.24).

Spawning Stock Biomass – SS2 estimates of the coastwide female spawning stock biomass declined from 60,106 mt in 1956 to 6,004 mt in 1994, and subsequently increased to 34,017 mt in 2005. Female spawning biomass depletion (B_0/B_t) fell to 0.11 in 1994 and subsequently increased to 0.64 in 2005.

Recruitment — The model estimate of virgin recruitment was higher for the northern area (3750 thousand age 0 fish) compared to the southern area (2503 thousand age 0 fish). Recruitments were generally similar in magnitude in both the north and south from 1972-1992, averaging 2008 in the north, and 2071 in the south. Subsequently, from 1993-2005, recruitments tended to be higher in the north, and averaged 4503 compared to 1309 for the same period in the south. Recent historically strong 1999 and 2000 year classes were estimated in the north.

Exploitation Status — In the northern area, the exploitation rate (catch/available biomass) peaked at 0.20 in 1991 and averaged 0.03 from 1956-1980, 0.12 from 1981-1997, and 0.02 from 1998-2005. Exploitation rates were generally higher in the southern area, peaking at 0.26 in 1989 and averaging 0.05 from 1956-1980, 0.20 from 1981-1997, and 0.10 from 1998-2005.

Recommendations: Research and Data Collection Needs – Emphasis should be placed on improving fishery age structure sampling size and geographical coverage in both regions. More frequent and synoptic fishery independent surveys should be conducted in both regions to aid in determination of stock status and recent recruitment.