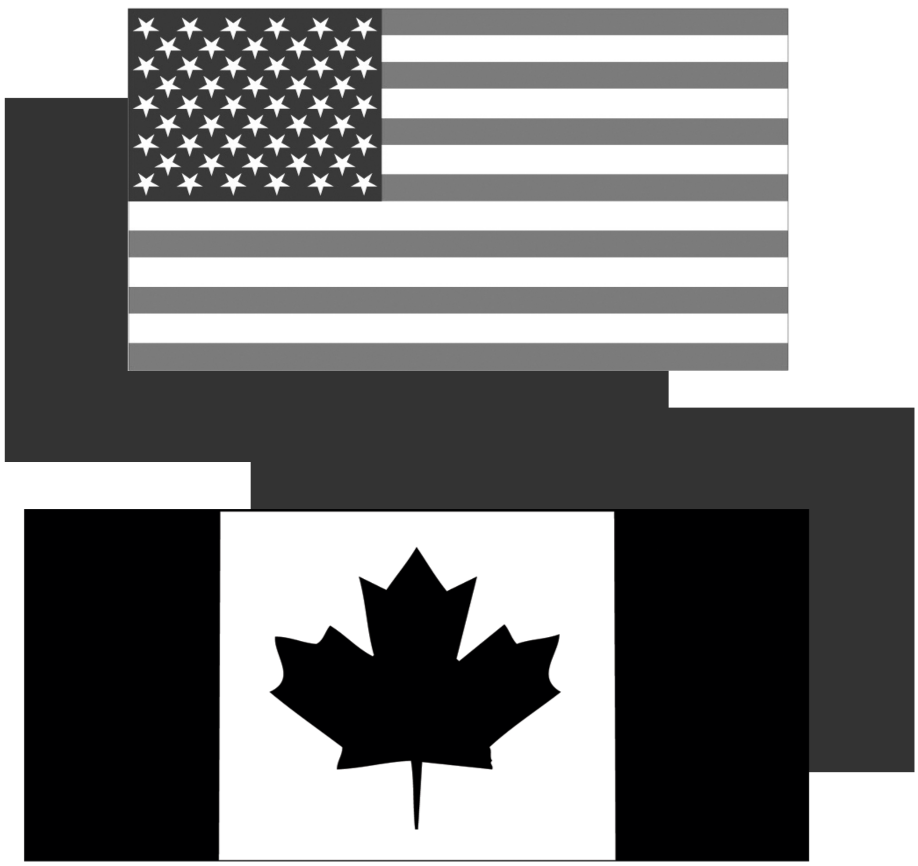
Report of the Technical Subcommittee
of the
Canada-United States Groundfish Committee
Fiftieth Annual Meeting of the TSC
May 5-6, 2009
Juneau, Alaska



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
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
2007	April 24-25	Santa Cruz, CA	Field	Brylinsky
2008	May 6-7	Seattle, WA	Wilkins	Brylinsky
2009	May 5-6	Juneau, AK	Clausen	Clausen

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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 5-6, 2009 in Juneau, Alaska. The meeting was hosted by the Alaska Fisheries Science Center, Auke Bay Laboratories, at the new Lena Pt. facility and chaired by Dave Clausen, AFSC Auke Bay Lab. As is done each year, participants reviewed previous year (2008) research achievements and projected current year (2009) 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), a long-standing TSC Working Group that was originally created by TSC in 1982. Kristen Munk (Alaska Department of Fish and Game (ADFG), representing CARE) reported on the CARE biennial workshop that was held in Seattle in April 2009. Age readers from eight different agencies on the Pacific Coast (ADFG, Alaska Fisheries Science Center (AFSC), Northwest Fisheries Science Center (NWFSC), SWFSC, Canada DFO, International Pacific Halibut Commission (IPHC), WDFW, and Oregon Department of Fish and Wildlife (ODFW)) participated in the workshop. Much of Kris's discussion focused on the recently established CARE Sablefish Age Readers Ad Hoc Working Group, which was formed to address problems in sablefish ageing amongst several agencies. Also discussed was the use of atomic bomb radiocarbon studies to validate ages of long-lived fish. Species recently validated using this method include shortspine thornyhead and eight other rockfish species (ADFG), and Greenland turbot and northern rockfish (AFSC).

The **Trawl Survey Working Group**, created under the auspices of the TSC, did not meet in 2009, but there are tentative plans for a meeting in 2010. The group includes representatives from Canada DFO, the AFSC, and the NWFSC. One topic that came up was that the trawl surveys may not be adequate for determining if threatened or endangered species are recovering in the short term.

Mark Wilkins of the AFSC discussed the **Field Data Acquisition Technology Workshop**, which was originally proposed at the 2005 TSC meeting. This workshop was held on April 1-3, 2009, at the AFSC in Seattle, and it represents a major accomplishment of the TSC. The purpose of the workshop was to present the various hardware and software tools that TSC member agencies and other groups use to collect research data during surveys at sea, as well as landing and logbook data from commercial vessels. Approximately 60 people attended the workshop, including both scientists and vendors. The general consensus among attendees was that the workshop was very useful, and most thought that in the future it would be good to hold new workshops every two or three years for sharing of ideas and experiences and to keep informed of changing technology.

There was much discussion at this year's TSC meeting regarding the occurrence of **oxygen minimum areas** off the U.S. west coast and southern British Columbia and the effect these have on fish distribution and abundance. The NWFSC and Canada DFO are now collecting data on dissolved oxygen concentrations during their bottom trawl surveys, and the IPHC is doing the same for its longline survey.

It was suggested that the 2010 Western Groundfish Conference may want to hold a special session on anoxic areas in the Northeast Pacific to address this issue.

The TSC meeting continues to be a valuable venue for discussing **sablefish issues** including potential data sharing, especially tag studies conducted by various agencies in the Gulf of Alaska and Canada. The TSC discussed that sablefish tag data from the AFSC, Canada DFO, and ADFG need to be combined so that a coastwide movement migration model can be created for the northern stock of sablefish (i.e., Alaska and northern B.C.) While future coordination between agencies working on sablefish research should be left entirely to the discretion of those agencies, the TSC will always be willing to facilitate a meeting for sablefish scientists to discuss potential collaborative research.

Other important topics discussed at the meeting included: 1) problems both Canada and the U.S. are having in how to assess stock condition for the numerous non-target or minor groundfish species that exist; 2) status of Canada's new integrated groundfish management system in B.C.; and 3) effects of whale interactions on longline surveys conducted by the IPHC, AFSC, and ADFG.

The **51th Annual Meeting of TSC** is scheduled for May 5-6, 2010 in Nanaimo, British Columbia. We hope to see representation from all the West Coast agencies that deal with groundfish research and management, especially those agencies that were not able to attend the 2009 meeting.

C. Minutes of the Technical Subcommittee

50th Annual Meeting of the Canada-U.S. Groundfish Committee's Technical Subcommittee (TSC)

May 5-6, 2009
AFSC/NOAA, Ted Stevens Marine Research Institute
17109 Point Lena Loop Road, Juneau, AK 99801
Host and Chair, Dave Clausen, AFSC

<u>Tuesday, May 5</u>

I. Call to Order – Dave Clausen, Chair, called the meeting to order at 9:20 am, May 5, 2009

II. Appointment of Secretary – Cara Rodgveller, AFSC Auke Bay Laboratories

III. Introductions - Greetings from Phil Rigby, Program Manager for ABL's Marine Ecology and Stock Assessment Program. Stephen Phillips requested that Phil check his files for old meeting minutes and reports (before the mid-1980's), since Phil was formerly a member of the TSC.

Hard copy reports available today are from: the Electronic Data Acquisition Technology workshop, 2008 TSC minutes, 2008 CARE report, 2009 AFSC report, TSC 2009 agenda, NPFMC 2006/2007 and 2007/2008 highlights, and the 2009 DFO report. The IPHC report is available online. The 2009 report will be compiled by Stephen Phillips. Dave Clausen commented that all agencies could not be represented at this meeting because of travel restrictions possibly due to the meeting being in Alaska. Jane DiCosimo and Stephen suggested bringing in more people through phone conferencing or the internet.

List of Participants

Cleo Brylinsky	Alaska Departlment of Fish and Game, Sitka, (*Cleo.Brylinsky@alaska.gov*)
Troy Buell	Oregon Department of Fish and Wildlife, Newport, (*Troy.v.Buell@state.or.us*)
Dave Clausen	Alaska Fisheries Science Center, Auke Bay Lab, Juneau, (*Dave.Clausen@noaa.gov*)
Jane DiCosimo	North Pacific Fishery Management Council, Anchorage, (*Jane.DiCosimo@noaa.gov*)
Claude Dykstra	International Pacific Halibut Commission, Seattle, (*Claude@iphc.washington.edu*)
Heather Gilroy	International Pacific Halibut Commission, Seattle, (*Heather@iphc.washington.edu*)

Aimee Keller	Northwest Fisheries Science Center, Seattle, (*Aimee.Keller@noaa.gov*)
Kristen Munk	CARE Rep. – Alaska Department of Fish and Game, Juneau, (*Kristen.Munk@alaska.gov*)
Stephen Phillips	Pacific States Marine Fisheries Commission, Portland, (*Stephen_Phillips@psmfc.org*) 503-595-3100
Cara Rodgveller	Alaska Fisheries Science Center, Auke Bay Lab, Juneau, (*Cara.Rodgveller@noaa.gov*)
Gail Smith	(5/5) Alaska Department of Fish and Game, Juneau, (*Gail.Smith@alaska.gov*)
Rick Stanley	Science Branch, Pacific Biological Station, Canada DFO, Nanaimo, (*Rick.Stanley@dfo-mpo.gc.ca*)
Mark Wilkins	(through teleconference 5/5), Alaska Fisheries Science Center, Seattle, (*Mark.Wilkins@noaa.gov*)

IV. Approval of the 2008 report – The 2008 Report was approved at 9:37.

V. Approval of the 2009 agenda – The 2009 Agenda was approved at 9:48.

VI. Working Group Reports

A. Committee of Age Reading Experts (CARE)

Kris Munk reviewed highlights of 2008 and discussed the CARE 2009 workshop. CARE website is located at www.psmfc.org/care/. The 2009 CARE workshop was held April 21-23 in Seattle at the AFSC.

The Sablefish Age Readers Ad Hoc Working Group arose from Mike Schirripa's intent of a comprehensive sablefish workshop; this working group had their first meeting in 2008 and met again at the 2009 CARE workshop. The group completed a comprehensive age structure exchange which included annotation of images to document and compare ageing techniques. This is valuable, but ageing from images leads to different interpretations. A study of known age-0y and age-1y sablefish from along the coast showed that southern sablefish are larger and have larger otoliths. Not all of the fish were collected in the same month, and while time of sampling likely explains some of the differences, the size differences still suggest there may be a difference from south to north. This size difference, which is believed to result in different growth patterns, may objectively explain some of the lack of agreement between age readers. CARE will come out with a report on this study.

A CARE age structure exchange invoice is available on the web. It is a new way to document age data resulting from CARE age structure exchanges. CARE is trying to recover past age-structured data as well and make it available on the web.

The CARE workshop changed its biennial rotation from even to odd years so as not to interfere with the Western Groundfish Conference, which is always held in even years. At the next workshop in 2011, CARE will discuss more imaging options, such as a 3-d imaging and new technologies. CARE started an online forum for discussion, but not many are using it yet.

CARE will be presenting a poster in Monterey, CA in August at the International Otolith Symposium, which is held every five years. The poster will have goals of the organization and what CARE does.

In response to an inquiry from Aimee regarding ageing of shortspine thornyhead: Kris has been ageing shortspine thornyhead since the early 1990's. She recently has used radiocarbon for age validation. Upwelling anomalies which occurred in the late 1950s and 1960s in the areas where the samples were from are bad for radiocarbon studies; these may lead to extreme variability in the radiocarbon signals which could be from the upwelling, confounding what error is perceived to result from ageing techniques. A paper will hopefully be out next year. PSMFC/AFSC will come up to Juneau next year to learn ADF&G ageing techniques. Shortspine thornyhead often have compressed annuli. Most were read using break and burn, some with thin section. Between reader error was 8% average percent error (APE), but very clear specimens were selected for the radiocarbon study and this APE was only 3%. Maximum age is 133y. Kris found that otolith weight is highly correlated with age, but there is not good enough resolution for using weight to predict ages.

There were no recommendations from CARE to TSC.

B. Trawl Survey Working Group Report

No formal meeting this year, but there are tentative plans for a meeting next February (Mark Wilkins, Aimee Keller, Rick Stanley); however, there was a mini-workshop last week. One issue they want to discuss is recovery plans for endangered species. Surveys are currently not adequate for determining if ESA species are recovering in short term.

C. Field Data Acquisition Technology Workshop

Mark Wilkins discussed that this workshop, which had been planned since 2005, was finally brought to fruition April 1-3, 2009. There was a good turn out of ~60 people. Vendor representatives from 20 companies, including manufacturers of ruggedized handheld computers, either presented or were available to show their products and services. There were also presentations by biologists of onboard data collection systems. The general consensus was that the workshop was very useful, and Mark and others think it would be good to continue every two or three years in the future for sharing of ideas and experiences. Eric Soderlund made a social networking website started for participants to keep in touch, http://edatworkshop.ning.com/. Videos, photos, and text can all be posted. A technical memorandum will also be prepared about the meeting. AFSC groundfish surveys are trying to upgrade their equipment very soon, and Mark encourages others to post their experiences on the website.

Observer Workshop in Maine (July 2009) will have an electronic equipment and monitoring component. At the observer conference, the Canadians will present an analysis of bias in reporting for certain observers, captains, or observer/captain combinations.

TSC to working group recommendation: The TSC thanks the organizers of the Data Acquisition Workshop and agrees that next year at the TSC meeting there should be an effort to plan another workshop.

D. Yelloweye Rockfish Working Group

TSC originally started the working group to discuss the potential for making a coast-wide assessment for yelloweye. There is no action on making a coast wide assessment though. The yelloweye working group was not active in the past year, but is being held in abeyance because it may be needed in the future. All yelloweye assessors are happy to share their data and the doors are always open for cooperation in the future. Cleo will be point person for yelloweye issues.

VII. Other Topics

A. Marine Reserves

Troy Buell (ODFW): Twenty proposals were received from the public for nine distinct areas off Oregon. Two were recommended to the governor by the ocean policy advisor, and these are being considered as well as other areas. They are looking for ecologically significant areas with minimal monetary effects. The areas that are being suggested are fishermen backed. Developing the marine reserves is dependent on funding. If they go through, Oregon will have a new project specifically dedicated to collecting baseline data and monitoring these areas. One area is off Newport at shallow depths, less than 50 meters. The other area is near Port Orford, and incorporates a marine reserve in shallow waters and a marine protected area that would regulate fishing out to the state three mile line; it is okay to fish salmon and crab but not groundfish in the marine protected area. It is unknown whether these areas would be closed to surveys.

Rick Stanley (DFO): In Canada if there are reserves the scientists do not sample in those areas. They are starting to monitor rockfish marine protected areas using ROV's for a time series of abundance in these areas. They feel the initial surveys were successful.

Mark Wilkins (AFSC) has North Pacific Research Board funds to figure out how to assess groundfish in untrawlable areas using near-bottom trawls in conjunction with split beam, echosounding, ROV's, and/or multi beam sonar. He will discuss this at the Trawl Working Group meeting next February.

Jane DiCosimo (NPFMC): The NPFMC approved closure of fishing in the Arctic except for subsistence and research purposes. The purpose is for studying the spatial distribution shifts of species due to climate change. They hope to proactively close the area in case species move north and fishermen want to follow. Not in regulation yet, it has just been approved by the NPFMC and needs to be approved by Secretary of Commerce. There is a cycle for submitting proposals to the NPFMC for closing off areas to fishing. Closures in the Aleutians and the Bering Sea are under review. These closures would protect crab, subsistence, and king salmon.

See the 2006/2007 and 2007/2008 groundfish highlights reports from the NPFMC. It is possible that some of the Bering Sea will be closed for Bering Sea skates.

B. Genetics and stock structure

Cleo Brylinsky (ADF&G): Mike Canino of the AFSC asked for samples from Pacific cod. Jane explained that the North Pacific Council Plan Teams and Scientific and Statistical Committee (SSC) are interested in geographic management (BS/AI) and that genetics may give a reason for dividing management by area. A group of SSC and Plan Team members has been meeting once a month to develop criteria for splitting areas. Dividing quotas by areas makes management more complicated. Paul Spencer (AFSC) is lead and will present information at the September Plan Team meetings.

Ben Koop (U. Victoria) asked Aimee, Cleo, and ABL sablefish staff for sablefish samples for a coastwise genetic comparison.

Claude Dykstra (IPHC): Since 2002 IPHC has been using microsatellites to look for variation in halibut, and they have found some weak differentiation. One finding is that Bering Sea halibut are more similar to Oregon halibut than Aleutian Islands halibut are. They are also trying to get Russian samples. The IPHC is collecting yelloweye samples in BC for a Simon Fraser University student who is studying the genetic differences between yelloweye in outside and inside waters.

Aimee Keller (NWFSC): Rockfish samples are being collected for species differentiation (e.g., canary, vermillion, and sunset). Genetic samples from corals and sea pens are also being collected for other researchers. They are also collecting voucher specimen for their genetics program. Newport is trying to get money to study genetic differentiation of juvenile rockfish.

Dave Clausen (AFSC) noted that Tony Gharrett has been studying the spatial structure of POP and found structure between relatively close areas in the central Gulf of Alaska. They are now looking for finer scale structure and will collect more samples in this year's AFSC Gulf of Alaska trawl survey.

Mark Wilkins (AFSC): RACE is collecting tissues and otoliths from rougheye and blackspotted rockfish. They will collect some from specimens for which they are relatively confident of the identifications, and all of the unknowns. Rick (DFO) also did a 100 sample ID test with Jay Orr and did not have success in visual ID for these two species. Mark is also doing a similar study for shortraker rockfish.

C. Western Groundfish Conference 2010 Update

First formal steering committee meeting will be soon. Dates will be April 26-30th in Juneau, AK. Cleo suggested a session on barotrauma. Rick suggested that the 2010 hosts figure out who is next in the rotation to hold the next meeting and ask them to come to the meeting prepared to accept or decline the responsibility.

VIII. Review of Agency Groundfish Research, Assessment and Management

A. Agency Overviews

1. ODFW

Caren Braby is the new program director, Maggie Sommer is the leader of the data shop, and Lynn Mattes and Daniel Ericson are new groundfish employees. Oregon is eventually going to use electronic fish tickets, and is starting to go that way. A Memorandum of Understanding with the Port Orford Ocean Resources Team (POORT) is currently being investigated for a cooperative community-based management pilot project that would use a smaller scale for management.

2. NWFSC

Mike Schirripa moved to the SEFSC, NOAA in Miami, the ecosystems team formerly with the Fisheries Resource Analysis and Monitoring (FRAM) Division moved to the Conservation Biology Division within the NWFSC, and Patty Burke is the new program manager for the FRAM monitoring program. Jonathan Cusick, who was the supervisor of the observer team, left this year for the east coast; Janell Majewski replaced him as the supervisor for the observer team. Jason Cope, Melissa Haltuch, Allen Hicks and Vlada Gertseva joined the assessment team during the past year. Jerry Leonard also joined FRAM this year on the economics team.

3. DFO

Jeff Fargo stepped down as groundfish head, but continues to work at DFO at Nanaimo. Greg Workman is now head of the groundfish section. They are trying to fill positions left open by retirees.

4. ADF&G

A port sampling technician was just hired for the Groundfish Project. Kyle Hebert stepped down as Marine Fisheries Supervisor and is now the ADF&G dive program coordinator. He is therefore no longer supervising the Groundfish Project.

5. AFSC

Dan Kimura retired as head of the Age and Growth Program and Tom Helser was hired to fill that position. In REFM, Sandra Lowe was hired to fill Anne Hollowed's job because Anne was promoted.

6. IPHC

Bill Clark retired and Steven Hare moved into his role, Juan Valero was hired, Cal Blood retired, one Canadian commission position retired, and Larry Johnson is new on the commission. Evangeline White was hired, and the IPHC hopes to hire an assistant director soon. There are ongoing negotiations with the University of Washington for office space that IPHC rents from them. Heather (IPHC): There will be a bycatch workshop in September; the focus will be on how halibut bycatch is treated in halibut stock assessment.

B. Multispecies Studies

1. NWFSC

The center is expanding measurements of dissolved oxygen on the slope and shelf as part of the groundfish trawl survey. New sites off California appear to be very low in oxygen with a reduced number of urchins observed at some stations relative to earlier years. There is an attempt to add ecosystem measurements to stock assessments in order to reduce variability in assessments.

2. DFO

Species in Canada are moving shallower with lower oxygen levels. The DFO has added oxygen meters on all survey tows.

3. AFSC

The Age and Growth Program at AFSC used bomb radiocarbon for validation of Greenland turbot and northern rockfish ages. Validation studies using bomb radiocarbon with giant grenadier and shortraker rockfish were not successful. Giant grenadier were not successful likely because these fish apparently do not reside within 20 meters of the surface during their first year, but it is unclear why the method did not work for shortraker. Last year the AFSC RACE Division did the Bering Sea slope and shelf trawl surveys, but the scheduled Aleutian Islands trawl survey had to be cancelled due to funding shortfalls. This year there will be a Gulf of Alaska shelf/slope trawl survey and a Bering Sea shelf trawl survey. The AFSC conducted its first-ever survey of U.S. waters in the Arctic Ocean off Alaska in 2008. One finding was a range extension for walleye pollock and Pacific cod. Most of the catch was invertebrates, especially brittle stars (41% of total catch) and Chionoecetes opilio crabs (10% of catch). NPFMC: U.S. waters of the Arctic will soon be closed to fishing.

4. ADF&G

Kris's lab has completed age validations for 9 species of rockfish. They had success with shortraker rockfish. They chose specimens with clear otolith patterns. With bomb radiocarbon you can validate individual specimens. High ages tend to be 40 years for many species. For black rockfish, the new maximum age is 56. This specimen was born before bombs detonated (i.e., before the increase in radiocarbon from background), so it is obvious that is at least 54 yrs old.

5. IPHC

Oceanography is now being collected on all sets of their longline survey using Seacat (Seabird). The sensors collect conductivity, oxygen, depth, and pH. By collecting oxygen, IPHC will be able to exclude CPUE's from anoxic areas, but they have not decided what the protocol will be yet. Anoxic zones change by season and tend to be inshore. The IPHC longline survey fishes in 20-275 fathoms. They have seen low oxygen areas near the lower half of Vancouver Island. The gear comes back with all of the baits, and not even any starfish or hagfish. IPHC cuts data for depredation of whales, but not for oxygen. NWFSC: Some species are better at living in low oxygen. Also you can get edge effects, with high concentrations of fish on the edges of low concentrations areas.

C. By Species

1. Pacific Cod

See agency reports; no additional information reported.

2. Nearshore Rockfish

a) ODFW

Single fish cages have been used to lower rockfish back to the bottom after capture to see if they survive barotrauma. After a few days the cages are pulled up to see if the fish are still alive. ODFW will be deploying an acoustic telemetry grid in the hypoxic zone off Cape Perpetua this summer. The state of Oregon had increased allowable harvest of minor nearshore rockfish species to increase black rockfish target fishery yield. There has been opportunistic sampling of rockfish gonads for histological studies of maturity. ODFW has little data on yelloweye rockfish, but a video lander is being developed for reef surveys.

b) DFO

Graduate students at UBC are looking at using remotely operated vehicles (ROV) to index abundance of rockfishes to enhance Rockfish Conservation Areas. Yelloweye rockfish are not listed as endangered or threatened. The Canadian federal government is considering whether to officially list as “threatened” the bocaccio and canary rockfish populations on the Pacific coast of Canada. If listed, a recovery plan must be in place for each species which may include a requirement that the species may not be captured without a special permit. A recovery plan may also require development of an Action Plan, which must include a description of the monitoring that will be put in place to track future abundance trends. We are currently conducting Management strategy simulation studies to assess whether or not our surveys provide sufficient precision to can meet the needs of a recovery plan.

c) ADF&G

Southeast AK fishermen are less interested in the Southeast black rockfish fishery because the price is low. Early in 2009 there was a yelloweye rockfish directed fishery in East Yakutat and Southern Southeast outside. ADF&G has hired a new port sampler, who is looking at bycatch of yelloweye in halibut deliveries. This year ADF&G will be doing a yelloweye survey with the *Delta* submersible in East Yakutat. There was a Board of Fish meeting in February 2008. They made a new order that gave managers the power to change the bycatch allowance of yelloweye rockfish by emergency order in-season. Because the bycatch allowance has been 10% in the longline fisheries, commercial fishermen have been constrained and have not been able to fully harvest their allocation of the TAC. The ability to raise the bycatch allowance will afford the possibility that the commercial allocation of the TAC will be harvested.

d) NWFSC

Since 1999, there were increases in biomass trends for seven rockfish species previously listed as overfished. Two rockfish species are expected to reach target biomass levels within a few years; however, rebuilding is expected to take more than 60 years for other rockfish species. Recent assessments were conducted for all of the depleted rockfish species, as well as several others. There will be a 2-week hook-and-line survey for structure-associated rockfish in the Southern California Bight again in 2009.

e) AFSC

Cara Rodgveller reported that oil globules, which provide energy to embryos and larvae during growth, were measured from developing quillback rockfish embryos in Southeast AK. The preliminary analysis, of samples from 90 females, shows that maternal age may not have an effect on oil globule size of progeny, even after accounting for the stage of development and for the capture date and location.

3. Shelf Rockfish

a) ODFW

A research project by ODFW suggests that using longer leaders on fishing gear can exclude demersal yelloweye rockfish when fishing for semi-pelagic yellowtail rockfish. The project also attempted to target halibut using similar gear with bait instead of artificial lures, but was unsuccessful in avoiding yelloweye bycatch.

4. Slope Rockfish

a) NWFSC

POP are on their way back up.

b) AFSC

There was an assessment in 2008 for the various slope rockfish species for the Bering Sea/Aleutians. In 2009, similar assessments will be conducted for slope rockfish in the Gulf of Alaska. There is a problem with identifying rougheye and blackspotted rockfish in the field. Christine Conrad of the AFSC Kodiak Lab is initiating studies on reproduction and maturity of slope rockfish.

5. Thornyheads

a) NWFSC

No assessment in 2008 or 2009.

b) AFSC

Dendrochronology methods did not appear to work for ageing shortspine thornyhead.

6. Sablefish

a) NWFSC

Caught a lot of age 0 or 1 sablefish last summer in the groundfish survey.

b) ADF&G

There was no stock assessment last year; instead ADF&G worked on a report about how they do the assessment that will be published this fall. Franz Mueter analyzed the ADF&G assessment and provided a report focusing on appropriateness of an age-structured assessment. It is hoped that this report will also be published this fall. The 2009 assessment will use two years of data. ADF&G provided their tag data from the Northern Southeast Inside area (NSEI) to AFSC for migration models. ADF&G wants to know if there is migration in and out of Chatham Strait. At the Board of Fish meeting, they adopted new sport fishing regulations regarding placing a bag, possession, and annual limit on sablefish (there were none previously). It is now legal to use electric reels, which are not defined. As it now stands, electric reels could be electric jigging machines or electric reels. Bag limit was originally set at 2 fish/day, 4 in possession, 8 annual limit. There was so much lobbying, that it was brought up again last week and changed to 4/day, 8 in possession for all sport fishermen with an 8 fish annual limit for non-residents only. The sport fishing for sablefish occurs in places without creel surveys, and the recording of sablefish catch on sport logbooks had not been required until this coming season. For the 2009 assessment, an estimate of the amount of sport-caught fish will continue to be taken off the top of the ABC along with other decrements, but the actual sport catch of sablefish is unknown. A pilot Pacific ocean shelf tracking network (POST) project, which is cooperative between the IPHC, POST, ADF&G and the AFSC, is being initiated this summer. POST hosts a submerged array of sonic detectors. They hope to track the movement of sablefish in and out of Chatham Strait. The project this summer will test equipment at deep depths. The plan is to leave the equipment in for a year to test how well receivers detect transmitters in all types of weather and currents, year round.

c) AFSC

Jon Heifetz explained to the TSC that tagging data from Canada, ADF&G, and the AFSC could all be put into a coastwise movement migration model. Jon said it is worth doing now. It is going to take someone to lead this project, though. The AFSC sablefish longline survey was completed last summer. Archival tags from sablefish tagged as juveniles are now starting to come in from the fishery. Cara reported that a study of longline survey catch rates showed that there is likely competition for hooks on the longline survey between sablefish and rougheye and shortraker rockfish and between sablefish and giant grenadier. Sablefish catch rates are not likely affected (see paper by Mike Sigler, 2000), but rockfish and giant grenadier catch rates are likely influenced. On March 17-19, the AFSC Auke Bay Laboratories hosted a Center of Independent Experts Review (CIE) of the Alaska sablefish assessment. It was open to the public, and representatives from the industry, ADF&G, the NPFMC, and the IPHC were present. The review went well and final reports will be released in near future. A response and write up will be prepared for the September NPFMC Plan Team meeting.

7. Halibut and IPHC Activities

a) IPHC

The pit tag dockside detection program continued last year. Tagged fish were released during the 2003 and 2004 halibut surveys. This year will be the last year for scanning dockside; there is also scanning on the survey. Pop-up archival tags (PAT), which record temperature and depth, were deployed last year and are programmed to pop off after 1 year at liberty. Questions that could be explored by the pop-up tags are: do halibut move deeper for spawning, and do they have site fidelity similar to what pit tags showed? Several PATs have released early; mostly large females are tagged. An ultrasound was used to determine sex of the fish for archival tags, and it was very successful. From the tags, it appears that females rise to the surface every 24 hrs or so in the winter, possibly to release eggs. Archival tags were placed internally in halibut, and their bodies were actively trying to expel the tags or grow over them. Because of this problem, a holding experiment was conducted to test the possibility of using external archival tags. IPHC is working on a study of swivel gear vs. non-swivel gear for retention of fish. IPHC did a removal study where five sets were fished per day in the same locations, for 5 days to get an estimate of catch probability from depletion, but it did not work because the fish were not depleted. Sonar is now being used for looking at hooking success. The sonar enables a view of the fish attacking the baited hooks. From this you can tell the species, size, and the number of attacks. IPHC is comparing electronic monitoring with actual observers. Two hundred and thirty sets were double monitored. They are trying to get North Pacific Research Board funding to do more vessels of different size classes. The data will be analyzed this year. The IPHC survey added stations in rocky habitat for rockfish for ODFW and WDFW. They are continuing with the WDFW requested locations this year. On the survey there has been some barotrauma work with yelloweye rockfish. Some of their air bladders were deflated, the fish were tagged with an acoustic tag, sank in a floating trap, and released. IPHC is deploying water column profilers coast-wide on all survey vessels this year. These are deployed at the start of haulback and read as they descend to the bottom. The longline hauler is used to pull it back. The sensors cost $20-25,000 each, need calibration every year, and are protected inside a stainless steel cage, which weighs 55 lbs. IPHC received a grant to purchase 15 and had two already. The purpose is to look at chemical properties of water in relation to catch rates. A study of mercury has showed that larger and older fish have higher mercury. They are also relating pollutants to sex, age, and location. Methyl mercury is stored in muscle tissue. IPHC will take part in the pilot POST project this year and is curious if the sensors can detect fish that are demersal to the sensors. Whale observations on the halibut survey are being taken. Also, bird counts are being conducted when offal is being released.

8. Flatfish

a) NWFSC

There will be a petrale assessment in 2009. A Hollings scholar will look at ageing of curlfin sole this year.

b) AFSC

There are behavior studies by the Newport facility on juvenile halibut and rock sole.

9. Lingcod

a) NWFSC

Lingcod were overfished but are no longer in the overfished category.

b) DFO

An assessment is planned this year.

c) ADF&G

The Board of Fish allowed ADF&G to change bycatch limits in-season to make sure the allocations are fully utilized, similar to what was done for yelloweye.

d) AFSC

Lingcod were tagged with archival tags on the sablefish longline survey.

10. Pacific Whiting

a) NWSC

There was an assessment in 2008 and there will be one in 2009. A study of ageing error, in part, led to a decrease in estimates of spawning biomass, which in turn reduced allocation in 2009.

11. Walleye Pollock

a) ADF&G

ADF&G is looking for recoveries of Floy-tagged walleye pollock in Southeast Alaska. In 2008, they were caught by jigging off the dock in Auke Bay and then tagged. Some of the fish were injected with oxytetracycline before release. The purpose of the study is to determine if there is a resident population in Auke Bay. Pollock are notorious for being hard to tag without mortalities, but they had low tagging/handling mortalities. So far, there have been two recoveries. There are plans to tag more in 2009.

b) AFSC

The quota for pollock in the eastern Bering Sea was decreased by 18% in 2009. There was a study comparing the NOAA RV *Oscar Dyson* to the NOAA RV *Miller Freeman* for acoustic assessment of walleye pollock. The *Dyson* is a newer vessel and makes less noise, so it does not disturb the fish as much and detects more fish.

12. Dogfish and Other Sharks

a) DFO

There will be an assessment next year. The basking shark is rare and may be listed as threatened or endangered by the Minister. This would not really affect fisheries because they are rarely caught.

13. Pacific Mackerel and Sardines – No information reported.

14. Skates

a) NPFMC

Broke Gulf skates out of Other Species group in the Gulf of Alaska Fishery Management Plan (FMP) in 2005. Bering Sea/Aleutian Islands skates are also being taken out of Other Species group possibly for 2011 fishing year. Squid have not been broken out in the Gulf of Alaska yet. Squid may be moved to the forage fish category or into the ecosystem component group.

b) NWFSC

Starting to age longnose skate using vertebrae.

c) ADF&G

A skate fishery started in Prince William Sound, and catches were different than expected because the survey was at different depths than the fishing depths.

d) DFO

IPHC survey will likely provide a useful relative abundance index for longnose skate.

15. Grenadiers

a) NPFMC

Grenadiers may move up in priority because the Council may be required to determine if they should be part of the Fishery Management Plans. This would move them out of the non-specified category.

b) AFSC

An updated assessment was completed in 2008. New information on age, maturity, growth, and natural mortality was added to the assessment. Bomb radiocarbon did not work for age validation. There was a five day experimental longline survey last year that sampled waters 1000-1600 m deep in the North Pacific off Dutch Harbor for giant grenadier and sablefish. The sablefish longline survey generally surveys depths only to 1000 m, and the purpose of the experimental survey was to investigate the abundance of giant grenadier and sablefish that occurred deeper. Results were that sablefish had a very low abundance, giant grenadier were caught in relatively large numbers at all depths to 1600 m, and Pacific grenadier were very numerous, especially at one station.

16. Other Species

a) Cabezon

NWFSC: There was an assessment prepared this year. ODFW: They are ageing otoliths for cabezon and have found that their length-at-maturity and age-at-maturity differ from CA fish.

b) Hagfish

ODFW: A fishery for live hagfish is possibly in development.

<u>Wednesday, May 6</u>

D. Other Related Studies

a) NWFSC

There was a test cruise for a new autonomous underwater vehicle (AUV) that is co-owned by the NMFS Pacific Islands Fisheries Science Center and the NWFSC. The AUV was tested in Hawaii and CA. The test cruises were successful. The planned uses for the AUV include habitat classification and rockfish enumeration and identification. They are also working to develop an open cod-end net with a camera system to help assess widow or canary rockfish. They are going to develop another open cod-end net that can fish close to the bottom. There will be a hake acoustic survey this summer, as part of their biennial survey schedule. The NWFSC is getting a new vessel called the NOAA RV *Bell Shimada*, which will be shared with the SWFSC. There may end up being 100% trawl coverage when they go to ITQs down south. There is an annual hake pre-recruit survey in the northern and southern California current system.

b) IPHC

The IPHC is trying to get funding to start an electronic logbook program.

c) DFO

There was a meeting between fishermen and the Assistant Deputy Minister to discuss the difficulty of assessing 150 different populations. Canada is looking at the Australia system of risk assessment, called ERAEF, the Ecological Risk Assessment of the Effects of Fishing, instead of full assessments for all species. The idea is to assess the risk to the ecosystem and not just each individual species.

d) NPFMC

Paul Spencer at the AFSC is doing an analysis of which stocks should be included in the North Pacific Fishery Management Plans. Right now there are hundreds of species not in the FMPs. Some of these could be brought into a category called “ecosystem component”. These would not have a quota and would be managed by risk management.

e) AFSC

The RACE habitat research team is using bottom typing determined by sonar to assess essential fish habitat.

E. Other Items

1. Integrated groundfish management in B.C. - update

DFO: There is currently 100% video coverage of longline and trap fishing in the commercial fishery with 10% of the video randomly checked. Fisher logs are compared with the video data and if the numbers match within defined tolerance limits, the fisher logs are deemed acceptable. If outside the tolerances, the fisher may be required to pay for 100% review of the footage and/or take an observer on subsequent trips. However, penalties were not actually imposed until year 3. DFO pays 1/3 of costs for this program. This is the first time discard data have been available from this fleet.

We examined the accuracy of the catch data by extrapolating the video data (10% of the fishery) to compare with official logbook and DMP catch estimates. The comparisons, using yelloweye rockfish as a test catch, indicated a close match.

IPHC: Could fishermen be misidentifying fish in logbooks? DFO: It depends. All rockfish must be retained for unloading which can be confirmed in the video check. Since the rockfish are sorted at unloading, misidentification by fishermen will have no impact. For species pairings or aggregates that are discarded and difficult to distinguish for reviewers and fishers, the system will only provide accurate estimates of the piece counts by species group, e.g., “birds”.

2. Marine mammal predation on groundfish

AFSC: The number of stations that sperm whales are sighted on the sablefish longline survey is increasing in the Eastern Gulf of Alaska. Killer whales depredate gear in the Bering Sea/Aleutian Islands and Western Gulf only. IPHC: The IPHC survey can move away from whales because they do not have set stations in a certain order like AFSC longline survey. AFSC: A study of the effects of sperm whale depredation found that catch rates do not differ significantly between depredated and non-depredated (due to natural variability between stations and between years). In the AFSC survey, skates with killer whale depredation are dropped from the CPUE computations. IPHC: The IPHC also drops some data for killer whale depredation. They are still working out a trigger for taking data out, though. This year they are collecting more data on sperm whales such as the number of bent, broken, and missing hooks on all skates. Sperm whales may be damaging gear more than we think, so determining the hook condition may lead to more knowledge about detecting sperm whale depredation. On IPHC surveys, they are also documenting when whales show up, where they are in relation to the boat, and their distance from vessel. The problem is you cannot observe the behavior in concert. Last year they saw killer whales moving eastward. Sperm whales seem to be cued by the propeller engaging, not the longline hauler. Fishermen can shake whales by putting out a dummy flag or fishing in shallower water. Reports are that killer whales will not feed in the dark, but this could just be anecdotal evidence. However, it never gets completely dark in AK in the summer. Sperm whales do not seem to want to eat snarled hooks. This could be an idea for a deterrent. ADF&G: Sperm whales are now following the ADF&G sablefish survey in the Northern Southeast Inside Area and may be depredating. Sperm whales have been seen by the commercial sablefish fishermen inside Chatham Strait recently. IPHC: There is evidence that sperm whales snap the line causing the fish to fall off the line. They then make creaking noises to zero in on fish and find them floating in the water. The creaking noises could be a way to identify when a sperm whale is actively depredating on the catch.

IX. Progress on 2008 Recommendations

A. From TSC to Itself - The recommendations made in 2008 did not require Progress Reports because the only recommendations were to disband the Sablefish Working Group and the GIS Working Group.

B. TSC to Parent Committee – No recommendations were made.

C. TSC to CARE – No recommendations were made.

X. 2009 Recommendations

A. From TSC to Itself - Steven (PSMFC): There is a need for a WDFW person to attend. TSC should ask councils to send a participant. A letter should be sent out by December to directors of agencies, regions, centers, state, and everyone's supervisors. This may promote attendance of TSC meetings. The TSC meeting this year was also lacking someone from Canada DFO management. It was likely hard to travel because this meeting was in AK, and the TSC hopes more can make it in future.

1. As in recent past years, a summary letter explaining the purpose of the TSC and highlights of the meeting should be sent to agency supervisors and/or division directors.

B. TSC to CARE - No recommendations were made

C. TSC to Parent Committee - The TSC recommends that a letter be sent to the Division Director of the NMFS AFSC Fisheries Monitoring and Analysis Division (FMA, sometimes referred to as the Alaska groundfish observer program) inviting a representative of this division to attend annual TSC meetings in the future. The TSC notes that other member agencies of the TSC, including Canada DFO, the NWFSC, and state agencies, regularly report information on developments in their observer programs at TSC meetings. Now that FMA is a separate division of the AFSC, the TSC believes that both the FMA Division and other fishery agencies on the Pacific coast would benefit from the increased exchange of information that would result if FMA were to participate in these meetings.

D. TSC to the Steering Committee of the Workshop on Electronic Data Acquisition Technology - The TSC wishes to acknowledge the perseverance and hard work of the steering committee in bringing this workshop to fruition. Committee members included Chairman Mark Wilkins (AFSC RACE Division, Seattle), Mark Freeman (ODFW, Newport), Robin Harrison (AFSC Race Division, Seattle), Tom Kong (IPHC, Seattle), Chris Lunsford (AFSC Auke Bay Laboratories, Juneau), Victor Simon (NWFSC FRAM, Seattle) Jerry Smetzer (ADF&G, Douglas, AK), Eric Soderlund (IPHC, Seattle), Vanessa Tuttle (NWFSC FRAM, Seattle), and Greg Workman (Canada DFO, Nanaimo). The workshop was first proposed at the 2005 TSC meeting, and was postponed several times before it was finally held April 1-3 2009 in Seattle. By all accounts, this was a highly successful and useful workshop, and the TSC congratulates the committee on a job well-done.

XI. Schedule and Location of 2010 Meeting

Dave Clausen will continue as chair. Location and schedule of 2010 Meeting: Parksville, B.C. (near Nanaimo), Wednesday May 5 and Thursday May 6, 2010. The traditional starting date of the meeting was shifted from Tuesday to Wednesday because the meeting falls just after the Western Groundfish Conference the previous week.

XI. Other

The meeting was adjourned at 11:05, May 6, 2009.

D. Parent Committee Minutes

Minutes of the 50th Annual Meeting
of the
Canada-U.S. Groundfish Committee
(aka "Parent Committee")

I. Call to Order

Chair Mr. Rick Stanley, DFO, represented Canada (for Gary Logan, DFO-Groundfish Management Unit), Stephen Phillips, represented the US (for Randy Fisher, PSMFC). Mr. Stanley called the meeting to order at 11:00 Wednesday, May 6, 2009. Also in attendance: Cleo Brylinsky (ADFG), and Dave Clausen (NMFS, AFSC Auk Bay)

II. Stephen Phillips was appointed secretary for the meeting.

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

IV. Adoption of May 2008 Parent Committee meeting minutes: The minutes were adopted as presented.

V. Progress on 2008 Parent Committee Recommendations

There were no recommendations

VI. 2009 Parent Committee Recommendations

1. Parent Committee agrees with the 2009 TSC recommendation to the Parent Committee that a letter be sent to the Division Director of the NMFS AFSC Fisheries Monitoring and Analysis Division (FMA, sometimes referred to as the Alaska groundfish observer program) inviting a representative of this division to attend annual TSC meetings in the future.

VII. Meeting Location

1. Location and schedule of 2010 Meeting: Nanaimo B.C., Wednesday May 5 and Thursday May 6, 2010. The traditional starting date of the meeting was shifted from Tuesday to Wednesday because the meeting falls just after the Western Groundfish Conference the previous week. Dave Clausen will continue as chair. Department of Fisheries and Oceans Canada will host.

VIII. Other Business

a. The Parent Committee thanks Dave Clausen for hosting and chairing the meeting and outstanding barbeque.

b. The Parent Committee thanks Cara Rodgveller for recording the minutes.

c. The Parent Committee thanks PMFC for its going support for the annual TSC meetings.

E. Agency Reports

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

AGENCY REPORTS

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1. ALASKA FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERES SERVICE

2. CANADA, BRITISH COLUMBIA GROUNDFISH FISHERIES

3. COMMITTEE OF AGE READING EXPERTS (CARE)

4. INTERNATIONAL PACIFIC HALIBUT COMMISSION (IPHC)

5. NORTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

6. SOUTHWEST FISHERIES SCIENCE CENTER, NATIONAL MARINE FISHERIES SERVICE

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

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

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

Alaska Fisheries Science Center
of the
National Marine Fisheries Service

2009 Agency Report
to the
Technical Subcommittee of the
Canada-U.S. Groundfish Committee

April 2009

Compiled by
Mark Wilkins, Tom Wilderbuer, and David Clausen

VIII. REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENTS, AND MANAGEMENT IN 2008

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, the Fisheries Monitoring and Analysis (FMA) Division, and the Auke Bay Laboratory (ABL). The RACE and REFM Divisions are divided along regional or disciplinary lines into a number of programs and tasks. The FMA Division performs all aspects of observer monitoring of the groundfish fleets operating in the North Pacific. The ABL conducts research and stock assessments for Gulf of Alaska groundfish. All Divisions work together closely to accomplish the missions of the Alaska Fisheries Science Center. 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 Center divisions are included as Appendices II - V.

RACE DIVISION

The core function of the Resource Assessment and Conservation Engineering (RACE) Division is to conduct quantitative fishery surveys and related ecological and oceanographic research to measure and describe the distribution and abundance of commercially important fish and crab stocks in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska and to investigate ways to reduce bycatch, bycatch mortality, and the effects of fishing on habitat. The staff is comprised of fishery and oceanography research scientists, geneticists, pathobiologists, technicians, IT Specialists, fishery equipment specialists, administrative support staff, and contract research associates. The status and trend information derived from both regular surveys and associated research are analyzed by Center stock assessment scientists and supplied to fishery management agencies and to the commercial fishing industry. RACE Division Programs include Fisheries Behavioral Ecology, Groundfish Assessment, Midwater Assessment and Conservation Engineering, Recruitment Processes, Shellfish Assessment, and Research Fishing Gear. These Programs operate from three locations in Seattle, WA, Newport, OR, and Kodiak, AK.

In 2008 one of the primary activities of the 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 2008 by RACE Groundfish Assessment Program (GAP) scientists; the annual eastern Bering Sea shelf survey and the biennial survey of the eastern Bering Sea upper continental slope. The scheduled biennial bottom trawl survey of the Aleutian Islands had to be cancelled for lack of funds. In 2009 GAP scientists will again conduct the annual Bering Sea shelf survey and the biennial Gulf of Alaska survey of the continental shelf and upper continental slope.

RACE scientists of the Habitat Research Team (HRT) continue research on essential habitats of groundfish. In FY06, the focus was on evaluating acoustic backscatter and benthic infauna community as predictors of groundfish distribution. Details on the work of the HRT can be found under *D. Other Related Studies.*

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 2008 and around Chirikof-Shelikof Strait in March 2008. A summer survey of pollock on the eastern Bering Sea shelf was conducted in June and July 2008. MACE staff and other RACE survey personnel continued work on the intervessel calibrations between the *Oscar Dyson* and the *Miller Freeman* with work on this project during the February 2008 survey of the Shumagin-Sanak area and the summer survey in the Bering Sea. Research cruises investigating bycatch issues also continued.

For more information on overall RACE Division programs, contact Division Director Russ 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

The Fisheries Monitoring and Analysis (FMA) Division is responsible for placement of observers on vessels fishing for groundfish species in the U.S. EEZ of the northeastern Pacific Ocean and Bering Sea. Observers collect data, which provide the basis for in-season management of the groundfish fisheries by NMFS. This observer data also provides a means for evaluating and developing management strategies by NMFS and the regional management council, and are used in the stock assessment process. Observers play important roles in providing information that is critical to the U.S. fishing industry.

During 2008, 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 799 observers to 296 vessels and 21 shore plants in Alaska. These observers spent 39,510 days collecting data in 2008. 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.

In January 2008, FMA implemented several long-awaited sampling and database changes that had been recommended in various independent reviews as well as by in-house staff. These changes fundamentally altered the way observers collect and record their data. Modifications were made to both the methods used to collect data at sea and to the AFSC database that houses the observer data. Now the data entry and storage mirror the sampling conducted in the field and relationships between samples and subsamples and hauls and trips are reflected in the structure of the database. In addition, observers are now asked to collect and individually record at least three samples for species composition from each sampled haul or fishing event. Previously, samples were pooled together. These changes allow for a better understanding of the statistical properties of the data and the estimates derived from that data. In particular, it is now possible to assess within-haul variance. For more information on the redesigned observer sampling go to: http://www.afsc.noaa.gov/Quarterly/jfm2008/jfmfeaturelead.htm

Patti Nelson was hired as FMA Division Deputy Director, replacing Martin Loefflad when he was promoted to FMA Division Director a year ago.

For more information on overall FMA Division programs, contact Division Director Martin Loefflad at (206)526-4194.

AUKE BAY LABORATORIES

The Auke Bay Laboratories (ABL), located in Juneau, Alaska, are a division of the NMFS Alaska Fisheries Science Center (AFSC). In 2006, what was formerly called ABL's "Groundfish Assessment Program" changed its name to the "Marine Ecology and Stock Assessment Program" (MESA), a name which more accurately reflects the varied tasks and research of this group. The MESA 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 17 scientists, including 16 permanent employees and 1 term employee. One personnel change in 2008 was that a former MESA staff member, Pat Malecha, transferred back to the MESA Program from ABL's Marine Salmon Program. Four employees in other ABL programs have also been involved with groundfish-related research in the past year.

In 2008 field and laboratory research, ABL's MESA 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) continued juvenile sablefish studies, including routine tagging of juveniles and electronic archival tagging of a subset of these fish; 2) a laboratory study of habitat preferences for young-of-the-year slope rockfish; 3) an investigation of the effect of maternal age on viability of quillback rockfish larvae; and 4) a deep-water (> 1,000 m depth) longline study of giant grenadier and sablefish abundance in the western Gulf of Alaska.

Ongoing analytic activities in 2008 involved management of ABL's sablefish tag database, analysis of sablefish logbook and observer data to determine fishery catch rates, and preparation of four detailed status of stocks documents for Alaska groundfish: sablefish; Gulf of Alaska sharks; Bering Sea/Aleutian Islands sharks; and grenadiers Another important analytic activity in 2008 was completion of an analysis of competition for hooks in the longline survey between sablefish and other species.

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

B. Multispecies Studies

1. Research

Fisheries Behavioral Ecology Program - RACE
The Fisheries Behavioral Ecology Program based in Newport, Oregon 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 2008 continued under long-term research themes related to recruitment processes, basic studies in fish ecology relevant to the definition of essential habitat, and bycatch stress.

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 program leader, an age validation researcher, IT/data specialist, and 9 age readers. Ages are usually determined from otoliths, but scales, finrays and vertebrae are sometimes used. Ageing protocols and production statistics for the Age and Growth Program at the AFSC can be found on the Age and Growth Program website (www.afsc.noaa.gov/REFM/Age/default.htm).

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, and big and longnose skates. Increasingly, the program is ageing non-commercial species, which either are possible candidates for commercial harvest, or may be important in monitoring the broader ecosystem. These species currently include yellow irish lords, sculpin (great, plain, warty, and bigmouth), giant grenadier, eulachon, and capelin.

In January 2009, Dr. Dan Kimura retired after 25 years of service at NMFS, with 22 of those years as the Age and Growth Program Leader. During his tenure, the Age and Growth Program expanded its reputation of not only providing high quality fish age data for stock assessments, but also becoming known as a first-class research lab on fish age validation. His guidance towards better age precision analysis, data management, documentation of ageing criteria, and publications on fish ageing studies has improved fish ageing science. He represented the Age and Growth Program at three International Fish Otolith Research and Application Symposiums. Dr. Kimura inspired numerous research projects using natural radionuclides, atomic bomb produced radiocarbon, and other fish age validation methods. His application of statistics, population modeling, and insightful leadership of the Age and Growth Program will be sorely missed. Dr. Kimura's many friends and colleagues at the AFSC wish him all the very best during his retirement.

Dr. Thomas Helser has been selected as the new Age and Growth Program Leader and will assume this position on May 11, 2009. Dr. Helser has a strong quantitative background in statistics and has worked on stock assessments on both the east and west coasts, including age and growth studies. He has worked for NMFS for a number of years, including about 10 years at the Northwest Fisheries Science Center. His resume is impressive and we are extremely pleased to have found such a well-qualified individual to lead the REFM Division's Age and Growth Program.

Recent research, as of April 2009, in the Age and Growth Program in 2008 has focused on the following areas:

1. Delsa Anderl, John Brogan, Beth Matta, and Jon Heifetz (Auke Bay) have been working on a sablefish age validation study that uses "known age" specimens from southeast Alaska. This is a unique and special study because known age specimens of groundfish are not common. Sablefish ageing is difficult and this study should lead to more accurate ages.
2. Charles Hutchinson, Todd TenBrink, and Delsa Anderl have been developing age determination methods for several sculpin species. Two manuscripts are in the draft stages and the preliminary titles are "Age determination of the yellow Irish lord, *Hemilepidotus jordani*: accounting for changes in natural mortality rates" and "Age, growth, and mortality of the plain sculpin, *Myoxocephalus jaok*, in the eastern Bering Sea."
3. A study by Beth Matta has found that rex sole in the Gulf of Alaska demonstrate geographic differences in growth rates. Length at age is smaller in the east and larger in the west. A relation to the quality and quantity of food is being investigated in collaboration with the AFSC Resource Ecology and Ecosystems Modeling Task Group.

4. John Brogan, Delsa Anderl, Dan Kimura, and Craig Kastelle have used bomb radiocarbon as an age validation tool for Greenland turbot. This species is a very difficult to age, and production age determination methods were recently developed and published by the Age and Growth Program in 2006. The current study confirmed that Greenland turbot is being aged correctly, but may continue to be a species with greater than average difficulty and lower precision than other flatfish. A manuscript is being prepared for this study.
5. Bomb radiocarbon was used by Craig Kastelle, Delsa Anderl, and Dan Kimura for an age validation study of yellowfin sole from the Bering Sea. The results from this study were generally good, but did not show conclusively that the ages were accurate. Instead, it demonstrated that further work is necessary to develop high quality reference radiocarbon chronologies for the eastern Bering Sea, a prerequisite for this type of study. A manuscript is being prepared for this study.
6. A new study is being initiated by Craig Kastelle in collaboration with Steve Wischniowski (International Pacific Halibut Commission) to develop a new bomb radiocarbon reference chronology based on juvenile Pacific halibut from the eastern Bering Sea. This will answer questions about geographical differences in the timing of bomb produced radiocarbon, and aid future age validation studies.
7. Four other studies in the Age and Growth Program using bomb radiocarbon are at various stages of completion. Northern rockfish ages have been validated, and a manuscript will be completed in the future. In a collaborative study with Bryan Black (Oregon State University), and Claudia Hand along with other staff of the Sclerochronology Lab at the Department of Fisheries and Oceans, Nanimo, Canada Geoduck clams are currently being examined. And two species, giant grenadier and shortraker rockfish have been examined and appear to not be amenable to this method.
8. Dendrochronology is being used by Beth Matta, Betty Goetz, and Charles Hutchinson to relate annual growth variability in four species to environmental signals. Currently, results are good for three flatfish species from the Bering Sea: yellowfin sole, northern rock sole, and Alaska place, and a manuscript is in preparation. This method appears to be less promising for shortspine thornyhead.
9. An AFSC fish ageing manual initiated by Dan Kimura and currently edited by Beth Matta, is nearing completion. This is a culmination of many years of work to document the methods and protocols used in the Age and Growth Program. All members of the Age and Growth Program have contributed to this effort.

For further information contact Dr. Thomas Helser (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 AFSC web site at: http://www.afsc.noaa.gov/REFM/REEM/Default.php.

Groundfish Stomach Sample Collection and Analysis
The Resource Ecology and Ecosystem Modeling (REEM) Program continued regular collection of food habits information on key fish predators in the North Pacific. Emphasis is being placed

on collecting stomachs during seasons and in regions where historic sampling has been less comprehensive. Emphasis is also being directed toward collection of stomachs with corresponding information about the zooplankton and benthic prey field. 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 2008, REEM collected samples and data during bottom trawl and/or midwater surveys of the Beaufort Sea, Aleutian Islands (AI), Gulf of Alaska (GOA) and eastern Bering Sea (EBS). Stomach samples were also collected during surveys by other agencies and by Observers during fishery operations. In total, 366 stomachs were collected from the Beaufort Sea, 11,737 from the EBS, 245 from the AI, and 2,155 from the GOA regions. Laboratory analysis was conducted on 5,890 fish stomachs from the Bering Sea, 1,671 fish stomachs from the GOA, and 591 fish stomachs from the AI. At-sea analysis was conducted on 1,323 fish stomachs from the EBS. The REEM predator-prey database was updated with 17,610 records in 2008. Complete database details can be found at http://www.afsc.noaa.gov/REFM/REEM/data/default.htm.

Predator/Prey Interactions and Fish Ecology

REEM is focusing on improving the life history parameters for five species of large-mouthed sculpins inhabiting the EBS and AI regions. This study is funded through the North Pacific Research Board (NPRB). The age and growth portion of the study has concluded with over 3,000 otoliths aged from samples collected during regional groundfish bottom trawl surveys and fishery operations. Results from the yellow Irish lord (*Hemilepidotus jordani*) and warty sculpin (*Myoxocephalus verrucosus*) were presented at the NPRB symposium held in Anchorage in January 2008 (Table 1). Bigmouth sculpin (*Hemitripterus bolini*), plain sculpin (*Myoxocephaulus jaok*), and great sculpin (*Myoxocephalus polyacanthocephalus*) samples have since been completed with results to be released in 2009.

Species	Region	Sex	Age	L_∞	K	t_0	r^2	n
YIL	EBS	M	24	468.1 (10.86)	0.257 (0.029)	-0.070 (0.311)	0.81	140
YIL	EBS	F	28	420.6 (4.35)	0.295 (0.019)	-0.022 (0.198)	0.83	246
YIL	AI	M	20	521.7 (16.99)	0.147 (0.018)	-0.851 (0.429)	0.84	160
YIL	AI	F	26	441.6 (7.59)	0.171 (0.015)	-1.258 (0.393)	0.79	238
WTY	EBS	M	15	433.5 (11.04)	0.362 (0.059)	0.039 (0.455)	0.50	267
WTY	EBS	F	18	537.0 (7.43)	0.259 (0.022)	-0.089 (0.283)	0.76	415

Table 1. Estimates of the von Bertalanffy growth parameters for recently aged yellow Irish lord (YIL) and warty sculpin (WTY), by region (eastern Bering Sea, EBS; and Aleutian Islands, AI) and sex. Age is the maximum age

estimated, r^2 is the coefficient of determination, and n is the sample size. Asymptotic standard errors are shown in parentheses below each parameter.

Seabird - Fishery Interaction Research

REEM personnel continue their local, national and international collaborative efforts to research seabird–fishery interactions, to improve monitoring of seabird bycatch, and to reduce the bycatch of seabirds, especially in coordination with the Pacific Seabird Group (PSG) (www.pacificseabirdgroup.org). At the 2008 PSG annual meeting, presentations were given on, "Determining spatial and temporal overlap of an endangered seabird with a large commercial trawl fishery," "The Trouble With Trawlers and Seabirds in the North Pacific Groundfish Fishery(ies)," and "Research – Regulation – Operation: An Evaluation of the Effectiveness of Seabird Mitigation Requirements in the Alaskan Demersal Groundfish Longline Fleet." It was noted that seabird bycatch has been reduced from an annual average (1993 to 2000) of 16,507 down to an annual average (2002 through 2006) of 5,137 (Figure x1). The average annual albatross bycatch for 1993 through 2000 was 1,051 while the annual average between 2002 and 2006 was 185. The research was originally designed to evaluate mitigation gear under commercial operations and to recommend actions that would be effective and relatively easy to use by fishermen.

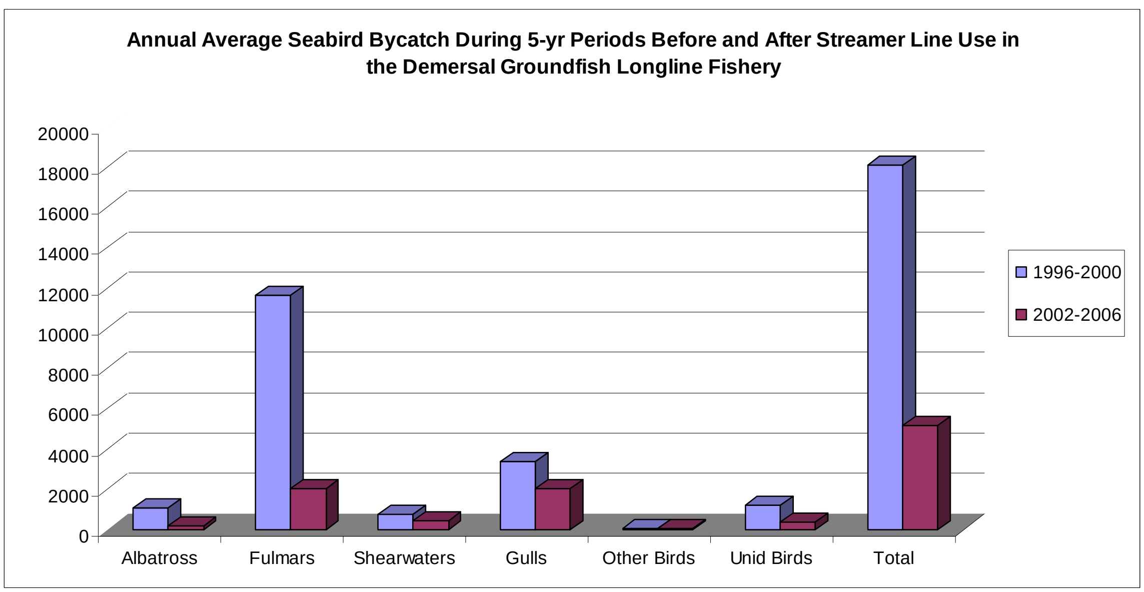

Figure 1. Annual average seabird bycatch during 5-year periods before and after streamer line use in the demersal groundfish longline fishery.

Although seabird bycatch is reduced, the AFSC strives to make full use of seabirds taken in commercial fisheries. Over the years, AFSC personnel have partnered with different groups to obtain funding support for seabird necropsies. The first such partnership involved the AFSC, the U.S. Fish and Wildlife Service, the U.S. Geologic Survey, and the University of Washington Burke Museum, with funding supplied by the National Science Foundation, to retain seabirds from high seas driftnets. More recently, Washington Sea Grant arranged for funding to necropsy birds collected under the North Pacific Groundfish Observer Program (by Observers, AFSC staff, and WSGP staff) during longline fishery integrated weight mitigation studies operations in

Alaska during July to December 2005. The Central Coast Marine Bird Health Study (Seabird Health Study) necropsied 417 seabird carcasses, summarized below. The full report is available on the AFSC website.
Of the 417 seabirds examined, Procellariids (albatrosses, fulmars, shearwaters, petrels and storm petrels) and Lariids (gulls) predominated, including Northern Fulmar (205), Glaucous-Winged Gull (103), Short-tailed Shearwater (48), Glaucous Gull (23), Slaty-Backed Gull (4), Gull species (32), Black-Legged Kittiwake (1), and Laysan Albatross (1). Overall, a total of 254 Procellariids were examined. A total of 75% of Procellariids were adults, 21% were immature, and 4% were unknown age class. By species, there were more adult (86%) than immature (9%) fulmars (n = 205) whereas there were more immature (71%) than adult (29%) shearwaters (n = 48). The single Laysan Albatross examined was an adult female. The male to female sex ratio was 3.0:1.0 in Northern Fulmars, compared with 1.3:1.0 in Short-Tailed Shearwaters. A total of 198 Northern Fulmars were examined for body condition, and 60% (n=119) were in good body condition (pectoral score = 2). Twenty-four percent (n=47) were in excellent body condition, and 16% (n=32) were thin. None of the Northern Fulmars were classified as severely emaciated, and all of the birds had subcutaneous fat (mean fat depth = 3.9 mm). In comparison, 83% of the Short-Tailed Shearwaters (n=19) were in good body condition, and 9% were classified as either in excellent body condition or thin. The Short-Tailed Shearwaters had an average of 2.5 mm of subcutaneous fat. The Laysan Albatross was in excellent body condition with 8mm of subcutaneous fat. About two-thirds of fulmars were light or double light (66%) color phase and one third were dark or double dark morphs (34%).

North Pacific Groundfish Observers have continued to collect seabird carcasses since 2005. Many of those birds are being necropsied through another partnership program with the non-profit organization Oikonos, who also coordinate with the Seabird Health Study facilities at Moss Landing Marine Lab.

Multispecies and Ecosystem Modeling
REEM personnel collaborated in the review of key concepts from graph theory and network analysis, which have not traditionally been used in fisheries applications. They applied these concepts to the food web of the Gulf of Alaska marine ecosystem to classify its structural properties, which suggest how the ecosystem as a whole may respond to heavy fishing pressure on its components. Three conceptual models of network structure: random, small world, and scale free, each have different implications for system behavior and tolerance to perturbations. Two food web network models were constructed using detailed quantitative information on the stomach contents of 57 predator (fish) species collected during trawl surveys of the Gulf of Alaska between 1981 and 2002 (Figure x2 shows one of the food webs, constructed using data from 2001). The resulting food webs displayed both small world and scale free network properties, suggesting that impacts on one species might spread to many through short interaction chains, and that while most food web connections are not critical, a small set of fished species support critical structural connections. It was concluded that ecosystem-based fishery management should therefore first focus on protecting the highly connected species in the network to avoid structural impacts of fishing on the food web.

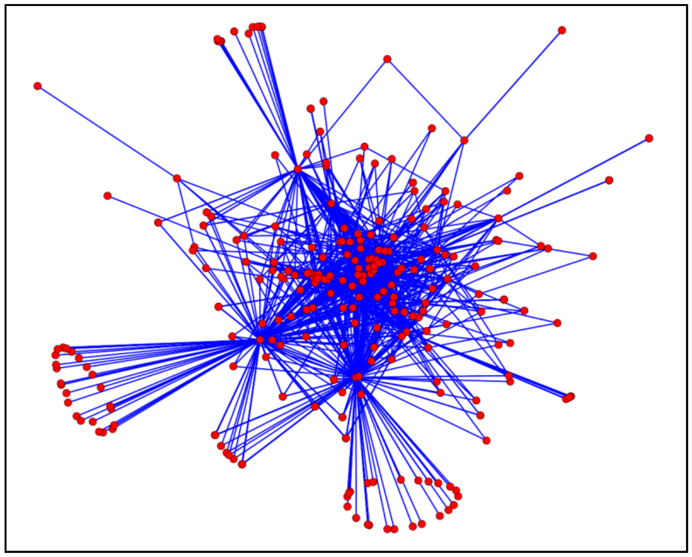

Figure 2. Network representation of the Gulf of Alaska groundfish food web in 2001.

REEM personnel also collaborated on another innovative application of a food web model. Given the large scale, complexity, and inscrutability of processes in marine ecosystems, an important question is where to invest limited resources in experimentation and observation to improve our knowledge for forecasting and management. Current ecosystem models can be used to identify both critical interactions requiring further study and potential ecosystem thresholds for fishery management. Model simulations were conducted for the Aleutian Islands ecosystem, systematically varying vital rates for each species/functional group in the food web and examining cumulative ecosystem responses which incorporated uncertainty. Results identified an interaction between two commercially important species which potentially contributes to instability in the ecosystem. Model simulations for the adjacent eastern Bering Sea and Gulf of Alaska ecosystems displayed different critical interactions, suggesting different research priorities. In another analysis, the effects of alternative fishing intensities were simulated in the Gulf of Alaska ecosystem model to determine whether thresholds existed where fishing fundamentally changed system properties. The challenge of considerable uncertainty in dynamic interaction (predator-prey functional response) parameters was overcome by generating millions of potential ecosystems with interaction parameters drawn at random from wide ranges, and retaining potential ecosystems where all species co-existed for 50 years under the different fishing regimes. A clear threshold was found between moderate and heavy exploitation rates where fishing damaged the robustness of the ecosystem and was more likely to contribute to system restructuring. Taken together, these types of simulations can help prioritize field and management research which can then be used to further improve models.

REEM personnel are actively involved with the NPRB's Bering Sea Integrated Ecosystem Research Program (BSIERP). This program is a 5-year, $51 million collaboration between the NPRB and the National Science Foundation, with more than 90 investigators examining the present and potential future of the Bering Sea ecosystem. REEM Program researchers are coordinating and developing the major modeling effort of BSIERP, studying the functional responses between groundfish predators and prey and performing associated field work. BSIERP is unique in that it aims to bring modelers and field researchers together at all stages of the project. REEM modelers presented their models to BSIERP principal investigators and researchers in order to receive feedback on the models' effectiveness at synthesizing the scientific results of the BSIERP effort.

Subsequently, substantial development was accomplished on the model, FEAST (Forage and Euphausiid Abundance in Space and Time) (Figure x3), which couples fish species, particularly forage species, to nutrients and plankton production on the grid of a Regional Oceanographic Model. The FEAST model will simulate the dynamics between plankton and fish communities on a 10-km scale grid of the Bering Sea, including dynamics for growth, migration, reproduction, and mortality. With respect to motile predators (fish and higher trophic levels), FEAST is designed around the "landscape approach" for modeling fish foraging, mortality, and growth. The landscape approach (also known as the dynamic habitat approach) treats the space of a model as a series of layers, each layer defining a different spatial (dynamic) quantification of habitat. For example, a temperature layer, a prey density layer, a prey size layer, and a mortality layer may be used, quantifying any given point for its "growth" or "predation" potential thus determining growth and survival (dynamic state variables) of the fish. The landscape approach has been successful, for example, at predicting the distance at which fish congregate around a front; in a front between warm and cold water, warm or cold adapted fish will approach the front from either side, stopping where gain from frontal concentrations of prey are cancelled out by thermal stress. This can be a powerful tool if modeling dynamic climate scenarios in which fronts shift, break down, or otherwise change over time.

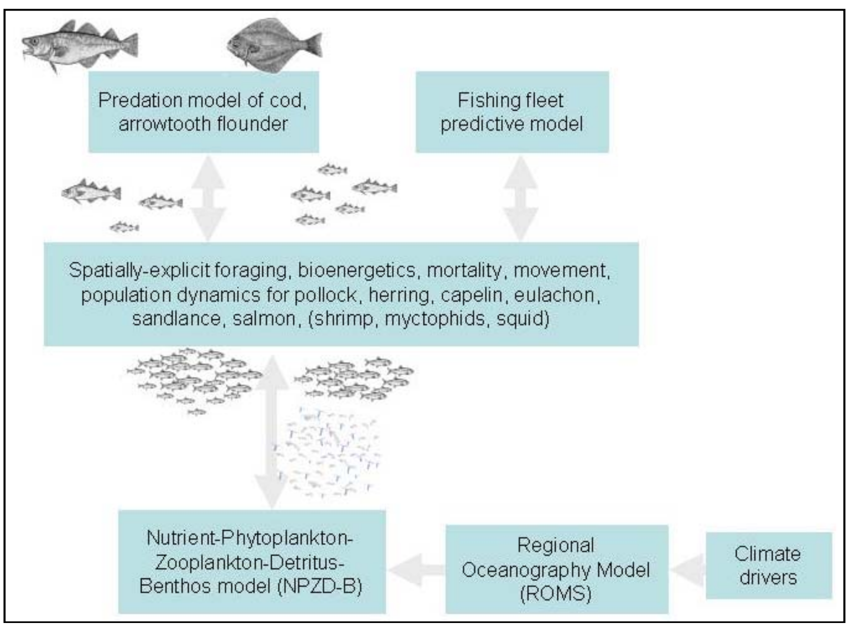

Figure 3. Diagram of the critical components of the FEAST model (Forage and Euphausiid Abundance in Space and Time)

Ecosystem Considerations

REEM personnel completed the Ecosystem Considerations report, which is a part of the Stock Assessment and Fisheries Evaluation (SAFE) submitted to the North Pacific Fisheries Management Council (NPFMC). The report was presented to the NPFMC Bering Sea/Aleutian Islands and Gulf of Alaska Plan Teams, the Scientific and Statistical Committee, and the

Advisory Panel. For this year's report, 45 indicators were updated, and four new contributions (on Arctic sea ice, groundfish condition, Gulf of Alaska lingcod bycatch, and Gulf of Alaska continuous plankton recorder data) were added. In addition, as a step towards developing Integrated Ecosystem Assessments (IEAs) for the region, an Ecosystem Assessment was updated following the Driver–Pressure–State–Impact–Response (DPSIR) model. As part of this effort, indicator trends were summarized in a graphical format, and combined indicators by species group were added (Figure x4). This represents a substantial improvement in the form and format of the Ecosystem Assessment. The information and data time series summarized in the report are available on the following website: http://access.afsc.noaa.gov/reem/ecoweb/index.cfm.

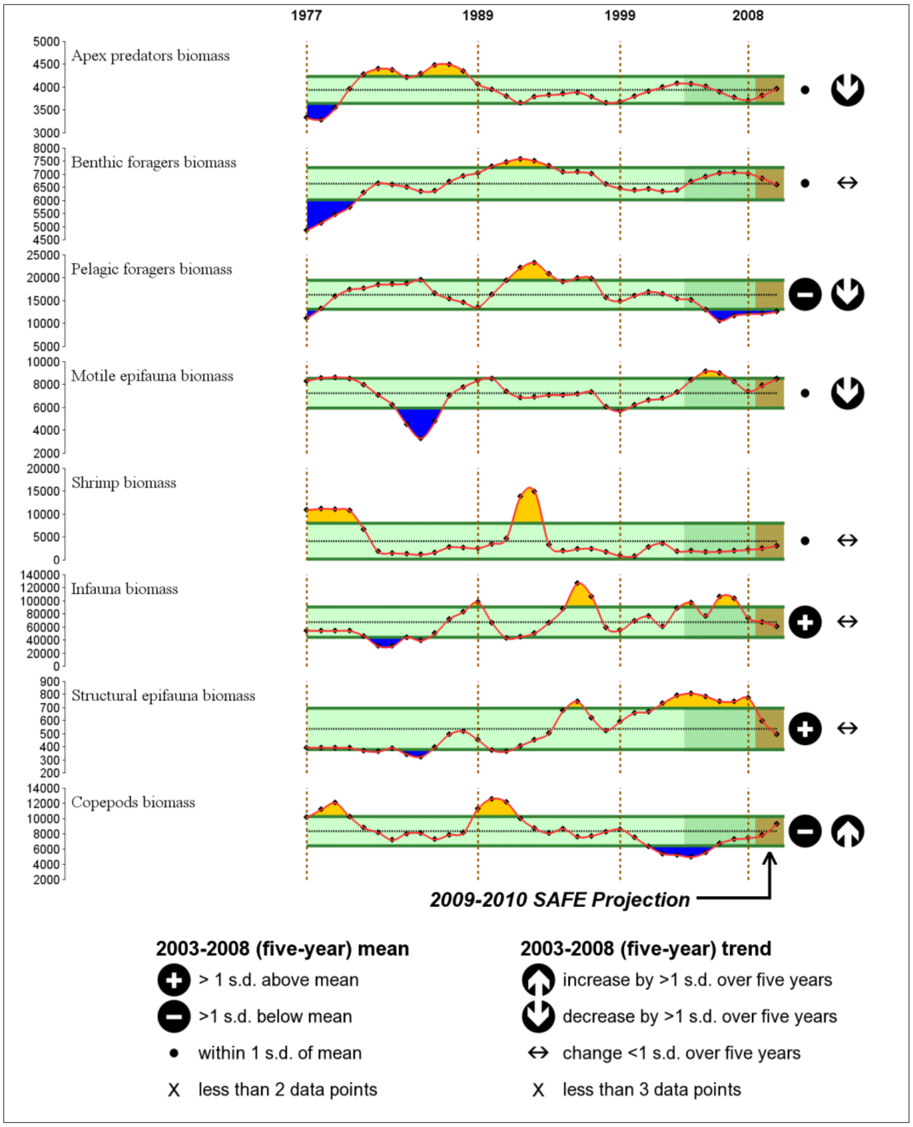

Figure 4. Time trends of biomass of major guilds (species groups) for the past 30 years in the eastern Bering Sea, from the Ecosystem Considerations chapter of the North Pacific Fisheries Management Council Stock Assessment and Fisheries Evaluation report for 2009. Green shaded area shows +/- 1 standard deviation of the time series for the measured time period.

For more information about REEM research, please contact Kerim Aydin at (206)526-4225.

2. 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 and submitted for review to the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Plan Teams of the North Pacific Fishery Management Council.

Assessment scientists provided analytic assistance on many current fisheries management issues. These included: 1) identification and prioritization of research activities intended to improve groundfish stock assessments; 2) continued refinement and review of Bering Sea crab stock assessments 3) research activities associated with the impacts of climate change 4) research activities associated with the incorporation of ecosystem variables in stock assessments 5) significant contribution and development of the analysis for the Chinook salmon bycatch Environmental Impact Statement and 6) various task members participated in numerous national and international committees and workshops on a variety of issues.

The Fishery Interaction Team (FIT), a part of the Status of Stocks and Multispecies Assessment Task, in the REFM Division, conducts studies to determine whether commercial fishing operations are capable of impacting the foraging success of Steller sea lions either through disturbance of prey schools or through direct competition for a common prey. The present research focus is on the three major groundfish prey of sea lions: walleye pollock, Pacific cod and Atka mackerel.

FIT investigates the potential effects of commercial fishing on sea lion prey in two ways. First, by conducting field studies to directly examine the impact of fishing on sea lion prey fields and to evaluate the efficacy of trawl exclusion zones. FIT research examines the hypothesis that large-scale commercial fisheries compete with sea lion populations by reducing the availability of prey in relatively localized areas. Since 2000 FIT has been conducting field studies to examine the impact of fishing on sea lion prey fields in all three major Alaska regions: the Gulf of Alaska, Bering Sea and Aleutian Islands.

The second way that FIT investigates the potential effects of commercial fishing on sea lion prey is by studying fish distribution, behavior and life history at spatial scales relevant to sea lion foraging (tens of nautical miles). This scale is much smaller than the spatial scales at which groundfish population dynamics are usually studied and at which stocks are assessed. This information is needed to construct a localized, spatially-explicit model of sea lion prey field dynamics that can be used to predict spatial and temporal shifts in the distribution and abundance of sea lion prey and potential effects of fishing on these prey fields.
FIT researchers collaborate with other AFSC scientists who are studying Steller sea lions and their prey, such as scientists in the Resource Ecology and Ecosystem Modeling program and the

National Marine Mammal Lab. For more information on the FIT program, contact Dr. Libby Logerwell or access the following web link: http://www.afsc.noaa.gov/REFM/Stocks/fit/FIT.htm

For further information on the SSMA task group, contact Dr. Anne Hollowed (206) 526-4223.

3. Management

Economics and Social Science Research Program – REFM
The Economics and Social Science Research Program of the REFM Division has been focusing on the following projects during 2008:

Sablefish:

Estimating Time-varying Bargaining Power: A Fishery Application
Harrison Fell and Alan Haynie* **For further information, contact Alan.Haynie@NOAA.gov*

Flatfish:

Amendment 80 Head and Gut Catcher/Processor Sector Economic Data Collection
Brian Garber-Yonts and Ron Felthoven* **For further information, contact Brian.Garber-Yonts@NOAA.gov or Ron.Felthoven@NOAA.gov*

Pollock:

A Method for the Design of Fixed Time-Area Closures to Reduce Salmon Bycatch
Alan Haynie* **For further information, contact Alan.Haynie@NOAA.gov*

A Tradable Salmon Bycatch Quota System for the Pollock Fishery?
Alan Haynie* **For further information, contact Alan.Haynie@NOAA.gov*

Climate Change and Changing Fisher Behavior in the Bering Sea Pollock fishery
Alan Haynie* **For further information, contact Alan.Haynie@NOAA.gov*

Evaluating the Cost and Effectiveness of Fixed and Rolling Bycatch Closures in the Bering Sea
Alan Haynie* **For further information, contact Alan.Haynie@NOAA.gov*

Modeling Spatial Location Choice with a Generalized Extreme Value Model
Alan Haynie* and David Layton **For further information, contact Alan.Haynie@NOAA.gov*

Predicting Fishing with Vessel Monitoring System (VMS) Data
Alan Haynie* and Patrick J. Sullivan **For further information, contact Alan.Haynie@NOAA.gov*

Measuring Harvesting Productivity of Pollock Catcher-Processors
Ron Felthoven* **For further information, contact Ron.Felthoven@NOAA.gov*

Alaska Fishery CGE Model Completed
Chang Seung* **For further information, contact chang.seung@noaa.gov*

Halibut:

Alaska Recreational Charter Boat Operator Research Development
Brian Garber-Yonts and Dan Lew* **For further information, contact Brian.Garber- Yonts@NOAA.gov*

The Effects of Rationalization on Processor Competition
Harrison Fell and Alan Haynie* *For further information, contact *Alan.Haynie@NOAA.gov*

Demand for Halibut Sport Fishing Trips in Alaska
Dan Lew* **For further information, contact Dan.Lew@NOAA.gov*

Economic Impacts of Alaska Saltwater Sport Fishing
Dan Lew and Chang Seung* **For further information, contact Dan.Lew@NOAA.gov*

General/Other:

Developing Socioeconomic Indicators for the Eastern Bering Sea Trawl Fishery
Chang Seung and Chang Ik Zhang* **For further information, contact Chang.Seung@NOAA.gov*

More details on these projects have been compiled in a separate report from the Economic and Social Sciences Research Program entitled: ***Research and Data Collection Project Summaries and Updates, 2008*****.**

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

1. Pacific Cod

a. Research

Diets of Juvenile Gadids in Nursery Areas – Kodiak Laboratory and FBE Newport
In 2008, researchers from the Kodiak Laboratory and the Fisheries Behavioral Ecology Program continued studies examining the habitat associations in juvenile Pacific cod in nursery areas around Kodiak Island. One aspect of these studies was to assess the diets of juvenile gadids in the nursery areas in order to quantify their degree of dietary overlap and the extent of cannibalism on younger conspecifics. Juvenile cod (age 1+ Pacific and saffron cod) were collected by hook and line and beach seining at two nursery sites around Kodiak Island, AK during the summer months in 2007 and 2008. To date, a total of 354 juvenile cod (n=260 saffron cod, 17.1-39.0 cm TL; n=94 Pacific cod, 17.4-36.0 cm TL) have been collected. Preliminary

results revealed the gadids consumed primarily benthic invertebrates and displayed a high degree of dietary overlap in 2008 (driven mainly by the importance of mysids and amphipods in the diets). Other common prey items included annelids (polychaeta spp.), crangonid shrimps, hermit crabs (Paguridae spp.), and fish (Pacific sand lance, *Ammodytes hexapterus*, Stichaeidae spp., and Cottidae spp.). Pacific cod had a higher rate of piscivory than saffron cod (2007- Pacific cod 16%; saffron cod 3%; 2008- Pacific cod (27%); saffron cod (23%)) although there was no evidence of inter-cohort cannibalism found in 2007 and 2008. A high degree of dietary overlap suggests competition for food resources may occur if food supplies become limited within the nursery areas. However, the diets of the two cod species varied noticeably outside the importance of mysids and amphipods which suggest these species are able to exploit different niches which may reduce competition. Furthermore, differences in the relative importance of secondary prey items (i.e. fish and decapods- Pacific cod *versus* isopods-saffron cod) may reflect small scale differences in habitat use by the juvenile gadids within the nursery areas. Inter-cohort cannibalism does not appear to be a factor affecting cod survival in these areas. However, the abundance of age 0+ cod can fluctuate greatly on a yearly basis within the nursery areas and it is possible that cannibalism is density dependent and is an important function when densities are high. Collections will continue in 2009 and a third year of sampling will allow for an assessment of the temporal variations in the food habits of these species.

For more information, please contact Brian Knoth, (907)481-1731.

Effects of Prey Quality During the Early Life History – RACE FBE Newport

In 2008, the FBEP with support from NPRB, conducted two experiments examining the effects of prey quality on growth and survival of larval and juvenile Pacific cod in the laboratory. The importance of prey quality on the survival of fish during their early life history has largely been ignored in fisheries, but it is anticipated to be an emerging issue in the wake of prey assemblage changes resulting from climate change and ocean acidification. Collaborations between researchers at Memorial University of Newfoundland, Oregon State University and AquaNutrition were established to produce diets of different lipid/fatty acid composition and determine how such diets are incorporated into the tissues of Pacific cod larvae/juveniles. In the first experiment, Pacific cod larvae were reared for a 5 week period on 4 diets comprised of varying ratios of essential long-chained fatty acids (PUFAs) i.e., docosohexaenoic (DHA) and eicosapentaenoic acid (EPA). Results demonstrated that Pacific cod larvae need high DHA:EPA ratios in their diet, but less so than other cold water marine gadids e.g., Atlantic cod and halibut.

In a second experiment, the FBEP explored the efficacy of using fatty acid (FA) biomarkers in linking juvenile cod to habitats and regions along the coast. Such biomarkers provide information on the direct and indirect trophic links to local habitats (e.g., eelgrass, kelp, mineral substrates, etc.), and ultimately, may provide a mechanism by which essential fish habitat contributes to the growth and survival of juvenile gadids in the nearshore. Fatty acid biomarkers for juvenile Atlantic cod have been used successfully to differentiate individuals with differences in habitat occupancy at small scales, and given Pacific cod's similar habitat preferences and nearshore residence to Atlantic cod (i.e., *Laminaria* and eelgrass areas), there is likelihood that such approaches will also work for this species. Initially in 2009, a ground-truthing experiment was conducted in which juvenile cod are exposed to two distinct FA diets over an 8-week period at 2temperatures (3 and 8ºC) in the laboratory. One diet will be rich in the short-chain polyunsaturated FAs (PUFAs) (18:2ω3+18:3ω3) representing a terrestrial signal typical of coastal marine areas with significant freshwater input. The other diet will be rich in the long-chained PUFA 22:6ω3, an essential FA typical of marine origin. Sampling from the flesh, liver and heart was conducted on a weekly basis to determine the rates at which various tissues incorporate dietary FAs. The final analysis FA profiles will also provide important data on nutritional status (essential FAs) and on bacterial loading (bacterial FAs). It is also anticipated the data from this experiment can be applied in the field to reconstruct historic and contemporaneous nursery residency from wild collected juvenile cod.

Nursery Habitat and Recruitment – RACE FBE Newport
To date, only a handful of studies have focused on habitat requirements of Pacific cod. In 2006, the Kodiak Lab and the Fisheries Behavioral Ecology Program initiated a spatially extensive coastal survey around Kodiak Island to determine preferential habitats of age 0 juvenile Pacific cod. The 2006 year class of age 0 juvenile cod was highly abundant and several key habitats were identified over the season. However, continued work in 2007 revealed an almost absence of age 0 juvenile cod in these same nursery areas, with instead, a high relative abundance of the 2006 year class i.e., age 1 cod. An analysis of the 2008 survey indicates a high relative abundance of the 2006 cohort as age-2 cod. Apart from the speculative mechanisms contributing to these temporal dynamics, these data raise several fundamental questions regarding the essential fish habitat for this species. For example, what role does nursery habitat play in regulating population dynamics in this species? Are Pacific cod nurseries limited by the availability of new recruits or do post-settlement processes in the nurseries (i.e., limited space, predator-prey interactions, food availability, etc.) ultimately limit productivity and recruitment into the adult population? The 2008 survey and continued work in 2009 will allow for the continued monitoring of adjacent cohorts of Pacific cod, a unique ability considering young age classes are either absent or underrepresented in both state and federal independent groundfish surveys. By linking coastal survey data with estimates of spawning stock biomass (e.g., fisheries dependent and independent sources), it is anticipated that through the continued surveying of nursery areas, there will be a basis from which to examine recruitment and the productive capacity of Pacific cod nursery areas as well as continue to examine the mechanisms driving such links.

Experiments on Vertical Migration – RACE FBE Newport
Laboratory experiments were conducted to simulate habitat conditions and test responses of Pacific cod to vertical gradients of light, temperature, and food distribution. Observations were made of depth, number of groups formed, and size of groups in juvenile 0+ and 1+ year cod. Fish avoided high light and cold water. Food introduction in warm isothermal water (9^{o}C) induced fish to feed and form more groups then when food was not present. In cold thermocline conditions (9 & 3^{o}C), food introduction into the lower third of the tank induced fish to swim downward but detection of food, feeding, and the formation of groups were initially inhibited by excursions into cold water. Increasing consumption of food during the hour after feeding indicated that fish adapted to cold water. Fish adapted to high light within an hour after initial exposure as indicated by higher movement in the water column. The effects of fish age were

minor and evident as interactions with environmental condition effects on the number of fish groups and size of groups. Pacific cod are able to adapt to changing ecological conditions and their behavioral flexibility in response to food, temperature, and light conditions make prediction of vertical distribution complex. Future field studies of Pacific cod diel vertical migration should include measurements of key environmental factors and consider the ability for fish to quickly adapt to changing conditions.

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

b. Stock Assessment

BERING SEA/ALEUTIANS

The present assessment is a revision of last year's assessment, incorporating an analysis of a combination of many model runs with different configurations. The assessment features ten major items of new input data. All are routine updates. Two of the new data sources stand out: the biomass of Pacific cod was estimated at 403,000 t from the 2008 EBS shelf bottom trawl survey (5% lower than the 2007 survey estimate and is the all-time low in the time series); and the population numbers for 2008 estimated by the survey was 477 million fish, down about 35% from the 2007 estimate. The addition of this new data point to the series of survey population numbers from 1979-2007 impacts the future projection of Pacific cod population numbers and biomass. Successive poor recruitment from 2001-2005 have caused the cod stock to decline, as estimated by surveys and the assessment model (it is just below $B_{40\%}$). The 2006 year class is estimated to be as strong as the 1992, 1996 and 1999 (1.6 times the 30 year average) year classes, which have sustained the stock over the past 17 years.

The assessment of the BSAI Pacific cod stock has been particularly challenging as more refinements are made to the modeling approaches and use of the data. The assessment describes the evolution of analytical approaches. Following a series of modifications from 1993 through 1997, the base assessment model remained completely unchanged from 1997 through 2001. As data refinement and analytical techniques developed, a major change took place in 2005 when the model was migrated to the Stock Synthesis 2 (SS2) program. Difficulties encountered in the 2006 assessment resulted in a thorough review of various assessment models in April 2007 during a public workshop that brought together 44 participants. Many suggestions for changes and refinements of the analytical approaches were made. Refinements continued in the 2007 and 2008 assessments based on suggestions from the Plan Teams and SSC.
The assessment authors developed eight versions of the analytical model for the November 2008 assessment. The following points distinguish these eight models.

Model A1: This is the “reference” model requested by the SSC at the October 2008 meeting. It is very similar to Model 5 from the preliminary (September 2008) assessment, the main difference being that the lower bound on the descending “width” parameter of the selectivity curves is reduced so that it is never constraining. The other differences with respect to Model 5 are: 1) the distribution of mid-year length at age 1 is set equal to the distribution around the first mode of the long-term trawl survey size data; and 2) for each gear and season, individual selectivity parameters are allowed to vary between blocks of years only if the cost of the additional parameters is outweighed by a sufficient improvement in the model's fit to the data.

Model A2: This is identical to Model A1, except that age composition data are not included. This model was requested by the SSC.

Model B1: This is similar to Model A1, except that more fisheries are assumed to exhibit asymptotic selectivity. *This is the authors' preferred model.*

Model B2: This is identical to Model B1, except that age composition data are not included.

Model C1: This is identical to Model B1, except that the natural mortality rate *M* is estimated internally.

Model D2: This is identical to Model B1, except that age composition data are not included, the maturity schedule is defined as a function of length rather than age, and *M* is estimated iteratively. This model was requested by members of the public.

Model E2: This is identical to Model B1, except that age composition data are not included, the post-1981 trawl survey selectivity schedule is constrained to be asymptotic, and *M* is estimated internally. This model was requested by members of the public.

Model F2: This differs from the other models in several respects. It is identical to Model 4 from last year's assessment and this year's preliminary assessment, except that the starting year is set at 1977. This model was requested by members of the public.

Because all of the models seem to perform reasonably well in terms of fitting the data, the authors used the following four major criteria for selection of the best model to represent the dynamics of the stock.

The model should estimate mean lengths for ages 1-3 that are close to the first three modes from the long-term average trawl survey size composition; The model should assume or estimate a reasonable value for M; The model should estimate a reasonable average for the product of trawl survey catchability and trawl survey selectivity for the 60-81 cm size range; and For models that satisfy the first three criteria above, the following "tie-breaker" criterion was used: Choose the model that implies the least drastic changes with respect to recent understanding regarding appropriate model structure and the size and productivity of the stock (i.e., do not make big changes in the model unless there is a compelling reason to do so).

Based on these criteria, Model B1 was selected by the authors to best represent the population dynamics of the BSAI Pacific cod stock.

The 2009 ABC of 176,000 t from the assessment is the same as the 2007 and 2008 ABC values of 176,000 t. This ABC pattern is not consistent with the 18% decline in the NMFS survey biomass from 2006 to 2007 and the 5% decline from 2007 to 2008, which currently is at its historic minimum however the Plan Team felt there was sufficient conservatism in holding ABC constant (rather than decreasing ABC) and waiting for next year's observations to ascertain the strength of the possibly above average 2006 year class.

According to criteria set by the SSC, this stock qualifies for management under Tier 3, where reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for the stock. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 426,000 t, 0.28 and 0.34, respectively. Pacific cod specifically qualifies for management under sub-tier "b" of Tier 3 because the projected biomass for 2009 (373,000 t) is below $B_{40\%}$. Fishing at the adjusted Tier 3b rate of 0.24 is projected to result in a 2009 catch of 182,000 t, which is the maximum permissible ABC under Amendment 56.

The recommended 2009 ABC of 176,000 is 3% below the maximum permissible value of 182,000 t. The Plan Team recommended the same ABC of 176,000 t also for 2010 until the 2006 year class shows strong enough to substantially increase spawning biomass.

The OFL for 2009 under Tier 3b is 212,000 t (F_{OFL}=0.29) and the projected OFL for 2010 is 235,000 t.

The stock is not overfished nor approaching an overfishing condition.

GULF OF ALASKA

Although no new survey information is available for Gulf of Alaska species, extensive work on the GOA Pacific cod model has occurred in the past year. Changes to the input data include updated catch data, recompilation of the pre-1990 fishery size composition data, updating the ageing error matrix, recompilation of the weight-at-length time series, updating the 2007 seasonal catch-per-unit-effort data from the longline, pot, and trawl fisheries, and splitting each trawl survey abundance estimate and size composition into fish smaller than 27 cm (referred to age the "sub-27" survey) and fish 27 cm and larger (referred to as the "27-plus" survey). New data to the model included age composition and length-at-age data from the 1987, 1990, and 1993 GOA shelf bottom trawl surveys, and preliminary catch rates for the 2008 longline and pot fisheries.

Three models were presented in the September 2008 Plan Team meeting which addressed many of the previous comments of the Plan Teams and the SSC. In particular, many aspects of the model were changed, including splitting the survey time series into large and small fish, weighting the age and length composition data, modeling the weight-at-length data, and estimation of catchability and selectivity. One of the three models is an "exploratory" model which made use of some new features of the Stock Synthesis modeling software.

Of the other two models, model A is the "reference" model requested by the SSC during its October 2008 meeting and is similar to the exploratory model from September 2008 (appended to the chapter) with the following two changes: 1) estimation of the descending slope of dome-shaped selectivity curves is unconstrained and 2) the distribution of length at age 1 during the summer is estimated externally rather than internally. Model B is the author's preferred model, and differs from Model A in that 1) a stepwise model selection process was used for incorporating time-varying selectivity; 2) a constant catchability was used for 27-plus survey; and 3) the input sample sizes for the age composition were decreased substantially.

The current GOA Pacific cod models are complex, with fish caught in multiple seasons with multiple fisheries and gear types, and estimation of complex dome-shaped selectivity curves that vary between years, seasons and gear types. A number of issues were noted by the Plan Team and authors regarding fit to survey data and estimation of selectivity. The fit of the preferred model to the 27-plus survey abundance was problematic in that each of the model estimates was an underestimate of the observed survey abundance estimate. The fit to this time series improved as the age and length compositions were down-weighted, which indicates some inconsistency in the input data which should be explored in more detail. Some of the fishery and survey selectivity curves show sharp reductions at older ages or larger sizes which seem implausible.

Model B results produced an estimated 2009 spawning biomass of 88,000 t, or 34% of unfished spawning biomass. The $B_{40\%}$ estimate was 102,200 t. Spawning biomass is projected have a large increase in the near future because of the 2006 year class which is estimated to be the highest on record. The extent of the rate of increase depends on the magnitude of this year class which was extremely uncertain being based solely on length frequencies collected in the 2007 trawl survey. This year-class has increased the estimate of the recruitment variability during the period 1978-2007 relative to the previous assessments.

Pacific cod are not overfished nor are they approaching an overfished condition.

For the 2009 fishing season, the results from the model are used as an improvement over Tier 5 and therefore Tier 3 harvest calculations are used. The model estimate of 2009 female spawning biomass is below $B_{40\%}$, therefore Gulf of Alaska Pacific cod are in Tier 3b. The projected 2009 age-0+ biomass estimate is 520,000 t. The probability of the stock being below $B_{20\%}$ was estimated to be less than 1% in 2009 and subsequent years. Therefore, the ABC for 2009 is 55,300 t (F_{ABC} =0.44, the maximum permissible under Tier 3b). The 2009 OFL under Tier 3b is 66,600 t (F_{OFL}= 0.54).

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

3. Shelf Rockfish

a. Research

GULF OF ALASKA

Maternal Age Effects on Larval Viability - Southeast Alaska Rockfish
Rockfish larvae contain an oil globule during embryonic development and at parturition that contains energy for growth and metabolic needs during development and the critical stage when larvae are first learning to feed. The size of this oil globule has been shown to be related to growth and survival of black rockfish larvae (*Sebastes melanops*) based on samples collected off Oregon. The oil globule size, and therefore the survival rate, was also related to the age of the

mother in black rockfish (Berkeley et al. 2004). If older rockfish mothers have more fit offspring than younger mothers, stock assessments should be modified to reflect this difference in recruitment.

Studies of larval quality of rockfish have only recently been initiated in Alaska. The environment in Alaska differs from the West Coast, and the age structure of many rockfish populations in Alaska still contain older fish. Additionally, studies in progress focus on relatively shallow-water species with different life histories than many of the deep-water species in Alaska. Our objectives were to collect quillback rockfish (*Sebastes maliger*), a demersal inshore rockfish, in Southeast Alaska and measure their oil globules from photographs of developing embryos. Because quillback reside in relatively deep water, they are an ideal prototype for honing methodologies for other species of rockfish that live in deep, offshore waters.

In 2006 and 2008, we collected 96 pregnant quillback rockfish and measured oil globules from a sub-sample of larvae, and otoliths from the mothers were aged by the AFSC REFM Division age and growth lab. The 2006 samples were analyzed for their protein, lipid, and water content, and their fatty acid profiles, and a paper was published describing the results. The main findings were that lipid was lost at a greater rate than protein through development, and that body lipid levels were highly correlated with oil globule size. Therefore, lipid is a good indicator of energetic status. Additionally, fatty acid profiles between early and late developing larvae differed, indicating that fatty acids were depleted at different rates. Some of these fatty acids may be useful for assessing the condition of larvae.

In 2008, live, pregnant females were transported to the wet lab at ABL to be cultured until parturition. Photographs of developing embryos were taken throughout embryogenesis and, if parturition was successful, starvation trials were conducted to test the ability of larvae to persist only on their oil globules. 2008 was the final year for data collection on this project, and we are beginning to analyze the relationship that maternal age has on larval quality.

Secondarily, we collected embryos and maternal muscle tissue in 2008 to examine multiple paternity in quillback rockfish. Multiple paternity may be a way of maximizing diversity to attempt a better chance of at least a portion of a female's offspring surviving in a variety of environmental conditions. Some laboratory studies have found multiple paternity in a brood of rockfish larvae from one female, indicating that females can spawn and store sperm from multiple males. We have the opportunity to examine multiple paternity rates in the field in quillback rockfish. Because the females will be aged as part of the maternal age effects projects, we will also be able to correlate female age with multiple paternity practices. Currently the samples are being run in the ABL genetics lab by Andrew Gray.

For more information, contact Cara Rodgveller at (907) 789-6052.

b. Stock Assessment

GULF OF ALASKA

Pelagic shelf rockfish – ABL

The pelagic shelf rockfish assemblage consists of four species (dusky, dark, yellowtail, and widow rockfish) that inhabit waters on the continental shelf in the Gulf of Alaska (GOA). Dusky rockfish (*Sebastes variabilis*) 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. Dark rockfish (*S. ciliatus*) share an inshore reef or kelp environment with black rockfish (*S. melanops*), and the two species are often caught together. In 1998, black rockfish in Alaska were placed under state jurisdiction.

In March 2007, the North Pacific Fishery Management Council took final action to remove dark rockfish from both the GOA FMP (PSR Complex) and BSAI FMP (other rockfish complex). Removing the species from the Federal FMP serves to turn full management authority of the stock over to the State of Alaska in both regions. At this time, the rules to implement these FMP amendments have not yet been finalized. Therefore, it would not be until at least the 2010 fishing season that dark rockfish would be removed from Federal management (including the associated contribution to OFLs and ABCs under the respective complexes in both regions) and full management authority would be turned over to the State.

Rockfish in the GOA have been moved to a biennial stock assessment schedule to coincide with data from the AFSC biennial trawl surveys in this region. In 2008, there was no new trawl survey so an updated projection is all that is required. For dark, widow, and yellowtail rockfish, the 2007 stock assessment estimates are rolled over for the 2009 fishery, resulting in a recommended ABC of 508 t. For dusky rockfish, new information for this year’s projection model was updated 2007 catch at 3,318 t and the best estimate of the 2008 catch at 3,527 t. Catch estimates used in the 2007 model were 3,245 t for 2007 and 4,719 t for 2008. This year’s projection model for dusky rockfish results in a recommended ABC of 4,723 t which is similar to last year’s dusky ABC of 4,719 t.

For the pelagic shelf rockfish complex, ABC and OFL for dark, widow, and yellowtail rockfish are combined with the ABC and OFL for dusky rockfish. For the 2009 fishery, we recommend the maximum allowable ABC for the pelagic shelf rockfish complex of 5,231 t. This ABC is similar to last year’s ABC of 5,227 t. The stock is not overfished, and dusky rockfish is not approaching overfishing status.

For more information, contact Chris Lunsford at (907) 789-6008 or Kalei Shotwell at (907) 789-6056.

4. Slope Rockfish

a. Research

BERING SEA, ALEUTIAN ISLANDS, AND GULF OF ALASKA

GULF OF ALASKA

Live Capture of Young-of-the-Year Slope Rockfish

As young-of-the-year, slope rockfish can be found in the upper water column over abyssal depths. Eventually, they adapt to a demersal life and are associated with the benthos. The relationship between juvenile slope rockfish and benthic habitat is poorly understood due to the depths at which the fish reside, which is usually greater than 150-200 m. In 2008, scientists from Auke Bay Laboratories Marine Ecology and Stock Assessment (MESA) Program took part in research activities aimed at capturing live young-of-the-year slope rockfish. The ultimate objective of the project is to identify habitat utilization of juvenile slope rockfish amongst various benthic habitat types such as sponge and coral.

In August, 27 surface trawls were performed onboard the Alaska Department of Fish and Game's (ADF&G) vessel *Medeia*. Trawling took place up to 60 nautical miles offshore of Southeast Alaska between Icy Point and Cape Ommaney. The trawl was equipped with an aluminum aquarium codend (livebox) that directed fish and invertebrates into a calm water-filled holding chamber. Once on deck, live specimens were transferred from the aquarium codend to holding tanks with running seawater. At the conclusion of the cruise, live rockfish were transferred to the Auke Bay Laboratories' Ted Stevens Marine Research Institute and placed in laboratory aquariums. Of the 1,478 rockfish captured, about 90% survived the trawling process including fish as small as 14 mm.

An estimated five or six different species of rockfish were captured in 2008, although genetic analyses will confirm species identifications. In a similar cruise in 2007, several species of rockfish were collected including Pacific ocean perch (*Sebastes alutus*), redstripe rockfish (*S. proriger*), rougheye rockfish (*S. aleutianus*), redbanded rockfish (*S. babcocki*), and rosethorn rockfish (*S. helvomaculatus*). The aquarium codend caught other live species as well, including juvenile and adult salmon (*Oncorhynchus* spp.), Pacific saury (*Cololabis saira*), larval rex sole(*Glyptocephalus zachirus*) and Dover sole (*Microstomus pacificus*), and Pacific herring (*Clupea pallasii*). Many unidentified small squid were also captured live. The greatest biomass in the catch was attributed to jellyfish, primarily *Aequorea* sp.

Once acclimated to conditions in the behavior lab, the rockfish were observed in four distinct habitat types (coral, sponge, cobble, and gravel) under both daytime and nighttime conditions. Habitat-mediated predation rates were also determined within the four habitats using great sculpin (*Myoxocephalus polyacanthocephalus*) as predators. This study builds on previous work that focused on quillback rockfish (*S. maliger*), a demersal shelf rockfish. These assessments will be helpful in determining the relative productivity of various habitats and will aid in establishing priorities for their protection.

For more information, contact Pat Malecha at (907) 789-6000.

Catch Efficiency of Longlines for Shortraker and Rougheye Rockfish in Alaska

Demersal rockfish of the family *Sebastes* can be difficult to assess with bottom trawl gear because they may inhabit untrawlable rocky habitats. In contrast, longline gear can often be successfully fished in these areas; however, many factors can affect longline catch rates besides fish density. In field studies conducted in 1994 and 1997 at 19 sites off Southeast Alaska, comparative data were collected on longline catch rates of shortraker (*Sebastes borealis*) and rougheye rockfish (*Sebastes aleutianus*) and on fish densities calculated from observations from a manned submersible. The purpose of these studies was to estimate the catchability coefficient of these two species on longline gear. On separate occasions, rockfish behavior in the presence of longline gear was observed from the submersible. Understanding the behavior of these rockfish in the presence of longline gear will guide the application of their catch rates in stock assessments. Although the data were collected more than 10 years ago, analysis of these data was just initiated this year, and a manuscript is being prepared.

Densities of shortraker rockfish based on observations from the submersible varied from 0 to 6,813 fish per square kilometer (mean of all sites = 2,709, S.D. = 3,095, n = 19). Densities of rougheye rockfish varied from 0 to 11,102 fish per square km (mean of all sites = 5,170, S.D. among sites = 5,416, n = 19). For shortraker rockfish, the linear regression of density and catch rate was not significant (*F*-ratio = 0.562, $r = 0.423$, *p*-value = 0.464). Rougheye rockfish catch rate was also not related to density at an α of 0.05, but was at an α of 0.1 (*F*-ratio = 3.085, $r = 0.626$, *p*-value = 0.097). The non-significance could be due to sample sizes, clumped distributions, or rockfish behavior on longline gear.

On dives where rockfish were observed during a longline set, the number of free-swimming fish increased throughout a set at a quicker rate than fish were caught. Shortraker and rougheye rockfish were attracted to the longline but many were not being caught even when baited hooks were available. We may have detected this trend because we did not observe the longline for a long enough period, or because rockfish are out-competed by other bait predators. Despite not knowing the cause of the reluctance of shortraker and rougheye rockfish to bite a baited hook, this behavior may affect the relationship between longline CPUE and density. We continue to analyze these data and interpret the appropriateness of longline gear as an index of abundance for shortraker and rougheye rockfish.

For more information, contact Cara Rodgveller at (907) 789-6052.

Rockfish Reproductive Study

RACE groundfish scientists initiated a multi-species rockfish reproductive study in the Gulf of Alaska with the objective of providing more accurate life history parameters to be utilized in stock assessment models. There is a need for more detailed assessment of the reproductive biology of most commercially important rockfish species including: Pacific ocean perch, northern rockfish, the rougheye rockfish complex (rougheye and blackspotted rockfish), shortraker rockfish and other members of the slope complex. Scientists from the Kodiak Laboratory have been working with NMFS North Pacific groundfish observers stationed at the fish processors in Kodiak to obtain rockfish samples. This collection request began in February 2009 and will continue throughout the remainder of the year but it is anticipated that most samples will be obtained during the Rockfish Pilot Program in the months of May through November. In addition, sampling requests have been submitted to the Alaska Department of Fish and Game large and small mesh surveys occurring in September and October, MACE acoustic surveys occurring in February and March, and the RACE Gulf of Alaska survey occurring during the summer months of 2009. Additional funds have been obtained from the National Cooperative Research Program to fund a charter within the winter months. This will enable scientists to obtain rockfish samples during the period of the year when no directed fisheries or survey work are occurring. It is anticipated that this research will not only enable scientists to derive reproductive parameter estimates needed for stock assessment but to examine these parameters over a number years to assess variability and causes of variability in these parameters.

For further information, contact Dr. Christina Conrath at (907)481-1732.

Research on Untrawlable Portions of Bottom Trawl Survey Areas Conducted in Gulf of Alaska

Biennial bottom trawl surveys conducted in the Gulf of Alaska (GOA) and Aleutians Islands (AI) by the National Marine Fisheries Service (NMFS) are a primary method of estimating and monitoring commercial groundfish abundance. These surveys follow a stratified random sampling design, however, trawling is not possible in areas that are too rough, hard or steep. Thus a persistent problem when using bottom trawl surveys accurately estimating groundfish biomass is the unknown (but presumed large) amount of the continental shelf that is not fishable with our standard survey bottom trawl gear.

In July we completed our second cruise using acoustics and video-groundtruthing to develop methods for classifying trawlable and untrawlable grounds in the GOA and AI trawl survey areas. All operations were conducted aboard the NOAA ship *Miller Freeman*. Acoustic data were collected continuously along a series of transects with a Simrad ER60 echo integration system incorporating four centerboard-mounted transducers (18, 38, 120, and 200 kHz). A towed camera and winch system with artificial lighting was used for video validation of acoustic data.

Only about half of the planned work was completed as the ship suffered mechanical problems and was forced to return to Dutch Harbor well before the completion of the cruise. Nevertheless, about 1,000 km of acoustic transect data (about 14 GB) were collected, along with over 10 hours of seafloor video and 5 CTD casts. Vessel motion data, which is critical for correcting the acoustic returns, were successfully collected throughout the cruise. Seafloor substrates types ranged from soft mud to gravel to boulders, providing a good test data set for distinguishing different acoustic signatures. We were able to locate limited areas of sponge and a skate nursery on a GOA Essential Fish Habitat closure area that is proposed as a potential Habitat Area of Particular Concern site. A new Atka mackerel (*Pleurogrammus monopterygius*) nursery area was also discovered.

We thank John Harms of the Northwest Fisheries Science Center and Matt Barnhart and Jim Benante of the Pacific States Marine Fisheries Commission for the use of their camera system and for so graciously sharing their expertise with the system with us. Scott McEntire (AFSC) provided technical expertise and equipment in preparation for this cruise. The cooperation and efficiency of the officers and crew of the *Miller Freeman* allowed for a successful cruise despite the shortened time frame.

For more information, please contact Michael Martin at (206) 526-4175 or Mark Zimmermann at (206)526-4119.

b. Stock Assessment

BERING SEA AND ALEUTIAN ISLANDS

Pacific Ocean Perch (POP)

Pacific Ocean Perch assessments are conducted on a two year cycle to coincide with the Aleutian Islands survey cycles. Since the survey was not conducted in 2008, a full stock assessment was not performed. For this year's assessment, changes in input included catch through August 30, 2008, the 2006 AI survey age composition, 2007 and 2008 AI fishery age compositions, and updates to historical Aleutian Islands survey data. There were no changes in the assessment methodology.

The estimated spawning biomass is projected to decline slightly from 137,000 t in 2008 to 133,000 t in 2009. Note that this represents an overall decline in the magnitude of the entire time trend of biomass from the 2006 assessment due to new estimates; for example the 2006 spawning biomass was assessed at 155,000 t by the 2006 assessment while the 2006 spawning biomass is assessed at 140,000 by the current assessment, so the magnitude of the overall spawning biomass estimate has dropped by over 10%. This change is primarily related to an increase in estimated catchability.

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 123,000 t, 0.057, and 0.068 respectively. There are reliable estimates of the 2009 spawning biomass (B), $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ and $B > B_{40\%}$ (133,000 t > 123,000 t). Therefore the POP reference fishing mortality is defined in Tier 3a. For this tier, F_{ABC} is constrained to be $\leq F_{40\%}$, and F_{OFL} is constrained to be equal to $F_{35\%}$. The ABC associated with the $F_{40\%}$ level of 0.057 is 18,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition. For 2009, the recommended ABC is 18,800 t, and the OFL is 22,300 t.

The ABCs were set regionally based on the proportions in combined survey biomass as follows: BS = 3,820 t, Eastern Aleutians (Area 541) = 4,200 t, Central Aleutians (Area 542) = 4,260 t, Western Aleutians (Area 543) = 6,520 t. The OFL fishing mortality rate is computed under Tier 3a and results in an OFL of 22,300 t. The OFL is not apportioned by area.

Northern rockfish

Northern rockfish assessments are conducted on a two year cycle to coincide with the Aleutian Islands survey cycles. Because the Aleutian Islands have not been surveyed since 2006, the catch data were again updated and the projection model was re-run using results from the 2006 assessment model as the starting point. The only change to the model was a decrease in the coefficient of variation for the prior distribution on natural mortality which helped stabilize the model. This resulted in a lower estimate of natural mortality and a lower estimate of $F_{40\%}$. New data included 2008 catch data, 2006 AI survey age composition, 2006 and 2007 fishery length compositions, and updated historical AI survey biomass estimates.

Projection results indicate that age 3+ biomass has increased steadily since 2002. Spawning biomass is projected to be 68,200 t in 2009, well above the $B_{40\%}$ estimate of 55,300 t.

The SSC has determined that this stock qualifies for management under Tier 3 due to the availability of reliable estimates for $B_{40\%}$ (55,300 t), $F_{40\%}$ (0.043), and $F_{35\%}$ (0.051). Because the female spawning biomass is greater than $B_{40\%}$, sub-tier "a" is applicable, with $F_{ABC} = F_{40\%}$ and $F_{OFL} = F_{35\%}$. Under Tier 3a, the maximum permissible ABC is 7,160 t, which is the recommendation for the 2009 ABC. The lower estimated natural mortality is largely responsible for this decrease from an ABC of 8,180 t in 2008. Under Tier 3a, the 2009 OFL is 8,540 t for the Bering Sea/Aleutian Islands combined. As the TAC has routinely been lower than the ABC, the TAC of the previous year was assumed as the 2009 catch, in order to make projections to 2010. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Shortraker/rougheye rockfish

Shortraker rockfish has been separated from the blackspotted and rougheye rockfish complex this year. In previous years, the shortraker and rougheye rockfish were assessed with a two-species surplus production model that accounted for potential covariance in catch estimates. This assessment now applies a single-species surplus production model to BSAI shortraker rockfish. Previous to this year, the last full assessment for shortraker rockfish was presented to the Plan Team in 2006, and an updated assessment was presented in 2007. New data included new catch estimates for 2007 and 2008, and updated survey biomass estimates for the Aleutian Islands. There was no Aleutian Islands survey in 2008.

The SSC has previously determined that reliable estimates only of biomass and natural mortality exist for shortraker rockfish, qualifying the species for management under Tier 5. The Tier 5 biomass estimate is based on the surplus production model. The Plan Team recommends setting F_{ABC} at the maximum permissible level under Tier 5, which is 75% of M. The accepted value of M is 0.030 for shortraker rockfish, resulting in an F_{ABC} value of 0.023.

The biomass estimate for 2009 is 17,200 t for shortraker rockfish, leading to a BSAI OFL of 516 t and an ABC of 387 t. 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.

The details of the full assessment conducted in 2006 are as follows: The 2006 Aleutian Islands survey biomass estimates for shortraker was 12,961 t. This estimate is at about the same magnitude of other surveys conducted in the Aleutian Islands since 1991. The stock assessment model indicates that shortraker rockfish are estimated to have been fairly stable, declining 13% from the 1980 abundance level.

Other Rockfish Complex

The BSAI "Other Rockfish" are also managed on a two year cycle to coincide with years when an Aleutian Islands survey is conducted. The BSAI "other rockfish" assessment considers the eight 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 2008 Eastern Bering Sea Slope survey data are included in this year's assessment. Catches in 2007 have been revised and the 2008 catch through 10/08/08 has been included composition data for shortspine thornyheads from the 2005-2007 EBS fishery and the 2008 EBS slope survey. Separate estimates of natural mortality (M) and biomass for shortspine thornyheads (SST; M=0.03), the most common species in the other rockfish complex, and the remaining species (M=0.09 based on dusky rockfish) in the complex were used.

Trends in spawning biomass are unknown. Stock biomass, as measured by trawl surveys of the EBS slope and in the Aleutian Islands, has increased since 1997. F_{ABC} is set at the maximum allowable under Tier 5 (F_{ABC} = 0.75×M). Multiplying these rates by the best estimates of shortspine thornyhead and other "other rockfish" biomass yields 2009 ABCs of 481 t in the EBS and 585 t in the AI. Plan Team recommends that OFL be set for the entire BSAI area, which under Tier 5 is calculated by multiplying the best estimates of total biomass for the area by the separate Ms and adding the results, which yields an OFL of 1,420 t for 2009 and 2010.

For 2009 dark rockfish is expected to be removed from the other rockfish complex by regulatory change with Amendment 77. Excluding dark rockfish the 2009 and 2010 ABC in the EBS is 481 t, and in the AI is 555 t. The 2009 and 2010 OFL in the BSAI = 1,380 t. As a Tier 5 complex, it is not possible to determine whether "other rockfish" are overfished or approaching an overfished condition.

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

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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 AFSC trawl survey that occurs in this region. In even years (such as 2008's assessment for the 2009 fishery) when there is only new catch information, we run only the projection model with updated catch data for single-species, age-structured assessments. In odd years (like 2007), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. New information for this year's projection is updated 2007 catch at 12,954 t and the best estimate of the 2008 catch at 12,258 t. Catch estimates used in last year's model were 12,410 t and 13,500 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 15,111 t from the updated projection. This ABC is very similar to last year's ABC of 14,999 t. Female spawning biomass remains above $B_{40\%}$, with projected biomass stable.

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

Northern Rockfish

Northern rockfish are the second most abundant slope rockfish in the Gulf of Alaska. Since 2005, Gulf of Alaska rockfish have been moved to a biennial stock assessment schedule to coincide with the biennial AFSC trawl survey that occurs in this region. In even years (such as 2008's assessment for the 2009 fishery) when there is only new catch information, we run only the projection model with updated catch data for single-species, age-structured assessments. In odd years (like 2007), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. New information for this year's projection is updated 2007 catch at 4,187 t and the best estimate of the 2008 catch at 3,904 t. Catch estimates used in last year's model were 3,866 t and 4,550 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 4,363 t from the updated projection. This ABC is similar to that projected in last year's SAFE for 2009 (4,350 t). The stock is not overfished, nor is it approaching overfishing status.

For more information, contact Jon Heifetz at (907) 789-6054.

Rougheye and Blackspotted Rockfish

A separable age-structured model is the primary assessment tool for Gulf of Alaska rougheye and blackspotted rockfish. This consists of an assessment model, which uses survey and fishery data to generate a historical time series of population estimates, and a projection model which uses results from the assessment model to predict future population estimates and recommended harvest levels. For Gulf of Alaska rockfish in alternate (even) years we present an executive summary to recommend harvest levels for the next (odd) year. For this off-cycle year, we only updated the 2007 projection model estimates with revised catch data for 2007 and a new catch estimate for 2008.

Orr and Hawkins (2008) formally verified the presence of two species, rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*S. melanostictus*), in what was once considered a single variable species with light and dark color morphs. Hereafter we refer to these two species together as the rougheye rockfish complex. Preliminary analysis of results from a 2005 and 2006 two-day experiment on the sablefish longline survey near Yakutat suggests a high proportion of misidentification for blackspotted rockfish. When compared to positively-identified genetic samples, at-sea scientists in the experiment only correctly identified blackspotted rockfish 47% of the time. Results from the expert scientist identification on photos of the same samples were improved but only to 63% accuracy. However, identification of rougheye rockfish was nearly 100% accurate in both cases. Upon reevaluation of photos, there were several other features that are important for correctly identifying blackspotted rockfish (J. Orr, personal communication). A new at-sea field identification pamphlet will be prepared and tested with genetic samples in the 2009 NMFS groundfish trawl survey to determine whether rapid and accurate identification of the two species can occur.

When observers and survey biologists can reliably identify both species, we can begin to develop a rationale for mixed species assessments and the potential implications for overfishing a weaker stock. We are also beginning to examine whether differences in life history characteristics (e.g., age and growth) exist for the two species. When combined with accurate species-specific catch and survey data, such information will help determine whether one species is a weaker stock and has a potential for overfishing.

New information for this year's projection is updated 2007 catch at 425 t and the best estimate of the 2008 catch at 370 t. Catch estimates used in last year's model were 397 t and 517 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 1,284 t from the updated projection. This ABC is very similar to last year's ABC of 1,286 t. The stock is not overfished, nor is it approaching overfishing status. Female spawning biomass is well above $B_{40\%}$, with projected biomass stable.

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

Shortraker and Other Slope Rockfish

Shortraker rockfish and "other slope rockfish" are distinct management categories in the Gulf of Alaska (GOA), but their assessments are presented in a combined report because both assessments are based on biomass estimates from trawl surveys, instead of modeling. "Other slope rockfish" are comprised primarily of sharpchin, harlequin, silvergray, and redstripe rockfish, plus a number of minor species. Rockfish in the GOA have been moved to a biennial stock assessment schedule to coincide with data from the AFSC biennial trawl surveys in the GOA. In 2008, no trawl survey was conducted in the GOA, and for this off-cycle year there is no new survey information for shortraker and other slope rockfish; therefore, the 2008 ABC values were rolled over and remain unchanged for 2009. As in previous assessments since 1994, an average of the Gulf-wide biomass from the three most recent trawl surveys (presently the 2003, 2005, and 2007 surveys) was used to determine current exploitable biomass. This results in an exploitable biomass of 39,905 mt for shortraker rockfish and 90,283 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 2008 and 2009 of 898 mt for shortraker rockfish and 4,297 mt for "other slope rockfish". Compared with ABCs in 2006 and 2007, these are both slight increases. Gulfwide catch of shortraker rockfish was 650 mt in 2007, and estimated catch in 2008 was 562 mt. Gulfwide catch of "other slope rockfish" in 2007 was 690 mt, and estimated catch in 2008 was 793 mt.

Shortraker rockfish have long been considered one of the most difficult rockfish species to age. In 2005, the AFSC REFM Division's Age and Growth Task developed a new, experimental technique for ageing otoliths of this species. In early 2007, this technique was used for the first time for "production ageing" of a sample of shortraker rockfish from the 2005 GOA trawl survey. The maximum age was 116 years, and the estimated mean population age in the GOA was quite old, 44 years. In 2008, a validation study of the shortraker ageing method was conducted based on carbon 14 levels in the otoliths from nuclear bomb testing in the 1960s. Results were unsuccessful, however, because carbon 14 could not found in sufficient quantity in the otoliths. Thus, alternative validation techniques will be necessary to verify the ageing methodology.

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

10. Thornyheads

b. Stock Assessment

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Thornyheads have been moved to a biennial stock assessment schedule to coincide with the timing of survey data. An executive summary representing the off-cycle assessment uses last year's key assessment parameters and projections for 2009 and 2010. New information includes updated 2007 and 2008 catches by area, information from the 2008 longline survey, and relative population number and weight for GOA thornyheads from the longline 2006-2008 surveys. New 2008 longline survey information indicates a large increase in the relative population numbers and weight of thornyheads caught in the survey. In contrast to the high numbers of thornyheads, the 2008 longline survey found low numbers of sablefish.

Gulfwide thornyhead biomass declined 10% in the 2007 GOA trawl survey compared with the 2005 trawl survey. However, most of this decrease was observed in the western GOA. The 2007 trawl survey biomass declined 45% and 11% in the Western and Central Gulf areas, while the Eastern Gulf biomass increased 15%.

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. Thornyhead rockfish are in Tier 5. No new information is incorporated into the projection, and last year's stock assessment recommendations are rolled over for 2009 and 2010. The 2009 ABC recommendation is 1,910 t and the OFL is 2,540 t.

For further information contact Sandra Lowe at (206) 526-4230.

6. Sablefish

a. Research

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2008 Sablefish Longline Survey
The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2008. The survey is a joint effort involving the AFSC's Auke Bay Laboratories and Resource Assessment and Conservation Engineering (RACE) Division. It replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from 1978 to 1994 and also samples gullies not sampled during the cooperative longline survey. In 2008, the thirtieth annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Aleutian

Islands was conducted. One hundred-forty-eight longline hauls (sets) were completed during 4 June–1 September 2008 by the chartered fishing vessel *Alaskan Leader*. 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*), shortspine thornyhead (*Sebastolobus alascanus*), arrowtooth flounder (*Atheresthes stomias*), and Pacific cod (*Gadus macrocephalus*). A total of 74,257 sablefish were caught during the survey. Sablefish, shortspine thornyhead, Greenland turbot (*Reinhardtius hippoglossoides*), spiny dogfish shark (*Squalus acanthias*), and lingcod (*Ophiodon elongates*) were tagged and released during the survey. To date, 221,167 sablefish have been tagged during the survey time series with 17,261 recoveries. Length-weight data and otoliths were collected from 2,003 sablefish. Killer whales *(Orcinus orca)* took fish from the longline at three stations in the Aleutian Islands region and two stations in the western Gulf of Alaska. Sperm whales *(Physeter macrocephalus)* were often present during haul back and were observed depredating on the longline at 18 stations in the eastern Gulf and 3 stations in the central Gulf of Alaska. This is the highest incidence of sperm whale interactions ever encountered during the survey. Occurrence of depredation in the eastern Gulf has ranged from 10% of sampling days that sperm whales were present in 2001 to 90% in 2008.

Several special projects were conducted during the 2008 longline survey. Spiny dogfish and lingcod were tagged with archival temperature/depth tags in the West Yakutat and central Gulf of Alaska regions. Photographs of sperm whales observed during the survey were taken for contribution to the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) sperm whale catalog. Yellow Irish lords were sampled for maturity information in the Aleutian Islands to help support sculpin life history studies. Finally, a 2-day gear experiment was conducted near Yakutat to compare the catching efficiency of standard, hand-baited survey gear to auto-baited gear.

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

Competition for Hooks on the Sablefish Longline Survey

Catch rates from longline surveys are used as indices of abundance for many fish species. Relative abundance estimates from longline surveys do not usually account for possible effects of gear saturation, which potentially creates competition among fish for baited hooks and misrepresentations of abundance trends. Scientists at ABL examined correlations between catch rates of sablefish *(Anoplopoma fimbria)* and giant grenadier (*Albatrossia pectoralis*) and between sablefish and shortraker (*Sebastes borealis*) and rougheye rockfish (*Sebastes aleutianus*) from 25 years of AFSC longline surveys in Alaska waters for evidence of competition for hooks. Sablefish and giant grenadier catch rates were negatively correlated in all six sablefish management areas (Bering Sea, Aleutian Islands, Western Gulf Of Alaska, Central Gulf of Alaska, West Yakutat, and East Yakutat/Southeast Outside), and sablefish and rockfish were negatively correlated in five of the six areas (all areas except Aleutian Islands). This indicates that there is likely competition for hooks on the AFSC longline surveys. Comparative analyses were done for AFSC trawl survey catch rates and no negative correlations were observed, indicating that the negative correlations on AFSC longline surveys are not due to differing habitat preferences or direct competition, but more likely can be attributed to competition for hooks. Available adjustments for hook competition may be biased if the probability of capture does not decrease linearly with baited hooks. A better understanding of each fish species' catch probabilities on longline gear is needed before adjustments for hook competition can be made. A journal article was recently published on this study.

For more information, contact Cara Rodgveller at (907) 789-6052.

Auke Bay Laboratory Sablefish Tag Recovery Program

The ABL MESA Program continued the processing of tag recoveries and administration of the reward program during 2008. Total sablefish tag recoveries for the year should exceed 600 when all are received. One fish at liberty for 35.4 years was recovered in 2008; it was released in Chatham Strait and recovered off Whale Bay on Baranof Island. Two other fish were out just under 30 years: one was released and recovered off Kodiak and the second was released off Salisbury Sound in southeast Alaska and recovered off Prince William Sound. Twenty-two sablefish tagged as juveniles were recovered in 2008. Three of these were the first recoveries of archival-tagged juveniles; data from the these archival tags, which will provide information on the depth and temperature experienced by the fish, are still being analyzed.

Tags from shortspine thornyheads, Greenland turbot, Pacific sleeper sharks, lingcod, and spiny dogfish are also maintained in the Sablefish Tag Database. Nine thornyheads, two turbot, and one archival-tagged spiny dogfish were recovered in 2008. The dogfish, a female, was released off Yakutat and recovered off northern Washington 205 days later.

Releases in 2008 included 3,295 adult sablefish, 607 shortspine thornyheads, 39 turbot (including 31 with archival tags), 49 lingcod (all archival), and 459 juvenile sablefish (121 archival).

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

Juvenile Sablefish Studies

Juvenile sablefish studies have been conducted by the Auke Bay Laboratories in Alaska since 1984 and were continued in 2008. A total of 337 juvenile sablefish (age 1+) were tagged with spaghetti tags and released during two cruises to St. John Baptist Bay near Sitka between May 15-19 and July 18-20. During the 2nd cruise, an additional 121 juvenile sablefish were implanted with electronic archival tags. Approximately 435 rod hours were recorded to catch the fish that were tagged in the two cruises. 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 526 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. We had expected to recover some archival tags in the 2008 fishery, and indeed we received three returns from the 2008 fishery. The juvenile sablefish tagging cruise will be conducted again this year from July 14-20.

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

b. Stock Assessment

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Relative to the 2007 assessment, we made some substantive changes to the 2008 assessment. When moving to a sex-specific model in 2007, the number of selectivity parameters was greatly increased. These parameters were estimated with high correlation and low precision. For this year we used simpler selectivity functions and linked some selectivity curves to improve parameter estimation without greatly affecting model fit or trends. We showed two steps to a recommended model that reduced the total parameters by thirteen with minimal effects on the overall model fit. New input data included relative abundance and length data from the 2008 longline survey, relative abundance and length data from the 2007 longline and trawl fisheries, and age data from the 2007 longline survey and longline fishery.

The fishery abundance index was up 5% from 2006 to 2007 (the 2008 data are not available yet). The survey abundance index decreased 2% from 2007 to 2008 and follows a 14% decrease from 2006 to 2007. Relative abundance in 2008 is 3% lower than 2000, and is at an all-time low for the domestic longline survey. Spawning biomass is projected to be similar from 2008 to 2009, and begin declining through 2012. We also include results from a study to test for sablefish cannibalism in pots, which showed no evidence of cannibalism, and the results of a gear experiment comparing hand-baited versus machine-baited longline sets**.** Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points are calculated using recruitments from 1977-2003. The updated point estimates of B40%, F40%, and F35% from this assessment are 115,120 t (combined across the EBS, AI, and GOA), 0.095, and 0.113, respectively. Projected spawning biomass (combined areas) for 2009 is 103,127 t (90% of B40%), placing sablefish in sub-tier "b"of Tier 3. The maximum permissible value of F_{ABC} under Tier 3b is 0.085 which translates into a 2009 ABC (combined areas) of 16,080 t. The maximum permissible yield for 2009 is an 11% decrease from the 2008 ABC of 18,030 t. The OFL fishing mortality rate is 0.101 which translates into a 2009 OFL (combined areas) of 19,000 t. This decrease is supported by an all-time low in the domestic longline survey abundance estimate and no evidence of any large incoming recruitment classes.
Spawning biomass is projected to decline through 2012, and then is expected to increase assuming average recruitment is achieved. Because of the lack of recent strong year classes, the maximum permissible ABC is projected to be 14,895 t in 2010 and 14,086 in 2011. Projected 2009 spawning biomass is 36% of unfished spawning biomass. Spawning biomass has increased from a low of 30% of unfished biomass in 2001 to a projected 36% in 2009. The 1997 year class has been an important contributor to the population but has been reduced and comprises only 13% of 2008 spawning biomass. The 2000 year class appears to be larger than the 1997 year class, but is only 85% mature and should also comprise 23% of spawning biomass in 2009.

Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

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

Center for Independent Experts (CIE) Review of Alaska Sablefish Assessment
A review of the Alaska sablefish stock assessment was held at NMFS' Auke Bay Laboratories in Juneau, Alaska from March 17-19, 2009. NMFS requested the Center for Independent Experts (CIE) to conduct this technical peer review. The CIE is a group affiliated with the University of Miami that provides independent peer reviews of NMFS science nationwide, including reviews of stock assessments for fish and marine mammals. This CIE review panel was comprised of three international experts and an AFSC assessment scientist who chaired the meeting. The panel evaluated whether the assessment incorporates the best available scientific information and provides a reasonable approach to understanding the population dynamics and stock status of sablefish in Alaska. Members of the public observed the presentations and participated in the discussions between the CIE panel and the NMFS scientists responsible for data collection and analysis. The final report is due on April 23, 2009, and will consist of individual reports from each panelist and a summary report. The meeting chair will present the results of the review during the September 2009 NPFMC Groundfish Plan Team meeting.

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

7. Flatfish

a. Research

Habitat Studies – FBE Newport OR
Field studies around Kodiak reveal that age-0 yr juvenile Pacific halibut and northern rock sole *Lepidopsetta polyxystra* aggregate in shallow coastal waters (<50m), where they associate with seafloor characterized by sparse to moderate coverage by ampharetid polychaete worm tubes. During the summer 2008, the ampharetid polychaete worm *Sabellides sibirica* was more common at the Pillar Creek Cove study site than during the preceding 7 years. The worm tubes formed a continuous 1 km wide turf (reef), at depths of 21–30 m. Age-0 flatfish density increased with depth, being highest at the edge of the worm turf, where the worms were patchy, and lowest in the dense turf. Microcosm studies revealed that juvenile flatfish cannot bury, a flatfishes first line of defense, when worm tubes are dense. In contrast, the patchy edges of the worm tube reef constitute habitat structure and may offer juvenile flatfish refuge from predation. To test this, juvenile flatfish were tethered over a range of depths (4 - 47 m). Predation mortality of tethered fish increased with depth over the range of 4 to 16 m, but then declined significantly at 21 m; the area of sparse worm tubes along the turf edge. This suggests that reduced predation risk in sparse/patchy worm tube cover may partially explain juvenile flatfish preference for this habitat. The non-mutually exclusive hypothesis that juveniles are attracted to this habitat by its associated forage base is being explored; during July through September, benthic grab samples

were taken, as well as fish for stomach analysis, to determine habitat specific prey availability and diets of juvenile flatfish. These samples are currently being worked-up.

Feeding and growth

A four-year study examining the spatial and temporal variation in growth rates of northern rock sole at three Kodiak Island nursery sites was completed. The study sampled a series of fixed-position transects at monthly intervals in the summer and autumn to determine patterns of abundance and growth rates. The results indicate that patterns of growth variation among sites are consistent among years with the Holiday Beach site, consistently supporting the fastest growth rates. The analyses indicate that spatial and temporal variation in nursery ground temperatures are not the primary determinant of juvenile growth rates. Other factors such as prey availability and predation risk appear to be influential. The data also demonstrate that considerable variation in body size exists shortly after settlement into juvenile nurseries. This body size variation was correlated with winter and spring ocean temperatures, suggesting that interannual variation in temperature may influence spawning time or larval growth rates in this population.

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

Arrowtooth flounder juvenile habitat

Little is known about the juvenile habitat of the arrowtooth flounder. RACE biologists at the Kodiak Laboratory will initiate a project this summer to examine the habitat of arrowtooth flounder in the late summer/early fall months. Previous research studying other flatfish species has revealed that arrowtooth flounder utilize inshore areas within this time period. Study sites will be sampled on a monthly basis between August and November to examine the seasonal habitat use of these inshore areas by juvenile arrowtooth flounder.

For further information, contact Dr. Christina Conrath at (907)481-1732.

b. Stock Assessment

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Yellowfin sole

The current assessment model has been modified to accommodate the sex-specific aspects of the population dynamics of yellowfin sole. The model now allows for the input of sex-specific estimates of fishery and survey age composition and weight-at-age and provides sex-specific estimates of population numbers, fishing mortality, selectivity, fishery and survey age composition and allows for the estimation of sex-specific natural mortality and catchability. The model retains the utility to fit combined sex data inputs.

The 2008 stock assessment incorporates the 2008 catch and survey biomass, the age compositions from the 2007 survey and 2007 catch and an update of weight-at-age estimates using biological data through 2007. The 2008 EBS bottom trawl survey resulted in a biomass estimate of 2,099,000 t, a decrease of 2.5% from the 2007 point estimate. 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 5 of the past 20 year classes have been at or above the long term average. The 2008 catch of 149,000 t represents the largest flatfish fishery in the United States and the five-year average exploitation rate has been 4% 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 25 years, = 1.14.

Several models were analyzed for this assessment. The models differed by changing whether natural mortality (*M*) or catchability (*Q*), or both, were estimated as free parameters in the model to determine the uncertainty of these key parameters and their effect on the model estimates. The SSC determined in 2006 that the reliability of the spawner recruit relationship estimated in the yellowfin sole assessment warranted moving this stock to Tier 1 management. In the yellowfin sole stock assessment model, a Ricker form of the stock-recruit relationship was fit to the estimates of female spawning biomass and recruitment and estimates of F_{MSY} and B_{MSY} were calculated, assuming that the fit to the stock-recruitment data points represent the long-term productivity of the stock. Results from these Tier 1 calculations for yellowfin sole indicate that the harmonic mean of the F_{MSY} estimate is very close to the geometric mean value of the F_{MSY} estimate due to the low variability in the parameter estimates. This result indicates that the estimates of F_{MSY} are obtained with very little uncertainty. To better understand how uncertainty in certain parameter estimates affects the Tier 1 harvest policy calculations for yellowfin sole, the following analysis was undertaken. Selectivity, catchability, natural mortality and recruitment variability (R sigma) were selected as important parameters whose uncertainty may directly affect the pdf of the estimate of F_{MSY}. Twelve different model configurations were chosen to illustrate the effect of a range of uncertainly in these individual parameter estimates (0.4 and 0.9 for M and 0.8, 1.0, 1.2 and 1.4 for R sigma) and how they affect the estimate of the harmonic mean of F_{MSY}.

Results indicated that increases in recruitment variability would have the largest effect on the pdf of the estimate of $F_{MSY,}$ whereas the uncertainty in the other parameters did not.

The Tier 1 recommendations for this stock are as follows: The estimate of B_{MSY} from the present assessment is 329,000 t. As in last year's assessment, 1978-2003 spawner recruit data were used as the basis to determine the Tier 1 harvest recommendation. This provided an $F_{ABC} = F_{harmonic}$ mean $F_{msy} = 0.19$. The $F_{OFL} = F_{MSY} = 0.2$. The product of the harmonic mean of F_{MSY} and the geometric mean of the 2009 biomass estimate produced the recommended ABC of 197,500 t and OFL of 210,000 t.

Model projections indicate that this stock is neither overfished nor approaching an overfished condition. This stock is predicted to be fairly stable or decrease slightly in the near future due to below average recruitment in the last 5 years.

Northern rock sole
The current assessment model has been modified to accommodate the sex-specific aspects of the population dynamics northern rock sole. The model now allows for the input of sex-specific estimates of fishery and survey age composition and weight-at-age and provides sex-specific estimates of population numbers, fishing mortality, selectivity, fishery and survey age composition and allows for the estimation of sex-specific natural mortality and catchability. The model retains the utility to fit combined sex data inputs.

Changes to the input data for the 2008 assessment include addition of the 2007 fishery age composition, 2007 survey age composition, the 2008 catch biomass and 2008 trawl survey biomass point estimate and standard error. The 2008 bottom trawl survey resulted in a biomass estimate of 2,031,000 t, virtually unchanged from last year's estimate of 2,032,000 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 1.5. Natural mortality was estimated as a free parameter (with q constrained as stated above) giving the best fit at M = 0.15. The model estimates that the biomass of rock sole has increased the past five years after declining from a peak value observed in 1995. The increase is due to strong recruitment from the 2001, 2002 and 2003 year classes which are now contributing to the population biomass. The model estimates the 2008 biomass of rock sole at 1,754,000 t, an increase of 5% over 2007 and about 4% less than the peak level observed in 1995.

The SSC determined in 2006 that the reliability of the spawner recruit relationship estimated in the northern rock sole assessment warranted moving this stock to Tier 1 management. In the northern rock sole stock assessment model, a Ricker form of the stock-recruit relationship was fit to the estimates of female spawning biomass and recruitment and estimates of F_{MSY} and B_{MSY} were calculated, assuming that the fit to the stock-recruitment data points represent the long-term productivity of the stock. Results from these Tier 1 calculations indicate that the harmonic mean of the F_{MSY} estimate is very close to the geometric mean value of the F_{MSY} estimate due to the low variability in the parameter estimates. This result indicates that the estimates of F_{MSY} are obtained with very little uncertainty. To better understand how uncertainty in certain parameter estimates affects the Tier 1 harvest policy calculations for northern rock sole, the following analysis was undertaken. Selectivity, catchability, natural mortality and recruitment variability (R sigma) were selected as important parameters whose uncertainty may directly affect the pdf of the estimate of F_{MSY}. Twelve different model configurations were chosen to illustrate the effect of a range of uncertainly in these individual parameter estimates (0.4 and 0.9 for M and 0.8, 1.0, 1.2 and 1.4 for R sigma) and how they affect the estimate of the harmonic mean of F_{MSY}. Results indicated that increases in recruitment variability would have the largest effect on the pdf of the estimate of $F_{MSY,}$ whereas the uncertainty in the other parameters had little effect.

The SSC has determined that northern rock sole qualifies as a Tier 1 stock; therefore the 2008 assessment was calculated using Tier 1 methodology. In 2006, the SSC selected the 1978-2001 spawner-recruit data set for the Tier 1 harvest recommendation. The Tier 1 2009 ABC harvest recommendation is 296,000 t (F_{ABC} = 0.177) and a 2009 OFL of 300,000 t (F_{OFL} = F_{MSY} = 0.179). The northern rock sole harvest is from a stable fishery that lightly exploits the stock because it is constrained by prohibited species catch limits and the BSAI optimum yield limit.

Model projections indicate that this stock is neither overfished nor approaching an overfished condition. Usually the fishery only takes a small portion of the northern rock sole ABC, but there will be more room in cap this year because the pollock ABC is lower.

Flathead sole

The latest assessment updated the previous by incorporating new catch, discard, survey biomass, length composition, and age composition data. The 2008 fishery length compositions, based on observer data, were added to the assessment and fishery length compositions from previous years (1990-2007) were recalculated. Sex-specific length compositions and mean bottom temperatures were also added. The 2008 trawl survey biomass estimate of 554,000 t was a 3% decrease over last year's estimate of 571,000 t. Survey biomass has been relatively stable over the past four years compared to the decrease observed from 1998-2000.

The 2008 stock assessment model estimates that the age 3+ biomass decreased from 836,800 t in 2007 to 822,400 t in 2008, a 2% decrease. Similarly, the model estimate of female spawning biomass has declined 1% from 257,500 t in 2007 to 255,100 t in 2008. This is a stock which has been in a slow decline since a peak level of 1,012,500 t in 1994 due to below average recruitment in recent years.

Several options regarding initial age compositions were added to the assessment model architecture. Runs incorporating these options were evaluated as alternatives to using last year's model. The configuration used last year was again selected as the best. An experimental option that used a lagged version of survey bottom temperatures to model temperature-dependent survey catchability was added to the model architecture. Lagging bottom temperature by one year resulted in a highly significant improvement in model fit to the survey biomass time series, although the resultant reference points were very similar, when compared with last year's model. Further research during the coming year is required to validate this result, assess its wider validity among other flatfish stocks, and determine plausible biological mechanisms behind it. As such, the lagged-temperature model is regarded as preliminary.

The SSC has determined that reliable estimates of $B_{40\%}$ (139,000 t), $F_{40\%}$, (0.28) and $F_{35\%}$ (0.34) exist for this stock, thereby qualifying the stock for management under Tier 3. Given that the projected 2009 spawning biomass of 246,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2009 were calculated under sub-tier "a" of Tier 3. The F_{ABC} was set at the $F_{40\%}$ (0.28) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2009 ABC of 71,400 t. The OFL was determined from the Tier 3a formula using the $F_{35\%}$ value of 0.34 to give a 2009 OFL of 83,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Alaska plaice

The 2008 assessment incorporated the 2008 shelf survey biomass estimate (509,382 t) and the 2008 catch data into the stock assessment model as well as the 2007 survey age composition. The survey biomass estimate was 20% higher in 2008 than in 2007 (survey biomass estimates have been highly variable in recent years). 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. Recent good recruitment from the 2000 – 2002 year classes may increase the biomass in the near future. In response to a request from the SSC, the length/age conversion matrix was extended from 45 to 60 cm. Catchability investigations do not indicate a temperature effect as shown for some of the 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 of the BSAI Groundfish FMP. The updated point estimates are $B_{40\%}$ = 148,000 t, $F_{40\%}$ = 0.62, and $F_{35\%}$ = 0.86. These are high values for flatfishes, but these values are the consequence of Alaska plaice maturing before recruiting to the fishery. Given that the projected 2009 spawning biomass of 385,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2009 were calculated under sub-tier "a" of Tier 3. Projected harvesting at the $F_{40\%}$ level gives a 2009 ABC of 232,000 t. The OFL was determined from the Tier 3a formula, which gives a 2009 OFL of 298,000 t.

The total estimated biomass of Alaska plaice is down slightly, but it is expected to increase because of the above average 1997 and 1998 year classes. Model projections indicate that this species is neither overfished nor approaching an overfished condition. There is not a targeted fishery for this species as there is presently no market. The total exploitation rate is quite low for Alaska plaice as it is caught only as bycatch and is mostly discarded.

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 81% of the "other flatfish" catch in 2008. Because of insufficient information about these species, no model analyses are possible. The latest assessment incorporates 2008 total catch and discard and 2008 trawl survey information. The 2008 EBS bottom trawl survey resulted in biomass estimates of 104,600 t, a 20% decrease from the point estimate of 133,500 t from the 2007 survey (the highest observed since 1980). The biomass of these species in the Aleutian Islands is 16,400 t from the 2006 survey, the highest observed since surveys began in 1983.

Due to the amount of information available, "other flatfish" are classified as a Tier 5 species complex with natural mortality rates as described below. Projected harvesting at the 0.75 M level, gives a 2009 ABC of 17,384 t for the "other flatfish" species. The corresponding 2009 OFL is 23,067 t. It is not possible to determine whether the "other flatfish" complex is overfished or approaching an overfished condition because it is Tier 5 and not managed under Tiers 1-3. Insufficient information about these species makes model analysis impossible.

Species-specific natural mortality rates are used to calculate ABC for the species in this complex, where they are available. Estimates of M for the GOA were used for Dover sole (0.085) and rex sole (0.17). All other species were assigned an M of 0.20. Starry flounder natural mortality estimates were examined (male M = 0.45, female M = 0.30), but are available only from the west coast stock assessment and may not be valid for Bering Sea starry flounder, so they are not being used at this time. Proportionally more butter sole are caught in the fishery than in the trawl survey. In response to the SSC's concern about the disproportionate amount of butter sole caught in the fishery relative to the survey, the authors note that this species is at the northern extent of its range, is at times captured in large quantities in a few trawl hauls, and thus the CV's are quite large.

Greenland turbot

This year's Greenland turbot assessment model included updated 2007 and 2008 catch data, EBS shelf survey 2008 biomass and length composition estimates, and aggregated longline survey data index for the EBS and Aleutian Islands regions through 2008. The 2008 EBS shelf trawl survey biomass estimate was down by about 19% from the 2007 estimate and estimates from the last three years average about 68% of the long-term mean value from this survey. The 2008 EBS slope trawl survey biomass estimate was 17,900 t compared to the next most recent (2004) estimate of 36,600 t. Most of this difference was attributed to the lack of Greenland turbot found in the 400-600 m depth strata compared to the other years.

As was done last year, a simplified Tier 5 approach was also provided for contrast to the Stock Synthesis 2 model results. Also as in last year's assessment, the slope-trawl survey was assumed to index 75% of the Greenland turbot stock inhabiting US waters. The current estimate of 2009 female spawning biomass is 56,400 t from the stock assessment model. Compared to the 2008 spawning biomass of 58,100 t this represents a slight decrease, consistent with the general decline prevalent since the mid 1970s.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock. Greenland turbot therefore qualifies for management under Tier 3. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 43,700 t, 0.46, and 0.57, respectively. Projected spawning biomass for 2009 is 58,200 t, placing Greenland turbot in sub-tier "a" of Tier 3. The maximum permissible value of F_{ABC} under this tier translates into a maximum permissible 2009 ABC of 11,900 t.

A possible reason for the differences in the survey and model estimates and trends is the unavailability of the entire biomass (e.g., large females) to the survey. For 2010 the authors intend to further evaluate possible reasons for the differences between survey and model biomass estimates.

Given the recent slope survey and continuing signs of favorable recruitments, the authors recommended an increase in the ABC over last year. The Team concurred with an increase; however, because of differences noted in biomass estimates, coupled with continuing uncertainties in stock trends, the Team recommended a stair-step procedure for increasing the ABC up to the maximum permissible ABC, assuming that there is a 2010 survey. If no survey occurs in 2010 the team recommends maintaining the 2009 ABC for 2010. The step for 2009 would yield an ABC that is 60% of the maximum permissible ABC, or 7,380 t, which corresponds to a full selection fishing mortality rate of 0.27. The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} = 0.57$, and translates into a 2009 OFL of 14,900 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. New last year was the incorporation of the 10 Aleutian Islands surveys biomass and size compositions into the assessment model. This year's EBS shelf bottom trawl survey resulted in a biomass estimate of 583,900 t, a 7% increase from the 2007 survey. The 2008 slope survey biomass estimate was 96,200 t, by far the highest biomass ever reported on the slope. The 2006 Aleutian Islands trawl survey estimate of 229,000 t was the highest ever estimated in that region. The stock assessment model indicates that the biomass is at its highest level since observations began in 1975 due to episodes of above average recruitment in the 1980s and again in the period 1998 to the present. 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 0.34. With the stock assessment model configured in this way, the population biomass was estimated at 1,090,100 t.

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, arrowtooth flounder was assessed for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 255,000 t, 0.24, and 0.29, respectively. Given that the projected 2009 spawning biomass of 802,000 t exceeds $B_{40\%}$, the Team's ABC and OFL recommendations for 2009 were calculated under sub-tier "a" of Tier 3. The Team recommends setting F_{ABC} at the $F_{40\%}$ (0.24) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2009 ABC of 156,000 t. The OFL fishing mortality rate under Tier 3a is $F_{35\%}$ (0.29), which translates to a 2009 OFL of 190,000 t.

The ABC recommendation is for the combined harvest of arrowtooth flounder and Kamchatka flounder, which are difficult to distinguish and had similar biomass trends from the EBS trawl survey since 1991. Ecosystem considerations of predator-prey dynamics of arrowtooth flounder in the Bering Sea indicated that the top prey species of arrowtooth flounders are juvenile pollock. However, juvenile arrowtooth flounder in the Bering Sea are an important prey for adult pollock. The ramification of increases of one of these species, with decreases of the other, has unknown consequences due to this duality of the predator-prey relationship.

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GULF OF ALASKA

Arrowtooth flounder

Since the Gulf of Alaska was not surveyed in 2008, the 2007 assessment is the basis for projecting the stock status forward for 2009 management. The 2007 survey biomass estimate for Gulf of Alaska arrowtooth flounder was 1,939,055 t, a 2% increase from the 2005 survey. This biomass estimate and the length composition from the 2007 survey were added to the age-structured stock assessment model, as well as the 2005 survey age composition. In addition, the age-length conversion matrix was updated with mean length at age data for 1984 to 2005 to better model growth.

New information available to update the projection model consists of the updated total catch for 2007 (25,364 t) and the current catch for 2008 (27,938 t as of October 11, 2008). The recommended ABC and OFL in last year's assessment were based on Tier 3, using $F_{40\%}$ and $F_{35\%}$, respectively. The projection model was run to generate estimates of biomass for 2008-2010. The 2009 catch was estimated as the average catch over the last 3 three years (2006 to 2008, 26,985 t) for use in the projections. The recommended ABC's for 2009 and 2010 are 221,512 t and 258,397 t, respectively. The new ABC recommendation for 2009 is slightly lower than that recommended for 2009 using last year's full assessment model (269,237 t). The ABC is apportioned as follows:

	Western	Central	West Yakutat	East Yakutat/SE	Total
2009	30,148	164,251	14,908	12,205	221,512
2010	29,843	162,591	14,757	12,082	219,273

Gulf of Alaska flatfish

The only new information available concerning the shallow and deep water flatfish complexes are the updated 2007 catch (8,788 t) and the best estimate of 2008 catch (7,390 t through October 11, 2008). Consequently, the recommended species-level ABCs and OFLs for 2009-10 are the same as those for 2008-9. The details from the 2007 assessments are listed below.

New data for the 2007 flatfish assessment included the 2007 NMFS bottom trawl survey biomass estimates and the 2007 catch. The 2007 survey biomass estimates were used to calculate ABC's for 2008 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 2007 exploitable biomass for each group (except for those species with age-structured models) is based directly on results from the 2007 NMFS trawl survey. Survey abundance estimates for the shallow water flatfish complex were higher in 2007 compared to 2005 for northern rock sole, southern rock sole, sand sole, starry flounder, butter sole and Alaska plaice. The 2007 survey abundance estimates were less than 2005 for yellowfin sole and English sole. The overall survey abundance estimates for the shallow water group increased by 70,824 t from 2005 to 2007.

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). Overall, the shallow water flatfish ABC increased from 51,450 t in 2007 to 60,989 in 2008. TACs are annually set below the ABC levels.

Survey estimates of Dover sole biomass increased from 213,221 t in 2005 to 280,990 in 2007. The stock assessment model for Dover sole indicated that age 3+ biomass estimates increased 9% from 2007 to 2008 (297,353 to 324,197) and that female spawning biomass estimates increased about 6%. Recruitment may have been high in 2002 and catches remain well below the TAC. The 2008 ABC using $F_{40\%}$ = 0.38 was estimated at 44,735 t, and the 2008 OFL using $F_{35\%}$= 0.494 was estimated at 55,787 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). 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.

2009 ABC area apportionment

Flatfish group	**Western**	**Central**	**WYAK**	**EYAK/SEO**	**Total**
Deep water	690	6,721	965	527	8,903
Shallow water	26,360	29,873	3,333	1,423	60,989

Flathead sole

Since the Gulf of Alaska was not surveyed in 2008, the 2007 assessment is the basis for projecting the stock status forward for 2009 management. Flathead sole is in Tier 3a. New information available to update the projection model consists of the total catch for 2007 (3,159 t) and the current catch for 2008 (2,825 as of Sept. 20, 2008). To run the projection model to predict ABC's for 2009 and 2010, estimates are required for the total catches in 2008 and 2009. Because it is likely that more flathead sole will be caught this year, and because the 2007 catch was the largest over the previous 5 years, the 2007 catch was used as a "best" estimate of the total catches taken in 2008 and 2009. Based on the updated projection model results, the recommended ABC's for 2009 and 2010 are 46,464 t and 47,652 t, respectively. The new ABC recommendation for 2009 is similar to that recommended for 2009 using last year's full assessment model (46,505 t). The details of the 2007 assessment are listed below.

The 2007 survey biomass estimate for flathead sole was 280,290 t, a 31% increase over the 2005 point estimate of 213,213 t. This new biomass estimate and the survey length data, as well as updated catch biomass and length comps were included in the assessment model. In addition, maturity parameters were updated and estimates of reference fishing mortality were estimated from spawner per recruit analysis. The 2008 biomass estimate from the age-structured model was 324,200 t, continuing a stable trend since the mid 1980s.

The projected 2008 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 2008 using $F_{40\%}$ = 0.38 was estimated at 44,735 t (increase of 5,625 t from 2007). The overfishing level using $F_{35\%}$ = 0.494, results in 55,787 t. Area apportionments of flathead sole ABC's for 2008 (using $F_{40\%}$) are based on the fraction of the 2007 survey biomass in each area:

Western	**Central**	**West Yakutat**	**East Yakutat/SE**	**Total**
12,507	28,174	3,420	634	44,735

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10. Walleye Pollock

a. 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 along the Gulf of Alaska shelf break between Chirikof and Middleton Islands

The MACE Program conducted a winter echo integration-trawl (EIT) survey aboard the NOAA ship *Miller Freeman*, targeting walleye pollock in the Shumagin Islands and Sanak Trough. The Shumagin Islands portion of the survey was conducted between 8-12 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 12-13 February along transects spaced 2-nmi apart.

In the Shumagin Islands, the densest walleye pollock aggregations were located in Shumagin Trough and off Renshaw Point, although the Renshaw Point quantities were significantly less than detected in earlier surveys. Most fish off Renshaw Point were age-3 (25-32 cm FL) or exceeded 40 cm FL. Significant quantities of age-1 pollock (8-13 cm FL) were detected in Shumagin Trough. The unweighted maturity composition for males longer than 40 cm FL was 23% immature, 35% developing, 42% pre-spawning, 0% spawning, and 0% spent. The maturity composition of females longer than 40 cm was 12% immature, 23% developing, 61% pre-spawning, 0% spawning, and 4% spent. The mean gonado-somatic index (GSI: ovary weight/body weight) for mature pre-spawning females was 0.08. The pollock EIT survey abundance estimate in the Shumagin Islands area was 1.6 billion pollock weighing 30,600 metric tons, based on catch data from 7 trawl hauls and acoustic data from 293 nmi of survey transects.

The densest pollock aggregations in Sanak Trough, which consisted of only adult pollock, were located in the central and eastern parts of the Trough. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 11% developing, 71% pre-spawning, 12% spawning, and 6% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 4% developing, 71% pre-spawning, 0% spawning, and 25% spent. The large percentage of spent females indicated that the survey timing was late. The average GSI for pre-spawning females was 0.14. The abundance estimate for Sanak Trough of 13 million pollock weighing 19,800 t, based on catch data from 2 trawl hauls and acoustic data from 120 nmi of survey transects, was the lowest in the time series.

The MACE Program also conducted winter EIT surveys aboard the NOAA ship *Oscar Dyson,* targeting walleye pollock along the shelfbreak from southeast of Chirikof Island to Middleton Island and in the Shelikof Strait area. The Shelikof Strait sea valley was surveyed from south of Chirikof Island to north Kuliak Bay on the Alaska Peninsula during 13-19 March along parallel transects spaced 7.5-nmi apart. The shelf break was surveyed during 19-21 March (Chirikof Island to the mouth of Chiniak Bay) and 28-31 March (Middleton Island to the mouth of Chiniak Bay) along parallel transects spaced 6-nmi apart.

In the Shelikof Strait area, the densest walleye pollock aggregations were detected from just south of the Strait proper to northeast of the Semidi Islands. Walleye pollock abundance was sparse along on the north side of the Strait, where historically the highest abundance of mature, pre-spawning walleye pollock was located. Most walleye pollock were generally located within 50 m of the seafloor over bottom depths exceeding 150 m. Trawl hauls conducted within Shelikof Strait proper revealed a mixture of age groups of walleye pollock, with age-1 fish dominating most catches by number. South of the Strait proper between Kodiak Island and the Semidi Islands, catches were dominated by both age-1 and age-2 fish. Age-1 fish heavily dominated catches at the extreme southern end of the Shelikof Strait survey area between the Semidi Islands and Chirikof Island. The unweighted maturity composition for males longer than 40 cm FL was 7% immature, 44% developing, 28% pre-spawning, 21% spawning, and 0% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 48% developing, 51% pre-spawning, 1% spawning, and 0% 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 47 cm. The average GSI for mature pre-spawning females was 0.12. The pollock abundance estimate for Shelikof Strait was 2.1 billion pollock weighing 208,000 t, based on catch data from 11 trawl hauls and acoustic data from 669 nmi of survey transects.

Along the Chirikof shelf break, walleye pollock were found in low densities between Chirikof Island and the mouth of Barnabas Trough in midwater layers between 275 and 400 m depth over bottom depths of 300-1,000 m. Few pollock were found east of the mouth of Barnabas Trough. However, dense Pacific ocean perch acoustic backscattering was detected in this area, particularly near the mouth of Amatuli Trench. Pollock size composition ranged from 33-69 cm with a mode at 57 cm FL. The unweighted maturity composition for males longer than 40 cm FL was 0% immature, 17% developing, 57% pre-spawning, 26% spawning, and 0% spent. The maturity composition of females longer than 40 cm FL was 0% immature, 3% developing, 97% pre-spawning, 0% spawning, and 0% spent. The high percentage of pre-spawning females indicates that peak spawning had not occurred. The average GSI for pre-spawning females was 0.16. The pollock abundance estimate for the area from Chirikof Island to the mouth of Barnabas Trough was 15 million pollock weighing 22,000 t, based on catch data from 2 trawl hauls and acoustic data from 145 nmi of survey transects. East of Barnabas Trough, the abundance estimate was 13 million pollock weighing 4,200 t, based on catch data from 7 trawl hauls and acoustic data from 410 nmi of survey transects.

BERING SEA

Summer echo integration-trawl survey on the eastern Bering Sea shelf

The MACE Program conducted an echo integration-trawl (EIT) survey of midwater walleye pollock (*Theragra chalcogramma*) between 2 June and 31 July 2008 aboard the NOAA ship *Oscar Dyson*. The survey design consisted of 31 north-south transects spaced 20 nautical miles (nmi) apart from Port Moller, Alaska across the U.S.-Russia Convention Line to the Cape Navarin area of Russia. The survey's primary objective was to collect 38 kHz echo integration and trawl information to estimate daytime midwater walleye pollock abundance and distribution. Additional survey sampling included conductivity-temperature-depth (CTD) and expendable bathythermograph (XBT) casts to characterize the Bering Sea shelf environment, and supplemental trawls to improve species identification using multiple frequency techniques. Macrozooplankton and micronekton layers (principally euphausiids) were sampled and target strength measurements were made as part of the multi-disciplinary Bering Sea Integrated Ecosystem Research Program (BSIERP) study. A number of new, specialized sampling devices were tested, including light level sensors, Simrad ME70 multibeam sonar, and a lowered echosounding system. Seabird and marine mammal species abundances were recorded. After the survey was completed, Aleutian wing trawl (AWT) codend mesh liner comparison data were collected to evaluate the impact of switching from a 1.25" to a 0.5" mesh liner, and additional acoustic, trawl, and free-floating buoy acoustic data were collected for the vessel comparison work between the *Oscar Dyson* and *Miller Freeman*.

Survey results showed that ocean conditions were cold in 2008, as in 2006 and 2007, compared to the previous 5 years. About 1/3 of the summed acoustic backscatter at 38 kHz observed during the 2008 survey was attributed to adult or juvenile walleye pollock. The remaining 38 kHz backscatter was attributed to an undifferentiated invertebrate-fish species mixture, or in a few isolated areas, to arctic cod, or unidentified fish. Fewer pollock were observed east of 170°W than in 2007 or 2006, and a larger percentage of those observed were inside the Steller Sea Lion Conservation Area (SCA). The majority of the pollock biomass in the U.S. Exclusive Economic Zone (EEZ) was located to the west and southwest of St. Matthew Island between the 100 m and 200 m isobaths. Estimated pollock abundance in midwater (between 16 m from the surface and 3 m off bottom) in the U.S. EEZ portion of the Bering Sea shelf was 4.70 billion fish weighing 0.997 million metric tons; in the Russian EEZ, there were 58.6 million fish weighing 0.03 million metric tons (3% of the total midwater biomass). East of 170°W (11% of total biomass) the predominant length mode was 55 cm inside the SCA and 51 cm outside the SCA. In the U.S. west of 170°W (86% of total biomass) modal lengths were 23, 32 and 47 cm. In Russia modal lengths were similar to those in the U.S. west of 170°W with proportionally more adults and fewer juveniles.

Age results indicated that inside the U.S. EEZ, age 2 and 3 fish were dominant numerically (62% and 22%, respectively) and together represented 46% of the total biomass. Walleye pollock ages 4+ totaled 16% of the population numerically and made up 53% of the total biomass. Age-1 pollock accounted for only 1% of the total estimated numbers and less than 0.1% of the biomass.

Analyses of walleye pollock vertical distribution indicated that 93% of adult biomass was within 40 m of the seafloor. Juveniles were found both near the seafloor and higher in the water column; 21% of juvenile biomass was within 60 m of the surface.

INTERVESSEL COMPARISON

The National Oceanic and Atmospheric Administration (NOAA) is building four noise-reduced fisheries research ships of a single design that are intended to conform to the ICES recommendations for underwater radiated noise. The first of these, the NOAA ship *Oscar Dyson*, operates in the North Pacific, where it is scheduled to replace the conventional (i.e. not noise-reduced) NOAA ship *Miller Freeman* as the primary vessel used to continue a long time-series of acoustic-trawl assessment surveys of walleye pollock (*Theragra chalcogramma*) in Alaska. Because the *Oscar Dyson* is a noise-reduced vessel whereas the *Miller Freeman* is not, there is concern that biomass indices derived from the two vessels will differ.

To ensure consistent results as the acoustic surveys transition to the *Oscar Dyson*, the Alaska Fisheries Science Center's (AFSC) Midwater Assessment and Conservation Engineering (MACE) program has undertaken a series of field experiments designed to establish if walleye pollock differentially avoid the two ships. Four different acoustic surveys of walleye pollock are routinely conducted by the AFSC: a summer survey of the eastern Bering Sea (2006, 2008), and winter surveys of pre-spawning fish in the vicinity of Bogoslof Island in the Bering Sea (2007), and Shelikof Strait (2007) and the Shumagin Islands (2008) in the Gulf of Alaska. The potential for differential vessel avoidance has been evaluated separately in each survey area as the walleye pollock in these surveys differ markedly in their depth distribution, age-structure, reproductive state, and environmental conditions.

The experiments followed a two-part design where the vessels 1) were arranged side by side during the survey transects, or 2) conducted a series of transects in which one vessel led and the other followed behind the leading vessel. During the side-by-side transects, one vessel conducted an acoustic survey using standard protocols along equally spaced transects. The accompanying vessel was laterally displaced by 0.5 -0.7 nautical miles (nmi) to the side of the survey vessel. The side-by-side transects were periodically interrupted to conduct a series of 5-nmi-long follow-the-leader transects oriented in an east/west direction and spaced 0.5 nmi apart. The other vessel followed at a distance of 1 nmi and was offset to starboard by 0.1 nmi. The paired acoustic data from both the side-by-side and follow-the-leader transects were analyzed in 5 nmi segments. During the Shumagin Islands survey, a dedicated experiment using an echosounder mounted in a free-floating buoy was conducted to characterize the behavioural responses of walleye pollock as they were approached and then passed by the *Oscar Dyson* and the *Miller Freeman*.

The comparison of acoustic backscatter observed by the vessels revealed strong contrasts among study areas. In daytime surveys in the eastern Bering Sea where the fish were the shallowest (< 120 m), there was no significant difference in acoustic backscatter strength in 2006 and 2008. This suggests that acoustic estimates from the *Oscar Dyson* and the *Miller Freeman* were not different in this area. This was also the case for the Bogoslof area, where walleye pollock were distributed between 400 and 700 m. However, significant differences were observed in the Shumagin Islands and Shelikof Strait. On average, acoustic abundance estimates from the *Oscar Dyson* were 31% higher than those from the *Miller Freeman* in the Shumagin islands and 13% higher in Shelikof Strait. The discrepancies in vessel ratio were greater for shallower fish, which is consistent with the expectation of a stronger response for fish closer to the vessels. The differential vessel avoidance observed during the Shumagins experiment was independently confirmed by the experiment conducted using the buoy-mounted echosounder. When the *Miller Freeman* passed the buoy, larger decreases in backscatter intensity and an increased diving response were observed compared to when the *Oscar Dyson* passed. The reaction was observed to begin ~45 seconds prior to the time the vessels passed over the buoy, which corresponds to a separation distance of ~270 m.

These studies demonstrate, for the first time, that a noise-reduced vessel designed to minimize fish avoidance detected more fish than a conventional (i.e. non-noise reduced) vessel under some survey conditions. The vessel-specific differences in acoustic survey results have implications for management of walleye pollock, which form the basis of a considerable fishery. In the case of the Shumagin Islands and Shelikof Strait abundance surveys, the acoustic estimates of abundance from the *Oscar Dyson* are expected to be higher than those conducted by the *Miller Freeman*. This result illustrates that there may be a 'vessel effect' , and that differential biases can be introduced into a time series by switching vessels, particularly in the case where the change involves a noise-reduced vessel designed to minimize avoidance such as the newest generation of NOAA fisheries research ships.

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

b. Stock Assessment

GULF OF ALASKA

The age-structured model developed using AD Model Builder and used for GOA W/C/WYK Pollock assessments in 1999-2007 is fundamentally unchanged. The 2008 pollock assessment features the following new data: (1) 2007 total catch and catch at age from the fishery, (2) 2008 biomass and 2007 and 2008 age composition from the Shelikof Strait EIT survey, (3) 2007 age composition from the NMFS bottom trawl survey, and (4) 2008 biomass and length composition from the ADF&G crab/groundfish trawl survey.

A vessel comparison (VC) experiment between *R/V Miller Freeman* and *R/V Oscar Dyson* was conducted in March 2007 during the Shelikof Strait acoustic-trawl survey. Results indicate that the ratio of 38 kHz pollock backscatter from the *R/V Oscar Dyson* relative to the *R/V Miller Freeman* was significantly greater than one (1.13), as would be expected if the quieter *R/V Oscar Dyson* reduced the avoidance response of the fish. Methods to incorporate this result in the assessment model were explored. The method applied was to treat the *R/V Miller Freeman* and the *R/V Oscar Dyson* time series as independent survey time series, and include the vessel comparison results directly in the log likelihood of the assessment model.

In 2007, the largest discrepancy between fishery data and the model prediction was a lower than expected abundance of the 2004 year class (age-3 fish), suggesting that this year class is less abundant than previously estimated. The abundance of this year class was also less than expected in the 2008 Shelikof Strait EIT survey. General trends in survey time series are fit reasonably well, but since each survey time series shows a different pattern of decline, the model is unable to fit all surveys simultaneously. The ADF&G survey matches the model trend better than any other survey, despite receiving less weight in model fitting. The 2007 NMFS trawl survey is nearly exactly equal to the model prediction. Since this survey is the most comprehensive survey, the consistency between the NMFS survey and the assessment lends support to assessment results.

The 2008 Shelikof Strait EIT trawl survey was the first conducted using the *R/V Oscar Dyson*. The 2008 biomass estimate for Shelikof Strait was 15% higher than the 2007 estimate. In winter of 2007, a vessel comparison experiment was conducted between the *R/V Miller Freeman* (MF) and the *R/V Oscar Dyson* (OD), which obtained an OD/MF ratio of 1.132. These results suggest that biomass was relatively constant from 2007 to 2008. Biomass estimates of Shelikof Strait fish ≥43 cm (a proxy for spawning biomass) decreased by 52% from the 2007 estimate, apparently due to below average recruitment to the spawning population in recent years. The 2008 ADF&G crab/groundfish survey biomass estimate increased 9% from 2007.

The assessment model, configured as described, fixed the NMFS bottom trawl survey catchability (q) at 1.0 and estimated other survey catchabilities. Although the likelihood is higher for models with q closer to 0.74, the change in likelihood is small (less than 1.5) between models with q fixed at 1.0 or estimated. Fixing q at 1.0 results in a more precautionary estimate of spawning biomass. Despite the significant difference in the ratio of pollock backscatter between the *R/V Miller Freeman* and the *R/V Oscar Dyson*, the impact on assessment results and recommended ABCs was minor regardless of the modeling approach. The 2009 spawning biomass and ABCs varied 5-7% across different model configurations, while population biomass varied by about 3%. Models that included a likelihood component for the vessel comparison experiment were considered to be a better approach from a technical perspective. The model results produced an estimated 2009 spawning biomass of 132,810 t, or 22.4% of unfished spawning biomass. The $B_{40\%}$ estimate is 237,000 t. Estimates of 2009 stock status indicate that spawning biomass remains low.

Pollock are not overfished nor are they approaching an overfished condition. Because model estimated 2009 female spawning biomass is below $B_{40\%}$, the W/C/WYK Gulf of Alaska pollock are in Tier 3b. The author recommended reducing F_{ABC} from the maximum permissible using the “constant buffer” approach (first accepted in the 2001 GOA pollock assessment). The projected 2009 age-3+ biomass estimate is 638,950 t. A Markov Chain Monte Carlo analysis indicated the probability of the stock being below $B_{20\%}$ to be highest in 2009, with a probability of 12%, but drops to less than 1% in subsequent years. Therefore, the ABC for 2009 is based on this precautionary model configuration and the adjusted harvest control rule is 43,270 t (F_{ABC}= 0.11) for GOA waters west of 140°W longitude (Note that this ABC recommendation is not reduced by 1,650 t to account for the Prince William Sound GHL, thus the final ABC is 41,620 for 2009). The 2009 OFL under Tier 3b is 58,590 t (F_{OFL}= 0.15).

Southeast Alaska pollock are in Tier 5 and the ABC and OFL recommendations are based on natural mortality (0.30) and the biomass from the 2007 survey. The 2007 NMFS bottom trawl survey increased 37% since 2005. This results in a 2009 ABC of 8,280 t, and a 2009 OFL of 11,040 t. In recent years, the two year projections of ABCs show increases that have not been realized. This could be due to a number of factors including the use of average recruitment in the current projection while below average recruitment is occurring, and juvenile natural mortality may be higher than assumed.

There were no major additions to the pollock stock assessment ecosystem considerations section this year. Previous results suggested that high predation mortality plus conservative fishing mortality might exceed GOA pollock production at present, and that this condition may have been in place since the late 1980s or early 1990s. The Plan Team thinks that this provides additional support for continued precautionary management of GOA pollock.

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

EASTERN BERING SEA

Consistent with the estimates produced in last year’s assessment, the abundance of EBS walleye pollock has declined steadily since 2003 due to poor recruitment from the 2001-2005 year classes. This string of five consecutive poor year classes is unprecedented in the known history of the stock which has sustained a fishery with annual removals of more than 1 million metric tons for 23 of the past 25 years.

New data in this year’s assessment include the following:
Updated total catch for 2007 and a preliminary estimate of the 2008 catch. Biomass estimates from the 2008 bottom trawl survey and the 2008 echo-integration trawl (EIT) survey. The estimate from the bottom trawl survey was 3.03 million t, down 30% from the 2007 estimate, and the third lowest point in the 1982-2008 time series. The estimate from the EIT survey was 0.942 million t, down 47% from last year’s survey, and the lowest in the 1979-2008 time series. Age composition data from the 2008 bottom trawl survey, updated age composition data from the 2007 EIT survey, and preliminary age composition data from the 2008 EIT survey (based on the age-length key from this year’s bottom trawl survey). The 2008 survey age compositions tend to confirm the strength of the large 2006 year class first observed in the 2007 surveys. Age and size composition data and weight-at-age data from the 2007 fishery.

There were no substantive changes to the stock assessment model this year. Consistent with the estimates produced in last year's assessment, age 3+ biomass of EBS walleye pollock has declined steadily since 2003 due to poor recruitment from the 2001-2005 year classes, with the age 3+ biomass for 2008 estimated to be the lowest in the time series since 1980. This string of five consecutive poor year classes is unprecedented in the known history of the stock. Spawning biomass is estimated to be 34% below B_{MSY} in 2008. The 2006 year class is reliably estimated to be well above average, therefore spawning biomass is projected to increase in the near future (25% below BMSY in 2009 and near B_{MSY} in 2010, if the stock is fished at the maximum permissible ABC).

The SSC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for EBS walleye pollock. Therefore, it qualifies for management under Tier 1. The assessment authors indicate that the Tier 1 reference points continue to be reliably estimated.

The updated estimate of B_{MSY} from the present assessment is 1.919 million t, compared to 1.88 million t from last year's assessment. Projected spawning biomass for 2009 is 1.443 million t, placing EBS walleye pollock in sub-tier "b" of Tier 1. As in recent assessments, the maximum permissible ABC harvest rate was based on the ratio between MSY and the equilibrium biomass corresponding to MSY. The harmonic mean of this ratio from the present assessment is 0.332, very close to last year's value of 0.341.

The harvest ratio of 0.332 is scaled according to the Tier 1b formula and then multiplied by the geometric mean of the projected fishable biomass for 2009 (3.321 million t) to obtain the maximum permissible ABC for 2009, which is 815,000 t. This ABC is 78% higher than the 2009 yield of 458,000 t that would correspond to a Tier 3b strategy based on a $B_{40\%}$ value of 2.43 million t.

The Plan Team supports the authors' recommendation to set 2009 ABC at the maximum permissible level of 815,000 t. The Team considered recommending a lower value, but concluded that the maximum permissible level is sufficiently conservative for the following reasons:

1) A 2009 ABC of 815,000 t will keep the spawning exploitation rate within the range experienced during the 1979-2005 period, and below the comparatively high values experienced in 2006-2008.
2) The Tier 1 harvest control rules already have a built-in precautionary adjustment for stocks that fall below B_{MSY}. Uncertainty is already factored into the Tier 1 harvest control rules.
3) A 2009 ABC of 815,000 t constitutes a large (18%) reduction from the 2008 ABC of 1 million t and would result in greater short-term catch stability than a lower ABC.
4) The strength of the 2006 year class, estimated for the first time in last year's assessment, has been confirmed after a second year of survey observations, and the confidence interval has tightened considerably in the present assessment. A strong 2006 year class following weak 2001-2005 year classes would also be consistent with the hypothesis that the 2006 year class was affected positively by both decreased temperature and increased copepod abundance.

Under a 2009 ABC of 815,000 t, the stock is expected to return to near B_{MSY} by 2010 if the stock is fished at the maximum permissible level.

The authors also recommended setting the preliminary ABC for 2010 at the maximum permissible level, which is 1.23 million t. However, the Team emphasizes that its recommendation next year for the final 2010 ABC will depend on the estimates of recent year class strengths contained in next year's stock assessment. For example, if the 2006 year class is only average (which appears unlikely based on the data presently available), this year's assessment indicates that the maximum permissible ABC for 2010 would be reduced to about 900,000 t. Next year's estimates of other incoming year classes will also factor into the recommendation for the final 2010 ABC.

The OFL harvest ratio under Tier 1a is 0.398, the arithmetic mean of the ratio between MSY and the equilibrium fishable biomass corresponding to MSY. The product of this ratio, rescaled according to the Tier 1b formula, and the geometric mean of the projected fishable biomass for 2009 gives the OFL for 2009, which is 977,000 t. The current projection for OFL in 2010 given a 2009 catch of 815,000 t is 1.43 million t. The walleye pollock stock in the EBS is not overfished and is not approaching an overfished condition.

Both copepods and euphausiids are present in the diet of pollock in all years. While estimates of copepod abundance are available, similar information on euphausiids is presently lacking. However, ongoing research should provide more information on euphausiid abundance in the next couple of years. The weakness of the 2001-2005 year classes suggests that it has been harder than average for pollock to survive through their first year. Recent abundance of apex predators has been within the range of historic variability, though pelagic foragers (including pollock) have declined recently, perhaps due to reduced prey (e.g., copepod) abundance during the early part of this decade. Pribilof fur seal pup weights in 2008 were lower on those rookeries where females forage on the shelf than for off-shelf foragers. This may have been due to insufficient local availability of forage for nursing females, requiring them to make longer than normal foraging trips.

ALEUTIAN ISLANDS

The AI pollock assessment underwent an extensive peer review during the summer of this year, conducted by the Council of Independent Experts (CIE). In response to this review, many changes were made in the assessment model. The only new data in the model consists of fishery catches in the area from 170-174°W, as recommended by the CIE reviewers. Changes to the model, all recommended by the CIE reviewers, were as follows:

A bootstrap method was used to compute annual catch at age, average weight at age, and input sample sizes for catch at age.

A constant sample size of 100 was assumed for survey age compositions, except for the 1991 survey, which was given a lower sample size due to non-representative age structure sampling.

The maturity schedule from the GOA pollock stock was used instead of the maturity schedule from the BS stock.

Survey selectivity was forced to be constant across the entire time series, and fishery selectivity was forced to be constant within each of three time blocks (pre-1992, 1992-2005, and post-2005).

Values of stock-recruitment parameters were assumed rather than estimated.

The age range for which average catchability is forced to equal 1.0 was changed from 8-10 years to 5-12 years, and the range of years used to estimate average recruitment was changed from 1990-2007 to 1978-2006.

To make projections, the selectivity curve estimated in the AI assessment model was used instead of the selectivity curve estimated in the EBS assessment model.

Spawning biomass and stock status trends

Relative to last year's assessment, the numerous revisions to this year's model resulted in a major change in the estimated trajectory of the stock relative to biomass reference points. In last year's assessment, the stock was estimated to have been well above $B_{40\%}$ for the entire time series. In contrast, this year's assessment estimates that spawning biomass reached a minimum level of about $B_{21\%}$ in 1999, increased steadily through 2006 to a level around $B_{30\%}$, and then remained fairly close to that level through the present. The increase in spawning biomass since 1999 has resulted more from a large decrease in harvest than from good recruitment, as there have been no above-average year classes spawned since 1983. However, it should be noted that the average recruitment for this stock is almost twice the median level. The 2000 year class was the first to exceed the median level since the 1989 year class. Spawning biomass for 2009 is projected to be 85,500 t.

The SSC has determined that this stock qualifies for management under Tier 3. The revised model estimates $B_{40\%}$ at a value of 113,000 t, placing the AI pollock stock in sub-tier "b" of Tier 3. Under Tier 3b, with $F_{40\%}$=0.29, the maximum permissible ABC for 2009 is 26,900 t. This value is more than 10 times the maximum catch taken in the last decade. Given that the stock is well below$B_{35\%}$, that all cohorts presently in the population are estimated to be below average, and that the assessment model is in a state of transition, the Plan Team recommending setting the 2009 ABC at some level lower than the maximum permissible. As an alternative to the maximum permissible ABC under Tier 3b, the assessment authors have provided the value corresponding to the maximum permissible ABC under Tier 5, which is 15,300 t (based on the model's estimated value of 0.22 for the natural mortality rate). The SSC set the ABC at the Tier 3b value. For OFL, the Tier 3b formula was also used: $F_{35\%}$=0.36, OFL for 2009 is 32,600 t. The projected OFL for 2010, given a 2009 catch of 2,000 t, is 36,800 t. The walleye pollock stock in the Aleutian Islands is not overfished and is not approaching an overfished condition. There is less than a 1% chance that the AI pollock stock will be below $B_{20\%}$ in 2009.

BOGOSLOF

This assessment has been placed on a biennial schedule, and Chapter 1b is basically a summary of last year's assessment. No survey took place this year. Survey biomass estimates since 2000 have all been lower than estimates prior to 2000, ranging from a low of 198,000 t in 2003 to a high of 301,000 t in 2000. The 2007 estimate was the highest since the 2000 estimate.

The SSC has determined that this stock qualifies for management under Tier 5. The ABC for this stock has been set using a formula similar to the Tier 3 formula, but substituting a reference biomass level of 2 million t for $B_{40\%}$. Given $F_{40\%}$=0.27, this results in F_{ABC}=0.022 and a 2009 ABC of 7,970 t. The projected ABC for 2010 is the same. Following the Tier 5 formula with M=0.20, OFL for 2009 is 58,400 t. The OFL for 2010 is the same. As a Tier 5 stock, it is not possible to determine whether Bogoslof pollock is overfished or is approaching an overfished condition.

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

11. Dogfish

a. 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 Laboratories, 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.

Spiny dogfish are a long-lived, slow-growing species. Length at age data collected from 2004-2007 in cooperation with the Sablefish Longline Survey, the Alaska Observer Program, and ADF&G and University of Alaska Fairbanks surveys were examined to determine the growth and age structure of the species in the Gulf of Alaska. Results suggest that spiny dogfish are among the slowest growing species of shark and grow to a larger size, older age, and mature later in the Gulf of Alaska than other regions in which they occur. Demographic analyses also suggest that the species has a low rate of natural mortality and fecundity, which combined with the age assessment suggest that the species can only tolerate a low level of fishing mortality. Recent work has been completed on an analysis of the diet of spiny dogfish, ontogenetic shifts in diet, and the potential ecological impacts on a seasonal and regional scale. The age, growth, demographic, and diet analyses are now included in the annual Stock Assessment and Fishery Evaluation (SAFE) report for sharks in the Gulf of Alaska.

For more information, contact Cindy Tribuzio at (907) 789-6415.

14. Other Species

a. Research

Ecosystem Considerations of Pacific Sleeper Sharks in the Northeast Pacific Ocean
Collaborative research is being conducted by the NMFS Auke Bay Laboratories (ABL) and the University of Alaska Fairbanks (UAF) on ecosystem considerations of Pacific sleeper shark bycatch in the northeast Pacific Ocean. Specific topics being addressed include the determination of Pacific sleeper shark relative abundance trends, distribution, habitat, and trophic level in Alaskan marine waters. Historical trends in area-weighted catch per unit effort (CPUE) of Pacific sleeper sharks in the northeast Pacific Ocean between the years 1979 and 2003 were determined from sablefish longline surveys. There are no directed fisheries or surveys for Pacific sleeper sharks in Alaskan marine waters; consequently, abundance estimation is limited to indirect methods. We analyzed Pacific sleeper shark incidental catch (bycatch) from sablefish longline surveys conducted on the upper continental slope of the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska between the years 1979 and 2003. Our objectives were to estimate trends in Pacific sleeper shark relative abundance and their statistical significance. A total of 1,565 Pacific sleeper sharks were captured by sablefish longline surveys between the years 1979 and 2003 with a sample effort of 19.7 million hooks. Area (km^2) weighted CPUE of Pacific sleeper sharks was analyzed from standardized sablefish longline surveys between the years 1982 and 2003 with bootstrap 95% confidence intervals as an index of relative abundance in numbers. Within the limited time series available for hypothesis testing, area-weighted CPUE of Pacific sleeper sharks increased significantly in the eastern Bering Sea between the years 1988 and 1994 and in the Gulf of Alaska between the years 1989 and 2003, but also decreased significantly in the Gulf of Alaska in 1997. The increasing trend in the Gulf of Alaska was driven entirely by one region, Shelikof Trough near Kodiak Island, where most (54%) Pacific sleeper sharks were captured. Increasing trends in area-weighted CPUE of Pacific sleeper sharks in the eastern Bering Sea and Shelikof Trough are consistent with previous analyses of fishery-dependent and fishery-independent data from the northeast Pacific Ocean and with evidence of a climatic regime shift that began in 1976 and 1977. Whether these increasing trends in CPUE represent an increase in the relative abundance of Pacific sleeper sharks at the population level or just reflect changes in local densities is unknown because of caveats associated with computing the area-weighted CPUE and because of a lack of information on the life history and distribution of Pacific sleeper sharks.

For more information, contact Dean Courtney at (808) 983-5345.

Deep-water Longline Study for Giant Grenadier and Sablefish
In August 2008, ABL used the chartered commercial longline vessel *Beauty Bay* to conduct a deep-water longline survey feasibility study in the western Gulf of Alaska. The objective was to investigate the abundance and biological characteristics of giant grenadier and sablefish in deep waters of the Gulf of Alaska that have not been previously sampled in fishery surveys. Longline and trawl surveys in Alaska both indicate that these two species are by far the most abundant fish at depths 400-1,000 m on the continental slope, but their abundance in deeper water is unknown. The study consisted of fishing five longline stations on August 6-10 east of Dutch Harbor at

depths up to 1,620 m. However, due to vessel mechanical problems and the difficult fishing conditions encountered at the deep-water stations, total fishing effort in the study was ~40% less than had been planned, and depth coverage was also less than ideal.

The study demonstrated that fishing longlines in deep water can present special problems, and that extra fishing effort may be needed to compensate for these problems. Because of the limited fishing effort and incomplete depth coverage, results of the study were not conclusive. However, catch rates of sablefish were extremely low, and those of giant grenadier were relatively high. This suggests that biomass of sablefish at depths >1,000 m in the western Gulf of Alaska is probably inconsequential, whereas considerable biomass of giant grenadier may exist at these depths. An unexpected finding of the study was the large abundance of another grenadier species, Pacific grenadier, at some of the deep-water stations. At one station, Pacific grenadier were caught on 56% of the hooks that were set.

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

Octopus life history – RACE Groundfish Kodiak/REFM collaboration

Initial stock assessments of octopus within the Gulf of Alaska have revealed that there is little life history information available for this group. RACE biologists at the Kodiak Laboratory in collaboration with REFM biologists in Seattle will initiate a life history study of Giant Pacific Octopus within the fall months. This study will likely co-occur with gear experimentation studies to examine the feasibility of an octopus fishery. A commercial fisher willing to provide octopus samples within the fall months during the pot cod fishery has been identified. These samples will be utilized to identify reproductive stages of the octopus to achieve a better understanding of the life history of this species.

For more information, contact Dr. Christina Conrath, (907)481-1732.

b. Stock Assessment

Shark Bycatch in Alaskan Waters

The shark bycatch assessment chapters from 2008 for the Bering Sea/Aleutian Islands (BSAI) and for Gulf of Alaska (GOA) were updated for 2009 and presented to the North Pacific Fishery Management Council's Groundfish Plan Teams in November 2008.

Incidental catch estimates for sharks are now available from the NMFS Alaska Regional Office (AKRO). Incidental catch for sharks was updated with the most recent AKRO estimates, and incidental catch from the years 1997–2007 was established as a baseline for identifying options for setting future sustainable incidental catch limits for sharks in the BSAI and GOA. Bottom trawl survey biomass data were updated for the 2008 Eastern Bering Sea (EBS) slope and shelf. Previous survey data were available from NMFS AFSC bottom trawl surveys in the EBS shelf (1979–2008), EBS slope (historical 1979-1991, and new time series 2002, 2004, 2008), and Aleutian Islands (1980–2006). Previous trawl survey data were available from NMFS AFSC bottom trawl surveys conducted triennially and biennially in the GOA (1984–2007).

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 incidental catch of Pacific sleeper sharks from 1997–2007 (414 mt) represented 8.6% of the available Pacific sleeper shark biomass from BSAI bottom trawl surveys in 1996–2007 (total of the average biomass from three surveys was 5,168 mt). Historically, 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. However, 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). The EBS slope survey was conducted again in 2008. The EBS shelf survey did not encounter sharks in 2007 or 2008 and the biomass estimates were zero, but the EBS slope survey did encounter sharks in 2008 (2,051 mt). 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 1997–2007 (482 mt) represented less than 1% of the available spiny dogfish biomass from GOA bottom trawl surveys in 1996–2007 (average biomass of spiny dogfish in the surveys was 66,771 mt). 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 1997–2007 (304 mt) represented less than 1% of the available Pacific sleeper shark biomass from GOA bottom trawl surveys 1996–2005 (average biomass of Pacific sleeper sharks was 37,821 mt). Average bycatch of salmon sharks from 1997–2007 (63 mt) was relatively small, and GOA bottom trawl survey biomass estimates for salmon sharks were unreliable because salmon sharks were only caught in four hauls from 1996–2007.

For more information, contact Cindy Tribuzio at (907) 789-6415.

Grenadiers in Alaska

In 2008, an updated complete assessment was done for grenadiers in Alaska and incorporated as an appendix into the North Pacific Fishery Management Council's (NPFMC) annual Stock Assessment and Fishery Evaluation Report. The first-ever assessment of grenadiers was done in 2006. Assessment of grenadiers is needed because of the possible inclusion of grenadiers in the NPFMC's Groundfish Management Plans and also because of the relatively large numbers of these fish that are taken as bycatch in other directed fisheries. Presently, grenadiers are not "specified" (i.e., included) in these management plans. As a result, fishermen are free to catch as many grenadiers as they want, and there is no official tracking of catch by management.

Giant grenadier (*Albatrossia pectoralis*) appears to be the only grenadier species to warrant management concern in Alaska at present. Survey information indicates that giant grenadier is the most abundant fish on the continental slope at depths 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 fishing for giant grenadier in Alaska, substantial numbers are taken as bycatch and discarded in the sablefish and Greenland turbot longline and pot fisheries. Discard mortality is 100%. Estimated annual catches of giant grenadier in Alaska based on observer data have ranged between 11,000 mt and 21,000 mt in the years 1997-2008. By geographic region, these catches averaged 2,901 mt in the eastern Bering Sea (EBS), 2,244 mt in the Aleutian Islands (AI), and 10,789 mt in the Gulf of Alaska (GOA).

In the assessment, data from AFSC bottom trawl and longline surveys were used to compute corresponding biomass estimates of giant grenadier as follows: EBS, 518,778 mt; AI, 979,256 mt; and GOA, 488,414 mt. The assessment applied an F=M=0.078 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, 30,349 mt; AI, 57,286 mt, and GOA, 28,572 mt. When these values are compared with the estimated catches of giant grenadiers, it appears that giant grenadiers are not being overfished at this time. However, the reported longevity, slow growth, and deep-sea habitat 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. Because of these special concerns for susceptibility of giant grenadier to overharvest, fishery managers should closely monitor future catches to ensure that overfishing does not occur.

The AFSC REFM Division Age and Growth Program aged giant grenadier for first time in 2006-2007 based on otoliths collected during the 2004 and 2006 NMFS longline surveys in the GOA for an age of maturity study. These ages were used in 2008 as the basis for determining the new mortality estimate of 0.078 that was used in the OFL and ABC computations. The aging procedure developed by the Age and Growth Program is considered experimental, and a small study was conducted in 2008 based on carbon 14 analysis of the otoliths in an attempt to confirm some of the ages. This study proved unsuccessful because carbon 14 could not be found in sufficient concentration in the otoliths, and other means of validation will be necessary.

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

D. Other Related Studies

Nearshore Fish Assemblages in Kachemak Bay, Alaska

Nearshore fishes were sampled in inner and outer Kachemak Bay near Homer, Alaska, in July 2008 to determine distribution and habitat use. Fish were sampled with a beach seine in three shallow-water (<5 m deep) habitats (bedrock outcrops, kelp, and sand/gravel). A total of 1,747 fish representing 25 species were captured in 15 seine hauls. Five species accounted for 82% of the total catch: in decreasing order of abundance, pink salmon (*Oncorhynchus gorbuscha*), walleye pollock (*Theragra chalcogramma*), juvenile cottids (Cottidae), saffron cod (*Eleginus gracilis*), and Pacific sand lance (*Ammodytes hexapterus*). Overall percent frequency of occurrence (FO) was 73% for saffron cod, 40% for pink salmon, 20% for walleye pollock, and 13% for both juvenile cottids and Pacific sand lance. Most fish captured were juveniles; mean length of the five most abundant species was less than 184 mm. Distribution and abundance of saffron cod appears to be increasing in Kachemak Bay: FO in beach seine catches was about 2% in 1976 and 9% in 1995 compared to 73% in 2008.

For more information, contact Scott Johnson at (907) 789-6063.

Bycatch Studies – Effects of fatigue on swimming in confined space (simulated codend) – RACE FBE Newport

Designing bycatch reduction devices in trawls is not a simple matter of passive filtration of fish. Fish motivation and ability to swim and orient to escape from nets changes with fatigue, light conditions, size, and species. When designing bycatch reduction devices for fish, it is important to measure and understand swimming abilities and motivation states. Walleye pollock and Pacific cod juveniles (1+, 2+, and 3+ year) were tested by swimming for 6 h at 9^{o}C in a circular flume which simulated confinement in a trawl cod end. The circular flume contained an outer zone of higher current speed and an inner zone of lower current speed (approximately half of the outer zone speed). Outer zone current speeds ranged from 0 - 42 cm s^{-1} and fish were able to choose swimming modes and directions in the current gradient. Fish were also chased with a net for 8 min to a state of fatigue in which they no longer responded to the net (simulating swimming in the mouth of a net and capture). Fatigued fish were then tested in the circular flume and responses were compared to control fish. Studies are ongoing and preliminary results have shown that current speed, fatigue, fish age, and species can act as factors in swimming behavior. We are also testing the effects of darkness and cold temperature (3^{o}C) on swimming behavior of control and fatigued fish in the circular flume.

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

RACE Habitat Research Team

Research by the RACE Division Habitat Research Team (HRT) 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 approach assumes that density data reflect habitat utilization, and the degree to which a habitat is utilized is considered to be indicative of habitat quality. Subsequent characterization of the habitat in these areas requires systematic mapping of the relevant biotic and abiotic variables, and the development of quantitative habitat models.

The research themes of the HRT include: (1) the identification of suitable predictor variables for building quantitative habitat models, (2) the development of tools for mapping these variables over large areas, and (3) the investigation of activities with potentially adverse effects on EFH, such as bottom trawling. In FY08, NOAA Corps hydrographer LT John Lomnicky completed his three-year assignment as a Benthic Mapping Specialist, the first such cross-over billet between NOAA hydrography and fisheries. His replacement, LTjg Meghan McGovern reported in June 2008. Two papers published in 2008 discussed the benefits of integrated ocean mapping (Lomnicky and McConnaughey, 2008; Lomnicky *et al.*, 2008).

The main research focus in FY08 was on evaluating acoustic backscatter and benthic infauna characteristics as predictors of groundfish distribution. Results of a study in 2002 in Bristol Bay to model the relationship between processed side scan sonar backscatter data and groundfish distributions were published (Yeung and McConnaughey 2008). Results of another study in 1999 in the eastern Bering Sea (EBS) to model the relationship between single-beam echosounder backscatter and groundfish distributions are in press (McConnaughey and Syrjala 2009). Acoustic data collected in 2006 during the multi-mission hydrographic-fisheries experiment ("FISHPAC") in the EBS were processed and prepared for analysis. Processing and analysis of the infauna and sediment grab samples collected during FISHPAC 2006 was completed, and a manuscript detailing the inter-relationship between sediment type, infauna community, and the distribution of groundfish was completed (Yeung *et al.*, in review). The second FISHPAC experiment in 2008 was significantly shortened due and the full study was rescheduled for FY09.

2008 HRT Research Activities

Long-range fisheries sidescan sonar (LRSSS) 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 is prohibitively expensive over large areas. Similarly, it has been estimated that remote sensing with conventional multibeam echosounders will require over 545 years and $5 billion to acquire data for mapping the U.S. EEZ. The development of a Long Range Side Scan Sonar (180 kHz) capable of very broad coverage (1.2 km swath) at high tow speeds (7.5 kts with 100% coverage, 12 kts maximum) addresses the need for greater efficiency when mapping and characterizing the seafloor for fisheries and habitat research. Research and development of the LRSSS and its fiber-optic interface has been progressing since 2004. A prototype LRSSS was successfully deployed and data were acquired during the 2006 FISHPAC experiment in the southeastern Bering Sea. The Factory Acceptance Test for the two LRSSS systems was completed in 2008 and a technical review of the results was undertaken. Some additional field data were acquired in the EBS during an abbreviated 2008 research cruise. Delivery of the first system is scheduled for 2009. In addition to side scan sonar, the LRSSS towfish also carries an independent single beam echosounder, an integrated multibeam echosounder, and a triplet of optical scatter sensors that measures the concentration of chlorophyll-a, dissolved organics and total particulates.

Acoustic backscatter for Essential Fish Habitat characterization (FISHPAC)

The first FISHPAC field experiment was conducted in the EBS in the summer of 2006 aboard the NOAA ship *Fairweather*[1]. The scientific objective of the cruise was to evaluate the utility of acoustic backscatter data for characterizing EFH, while simultaneously comparing the performance of five different sonar systems. The five systems included two hull-mounted multibeam echosounders on *Fairweather* (50 kHz, 100 kHz); a high-resolution interferometric side scan sonar (455 kHz), the prototype LRSSS (180 kHz), and a vertical incidence echosounder (38 kHz) mounted on the LRSSS towfish. Multiple passes were made along 720 nmi of survey

[1] See http://www.afsc.noaa.gov/RACE/surveys/cruise_archives/cruises2006/results_FW-FISHPAC2006.pdf

tracklines spanning strong gradients of groundfish abundance that are represented in a time series of fixed-station annual trawl survey catches. Three sampling devices - (1) a Free Fall Cone Penetrometer (FFCPT), (2) a SEABed Observation and Sampling System (SEABOSS), and (3) a Towed Auto-Compensating Optical System (TACOS) - were used at selected stations on the tracklines to groundtruth acoustic backscatter and assemble a multifaceted understanding of the seafloor. The performance of each acoustical system will be evaluated based on the degree of statistical correlation between normalized backscatter and fish density. The benefits and costs of each system will be compared to identify the most appropriate system for broad-scale mapping of the EBS shelf. Acoustic data are being processed in collaboration with FISHPAC research partners at the University of New Hampshire Center for Coastal and Ocean Mapping and the NOAA Pacific Hydrographic Branch. Approximately 920 nmi of unique trackline data were acquired using the *Fairweather*'s two multibeam echosounders. These bathymetry data have been processed and formally submitted for NOAA nautical chart updates. FFCPT data, TACOS imagery, and SEABOSS imagery have been processed. Infauna identification and sediment grain size analyses have been completed. Additional acceptance testing of the LRSSS near Catalina Island and field trials in Puget Sound occurred in 2008. Some additional field work was also conducted in the EBS in summer 2008.[2] *Fairweather* departed Dutch Harbor on 7 August after reaching minimum staffing level, completing winch repairs, and conducting local gear trials. Surveying began on 8 August and Fairweather returned to Dutch Harbor on the morning of 10 August. There were a number of significant accomplishments despite limited sea time. During pre-cruise testing near Dutch Harbor, the capability to deploy both a side scan sonar and the FFCPT to simultaneously collect seabed backscatter, sound velocity profiles and geotechnical properties of sediment (groundtruth) was demonstrated while underway at 6 kts. The project also: (1) collected new Reson 8111 and 8160 survey data along a previously surveyed (2006 FISHPAC) transect to enable interannual comparison of backscatter characteristics; (2) completed multibeam and side scan sonar surveys at active hydrothermal features near the port of Dutch Harbor; (3) collected new infauna samples as part of a continuing project to characterize these communities in the EBS; (4) collected LRSSS reconnaissance data along two cross-shelf transects totaling 220 nmi, at depths of 80-1300 meters; (5) collected continuous dissolved organics (red 370 nm), chlorophyll-a (green 470 nm), and total particulate concentration (blue 660 nm) data from the pelagic environment along the same two cross-shelf transects; (6) acquired hydrographic-quality bathymetry data for updating NOAA nautical charts of an area with outdated or non-existent information; and thus (7) further demonstrated the feasibility of the multi-mission Integrated Ocean and Coastal Mapping (IOCM) concept. A make-up cruise scheduled for 2009 will acquire habitat and acoustic data north of the 2006 study area as planned for 2008. Coverage of the entire EBS with the most cost-effective acoustic system is targeted in the future.

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 model 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 was collected along survey lines totaling nearly 600 linear miles. In addition to providing spatial context for the ongoing trawl impact study in Bristol Bay, the survey also intersected 18 RACE Division trawl survey stations and followed 78

[2] See http://www.afsc.noaa.gov/RACE/surveys/cruise_archives/cruises2008/FISHPAC cruise report 2008 (10-15-08) (2).pdf

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. Acoustic variables from *QTC* software processing of raw digital backscatter data were used in multiple linear regression to model individual species abundance from bottom-trawl survey data (Yeung and McConnaughey 2008). The acoustic variables were the three Q-values (Q1, Q2, Q3) representing the first three principal components of the data derived from image analysis of backscatter echoes, and a complexity metric (compx) measuring the variance of Q-values in a geographic area. Habitat models for flathead sole (*Hippoglossoides elassodon*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), red king crab (*Paralithodes camtschaticus*), basket star (*Gorgonocephalus eucnemis*), and sponges (Porifera) include acoustic variables as significant predictors. For these six taxa, full models explained 67-86% of variability in abundance, with 9-54% of that total contributed by the acoustic predictors. The results suggest that acoustic data could advance habitat research for some bottom-associated marine species.

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 nmi trackline in the EBS during a 1999 hydroacoustic fishery survey on the NOAA ship *Miller Freeman* (McConnaughey and Syrjala, 200). The acoustic data were processed with QTC algorithms to produce continuous variables, namely the first three principal components (the Q-values Q1, Q2 and Q3). These results were then merged with 23 years of RACE trawl survey data from the EBS shelf (1982-2004). Statistical analyses using generalized additive models (GAM) showed significant contributions of the continuous acoustic variables to the best habitat models for eight species of fish and two species of crab: Alaska plaice (*Pleuronectes quadrituberculatus*), yellowfin sole (*P. asper*), flathead sole (*Hippoglossoides elassodon*), rock sole (*Lepidopsetta* spp.), arrowtooth flounder (*Atheresthes stomias*), Pacific halibut (*Hippoglossus stenolepis*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), snow crab (*Chionoecetes bairdi*), and opilio crab (*C. opilio*). The full models explained 28-77% of variability in abundance, with 2-13% of that contributed by the acoustic variables. These results are similar to, although less compelling than, those from the study using side scan sonar in Bristol Bay (Yeung and McConnaughey, 2008). Taken together, the studies suggest there are important differences in the relative costs and benefits of different acoustic systems and these should be considered when developing plans for broad-scale (EEZ) seabed mapping. Collaborative research with QTC has also resulted in a fully-automated objective classification process based on the Q-values, involving a new application of the Bayesian Information Criterion (BIC). An optimal classification scheme for the EBS shelf has been identified (14 distinct classes of bottom types for 38 kHz data).

Short-term trawling effects and recovery monitoring in the EBS

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 pre-designated 10-mi long research corridors were sampled before and after a trawling disturbance with commercial gear (NETS 91/140 Aleutian cod combination). Biological sampling consisted of 15 min research trawls for epifauna (n=72 total) and 0.1 m^2 van Veen grab samples for infauna (n=144 total at 2 per epifauna site). At each infauna sampling site, a second grab sample (n=144 total) was collected for characterizing carbon and nitrogen levels in surficial sediments, as well as grain size properties. Each of the experimental and control corridors was also surveyed twice using a Klein 5410 side scan sonar system. The corridors were revisited in 2002 to monitor recovery. There was no commercial trawling event, and a total of 36 epifauna trawls, 72 infauna grabs, 72 sediment grabs, and one side scan survey per corridor were performed in 2002. Combined, these data quantify recovery in the experimental corridors after one year using corrections for temporal variability measured in the control corridors. The experimental design for this study will accommodate one additional series of epifauna sampling and multiple years of grab sampling after 2002; the final recovery monitoring event has not been scheduled. Processing of all 2001 and 2002 samples has been completed and statistical analysis is in progress. Preliminary observations indicate a very diverse epifaunal community (approximately 90 distinct taxa) on very-fine olive-gray sand at 60 m depth. The seafloor appears to be brushed smooth in the 2001 side scan imagery, probably due to the sizable storm waves and strong tidal currents that regularly disturb the area. Occasional video deployments on the trawls indicated somewhat greater complexity. Derelict crab pots are scattered throughout the study area and there is evidence of extensive feeding by walrus (Bornhold *et al*. 2006[3]). The physical effects of trawling were not dramatic probably due to the tightly compacted coarse-sand condition of the seabed, however distinctive patterns were detectable in the post-trawl sidescan surveys that were not present in imagery collected prior to trawling. Preliminary statistical results for the epifaunal invertebrates also indicate minimal effects of trawling.

Infauna community for Essential Fish Habitat characterization

The development of habitat models for managed species in the EBS is hampered by a lack of basic environmental and ecological information. In particular, there is a critical need for studying benthic infauna as a component of essential fish habitat (EFH) and a link in fisheries productivity. Benthic infauna constitute substantial portions of the diets of many fishes, crustaceans, mollusks, marine mammals and seabirds at various ontogenetic stages. Since food availability is a strong driving force in habitat selection, the structure of the infauna community can be a useful predictor of favorable habitat for fish/invertebrate predators. Benthic infauna are also key indicators of biodiversity, as well as a primary group used in monitoring anthropogenic and natural changes in benthic, especially soft-bottom, environments. The HRT is collaborating with the Resource Ecology and Ecosystem Modeling (REEM) program (Mei-Sun Yang) in the AFSC Resource Ecology and Fisheries Management (REFM) division to study the infauna community in the EBS for EFH characterization. The initial steps are to describe the spatial patterns of the infauna community and associated habitat characteristics, and to spatially link these variables to groundfish distributions. Next, functional relationships will be established and incorporated into habitat models for individual groundfish species. Paired infauna and sediment benthic grab samples were collected at 26 different locations during the 2006 FISHPAC survey; these were the first new observations on EBS polychaetes in nearly three decades (Yeung *et al.*, 200). Canonical correspondence analysis indicated that surficial sediment was the most important factor in organizing the polychaete community, over other common environmental variables such as depth and temperature. Co-correspondence analysis of the distributions of the groundfishes and polychaete families did not indicate that predators are associated with specific

[3] Bornhold, B.D., C.V. Jay, R.A. McConnaughey, G. Rathwell, K. Rhynas and W. Collins. 2006. Walrus foraging marks on the seafloor in Bristol Bay, Alaska – a reconnaissance survey. Geo-Marine Letters 25: 293-299.

prey taxa. Instead, prey availability may dictate consumption (or larger sample sizes may be required to demonstrate the predator-prey associations). Additional grab sampling that was planned for the 2008 FISHPAC survey, extending coverage north of the 2006 survey, will be undertaken in 2009. During the 2009 RACE summer bottom trawl survey, stomachs from selected flatfish species, such as yellowfin sole (*Limanda aspera*), will be collected near these grab sampling locations.

Benthic invertebrate ecology knowledge base
Benthic invertebrates constitute the living component of benthic habitat, functioning as predators, prey, competitors, and shelter for managed species. They are indicators of environmental conditions and a driving force behind the distribution of managed species. Recognizing the need for ecological information on benthic invertebrates in the EBS to support habitat and fisheries research, a knowledge base is being compiled, including: (1) a comprehensive guide to the life history and ecology of key epibenthic macro-invertebrates; and (2) a database of EBS infauna from grab samples collected during HRT trawl impact studies and the FISHPAC project. During FY08, a synopsis of the life history and ecology of the neptunid snails (genus *Neptunea*) was completed and a literature database was assembled.

For additional information, see http://www.afsc.noaa.gov/RACE/groundfish/hrt/default.php or contact Dr. Bob McConnaughey, (206) 526-4150.

Research Related to Improving Bottom Trawl Surveys

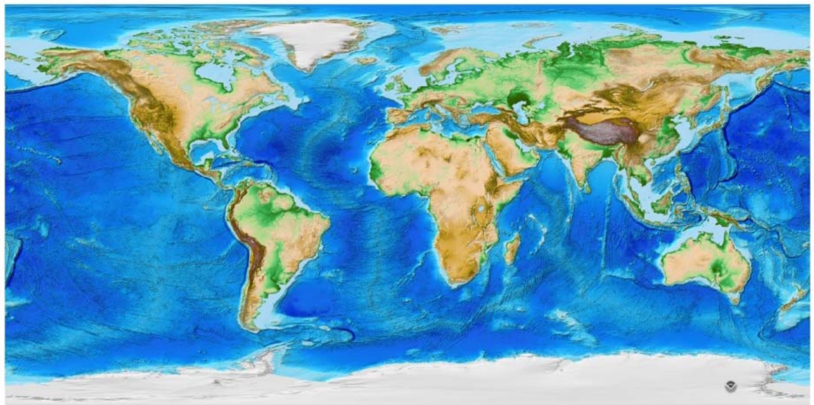
Working Group for Bottom Trawl Survey Improvements (WGBTSI) - Reducing Error in Area Swept Estimates
The Groundfish Assessment Program's Working Group for Bottom Trawl Survey Improvements (WGBTSI) continues to critically review our bottom trawl surveys and to recommend ways to reduce systematic errors in survey procedures and data analyses. Work in 2008 focused on improving estimates of distance fished and average net width during survey trawl hauls by improving the smoothing algorithms used to analyze position and net mensuration data. Using a cubic spline smoother appears to be the most accurate and robust method of smoothing these data. A report of this research will be released soon.

For additional information please contact Stan Kotwicki, (206) 526-6614.

E. Other Items

GIS Resources

Data
A new color shaded-relief image of Earth from ETOPO1 Ice Surface, created by NGDC, is downloadable as a georeferenced TIFF or KMZ file from http://www.ngdc.noaa.gov/mgg/global/global.html.



GEBCO_08 Grid. a global 30 arc-second grid was released January 2009. It is generated by combining quality-controlled ship depth soundings with interpolation between sounding points guided by satellite-derived gravity data. It is available from http://www.gebco.net/data_and_products/gridded_bathymetry_data/. The data are made available from this web application in the form of netCDF files and can be used with Generic Mapping Tools (GMT) software system.

Other Tools

Satellite Extension

There is now a new version of the Environmental Data Connector (EDC) that is compatible with ArcGIS 9.3. The EDC uses a Java-based browser to allow users to connect to THREDDS (Thematic Real-time Environmental Distributed Data Services) catalogs. The connector leverages existing components from the Unidata libraries so that users can filter large amounts of data in space and time. The data is then converted to raster or feature classes in ArcGIS and is available for standard GIS analysis and display. The EDC is also provided by ASA as a stand-alone. It is available from http://www.pfeg.noaa.gov/products/EDC/.

Ecosystem-Based Management (EBM) tools are software or other highly documented methods that can help implement EBM in coastal and marine environments and their watersheds. Some tools are designed to be used with a GIS while others are stand alone. Check out http://www.ebmtools.org/ for more information.

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

APPENDIX I - Alaska Fisheries Science Center Groundfish-Related Publications and Documents In Press – January 2008 through April 2009

(AFSC authors in bold text)

Alaska Fisheries Science Center (AFSC) Peer-Reviewed Journal Reports and Technical Memoranda in 2008 and early 2009 (AFSC authors are in bold).

Note: Listings of 2008 Groundfish Stock Assessment Reports and AFSC Processed Reports are accessible by following the links provided below to the appropriate AFSC web page.

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2008. Results of the 2007 eastern Bering Sea continental shelf bottom trawl survey of groundfish and invertebrate resources. U. S. Dep. Commer., NOAA Tech. Memo., NMFS-AFSC-181, 195 p. Online. (.pdf, 7.15MB).

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2008. Rise and fall of jellyfish in the eastern Bering Sea in relation to climate regime shifts. Prog. Oceanogr. 77:103-111.

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RESOURCE ASSESSMENT AND CONSERVATION ENGINEERING DIVISION
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Midwater Assessment
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K. Williams
N. Williamson
T. Yasenak
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Conservation Engineering
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Vice - Otto*

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J. Goyne
L. Chilton
P. Cummiskey
J. Haaga
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B. Malley
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B. O'Gorman
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Fisheries Resource Pathobiology (Seattle)
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Groundfish Assessment
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L. Britt
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J. Hoff
S. Kotwicki
G. Mundell
D. Nichol
D. Stevenson
K. Weinberg
B. Lauth**

Gulf of Alaska Aleutian Is. Groundfish
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J. Orr
N. Raring
C. Rooper
D. Shaw
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P. Van Szalay
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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		
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ADP

Blaisdell, Mark

Wennberg, Sherrie

Revised April 2005

APPENDIX IV - Auke Bay Laboratory Marine Ecology and Stock Assessment (MESA) Program Staff

Name	Duties
Phil Rigby	Program Manager
Doris Alcorn	Seafloor Ecology, Outreach
Dave Clausen	Rockfish, Grenadiers, Alaska Groundfish
Dave Csepp	Forage Fish, Hydroacoustics
Jeff Fujioka	Sablefish, Rockfish, Stock Assessment, Effects of Fishing
Dana Hanselman	Sablefish, Rockfish, 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
Pat Malecha	Groundfish Ecology, Effects of Fishing
Nancy Maloney	Sablefish Tag Database, Longline Survey, and Seamounts
Cara Rodgveller	Sablefish, Rockfish, Longline Survey, Grenadiers
Tom Rutecki	Sablefish, Webmaster
Kalei Shotwell	Groundfish Habitat, Rockfish, Stock Assessment
Robert Stone	Seafloor Ecology, Effects of Fishing, Coral and Sponge Life History
Cindy Tribuzio	Sharks, Stock Assessment

Other ABL Staff Working on Groundfish-related Research

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

CANADA

British Columbia Groundfish Fisheries and Their Investigations in 2008

Prepared for the 50th Annual Meeting of the Technical Sub-Committee of the Canada-United States Groundfish Committee
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April 2009

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REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT, AND MANAGEMENT

A. 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	Mr. Mark Saunders (New)
Marine Ecosystems & Aquaculture	Dr. Laura Brown (New)

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

Groundfish	Mr. Greg Workman (New – Acting)
Invertebrates	Mr. Jim Boutillier
Pelagic Fish Research & Conservation Biology	Mr. Jake Schweigert
Applied Technologies	Mr. Ken Cooke
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 are conducted in the Applied Technologies Section. The Canadian Coast Guard operates DFO research vessels. These vessels include the *W.E. Ricker, J.P. Tully, Vector* and *Neocaligus*. A replacement vessel for the *W.E. Ricker* has been designed and costs estimates generated, unfortunately the chosen design came in over budget resulting in a review of the SOR (Statement of Requirements) and a likely delay until 2013 or beyond for a replacement of the *WE Ricker*.

The Pacific Region Headquarters (RHQ) of Fisheries and Oceans Canada are located at 401 Burrard Street, in Vancouver (BC, V6C 3S4). Management of groundfish resources is the responsibility of the Pacific Region Groundfish Coordinator (Mr. Gary Logan) within the Fisheries Management Branch, RHQ. 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 the 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.meds-sdmm.dfo-mpo.gc.ca/csas/applications/Publications/publicationIndex_e.asp

Trawl, sablefish, rockfish, lingcod, dogfish and halibut fisheries continue to be managed with Individual Vessel Quotas (IVQs). IVQs can be for specific areas or coast wide. 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 implemented the "Groundfish Integration Strategy" years for the 2006/2007 fishing season as a three year pilot. In particular, DFO and the commercial fishery sectors (gear types) are working towards an integrated fishery plan. The plan calls for individual transferable quotas in all commercial groundfish sectors. All vessels require 100% monitoring of their discarded and retained catch. Details can be viewed in the 2009/2010 integrated fisheries management plan at http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/MPlans.htm?&lang=en (You will need to sign-in or register for this site to view material).

A shift in the funding of industry collaborations, particularly in conducting cooperative surveys, was required after the *Larocque* court decision of June 23, 2006. Prior to the *Larocque* decision, compensation provided to fishers for their data collection services took the form of the proceeds of the unavoidable fish kills in the research surveys, less any samples retained for detailed scientific analysis. In instances where these proceeds did not cover the cost of the research survey, the department allowed fishers to catch additional fish for payment purposes. Post – Larocque these "top up" payment fishing activities are no longer possible. Larocque Relief Funding, to replace fish allocations, was provided in 2007 and will continue to fund surveys through 2012. Details at http://www.dfo-mpo.gc.ca/Science/newpoli-polinouv/guidance-conseils-eng.htm

B. Multispecies or ecosystem models

Groundfish Staff participated in the Strait of Georgia Ecosystem Research Initiative Project during a two week hydroacoustic/trawl survey during February of 2009.

The Central Theme of this Ecosystem Research Initiative is "The Strait of Georgia in 2030", i.e. what might the Strait of Georgia be like in 2030. Responding to this challenge of imagining the future, or constructing scenarios, involves: 1) understanding how this ecosystem works, 2) identifying the various drivers of change most likely to determine future conditions, and finally 3) analyzing the future responses of the system under the influences of these drivers of change. The research conducted within this Initiative is designed to align with the Departmental goals of ensuring a healthy and productive aquatic ecosystem in the Strait of Georgia, and to support sustainable fisheries and aquaculture in the Strait. This research imitative currently comprises over thirty research projects and involves over fifty researchers. Details at http://www-sci.pac.dfo-mpo.gc.ca/sogeri/default_e.htm

In a separate unrelated research project the relationship between reduced oxygen concentration in BC coastal waters and the distribution of groundfish species was investigated. Concurrent with the shallowing of the oxygen minimum layer in coastal waters there has been a shift in groundfish species distributions to shallower waters. The change is most pronounced for species normally found below 150 m depth and is areas most exposed to the open ocean, e.g. the west coasts of Vancouver Island and the Queen Charlotte Islands.

C. By species

1. Pacific cod

a. Research program
No new research was conducted on Pacific cod in 2008.

b. Stock assessments
No new stock assessments for Pacific cod were conducted in 2008, or are planned for 2009.

2a. Rockfish – offshore

a. Research programs
This program originally focused on the assessment of rockfish species living on the continental slope of British Columbia. Seven rockfish species in particular were monitored annually: Pacific ocean perch (*Sebastes alutus*), yellowmouth rockfish (*S. reedi*), rougheye rockfish (*S. aleutianus,* now including a separate species called blackspotted rockfish *S. melanostictus*), shortraker rockfish (*S. borealis*), redstripe rockfish (*S. proriger*), shortspine thornyhead (*Sebastolobus alascanus*), and longspine thornyhead (*S. altivelis*). This monitoring ceased in 2000, and since then our group tackles a variety of issues: stock assessment, COSEWIC listing requirements, oceanographic exploration, software development for the R statistical platform, scientific research in marine ecological modeling. There is a fair degree of inter-program collaboration.

Currently, DFO's groundfish program of synoptic surveys conducts all field research work for the slope rockfish species. A separate program, headed by Andrew Edwards, focuses on the development of models and software tools for the analysis of data pertaining to groundfish and other species. We also remain fortunate to keep the interest of Jon T. Schnute (scientist emeritus) who contributes considerable time and expertise to our program.

Aside from work on ecosystem models (e.g., migration patterns, density-dependent mortality), Andrew Edwards joined forces with the other new scientists at PBS to foster the rejuvenation of scientific collaboration and exploration at PBS. Notably, the seminar schedule was enhanced and a series of R workshops, coordinated by Michael Folkes, featured many interesting topics: Bayesian methods (Steve Martell), S4 class structure (Jon Schnute), management strategy evaluation (Sean Cox), microarray data analysis (Isabella Ghement), FLR (Laurie Kell).

In 2008 we continued revisions on our publicly available software packages *PBSmapping*, *PBSmodelling*, and *PBSddesolve*, available as libraries for the statistical language R (Comprehensive R Archive Network, http://cran.r-project.org/). Numerous stock assessments and other reports on Canadian groundfish have used *PBSmapping* for portraying spatial information on maps. We encourage our colleagues elsewhere to check this out, because it can be very effective for portraying detailed and summary spatial information from individual groundfish tows. We have also started to build upon the foundations of *PBSmodelling*.

In collaboration with Anisa Egeli, a third-year student at Vancouver Island University (formerly Malaspina University-College), we developed prototypes for possible new R packages: *PBSadmb* – integrating AD Model Builder code for direct use by R; *PBSadolc* – making the ADOL-C library (automatic differentiation of algorithms by Andrea Walther and Andreas Griewank) available to R; and *Sunscreen* – introducing a new model that explores environmental effects on the production of a natural sunscreen found in juvenile coho salmon (original research by Max Bothwell at PBS).

We also created a novelty package called *PBSresilate* that provides differential solutions to three-state models and illustrates the three-dimensional results using the R library *rgl*. This package can be used to explore resilience theory, and was inspired by Buzz Holling who just happened to move in next door to Jon Schnute in Nanaimo.

b. Stock assessments

No stock assessments yielding quotas occurred in 2008. However, Rowan Haigh and Paul Starr finalized papers on yellowmouth rockfish *Sebastes reedi* and darkblotched rockfish *S. crameri* in BC coastal waters. This information was compiled for use by multiple clients, including potential writers of COSEWIC stock status reports. Additionally, Andrew Edwards, Paul Starr, and Rowan Haigh started work on a Pacific ocean perch assessment for Queen Charlotte Sound.

c. Research activities for 2009

Andrew Edwards is currently on paternity leave until August, and Paul Starr is working hard in New Zealand. Upon their return to PBS, we will continue work on the Pacific ocean perch (POP) assessment. Biological data indicate that the POP stocks in Goose Island, Mitchell's and Moresby Gulllies are not sufficiently different to warrant separate assessments. Therefore, we shall probably treat Queen Charlotte Sound as one "designatable unit" (in COSEWIC parlance) for the initial assessment. DFO Groundfish Management encourages us to provide advice through a management strategy evaluation (MSE) framework. This may not happen in 2009; however, the technology behind these simulations is changing all the time. One of our section members, Chris Grandin, has acquired a Tesla Supercomputer which he hopes will eventually supply the group with rapid MSE simulation results.

Andrew's research priorities for 2009 will focus on movement strategies of animals and fishermen, species-area relationships, and possibly the dynamics of discarding.

Work with Jon Schnute will focus on directing Vancouver Island University students to enhance existing R packages or create new ones. In collaboration with Rob Kronlund, we plan to utilize the brilliance of Alex Couture-Beil once again for upgrades to *PBSmodelling*'s GUI system.

2b. Rockfish – shelf

a. Research Programs in 2008

Staff initiated a study with the help of James Orr of the NMFS of whether blackspotted and rougheye could be distinguished from one another during bottom trawl surveys. Results were disappointing. DFO staff found the field diagnostics ambiguous. A sorted sample of 100 specimens was examined with genetics at PBS. The genetics analysis confirmed that field id was poor and even Dr. Orr, using photographs, only achieved 90% success, similar to some parallel work in Alaska. At this time, we will not be attempting to distinguish between these species in future surveys; nor will be requesting that at-sea-observers or dockside monitors sort the two species.

DFO staff collaborated with Dr. McAllister and Ms. Robyn Forrest, a research associate at U.B.C. and Dr. Martin Dorn (National Marine Fisheries Service) in a meta-data analysis of steepness of rockfishes. This paper is soon to be submitted to the Fishery Bulletin.

b. Stock assessments in 2008

A stock assessment of bocaccio was reviewed at the Pacific Science Advisory Review Committee in October 2008. A “threatened” designation for the population of canary rockfish in Canada has been recommended by the Committee on Status of Endangered Species in Canada. If accepted by the Governor in Council in late 2010, then a Recovery Strategy has to be in place by late 2011. This assessment is intended to provide assessment elements and harvest advice for preparation of the Recovery Strategy.

The assessment indicated that the stock has declined to 10-15% of unfished biomass and lies within the Critical zone as defined by DFO DRAFT Harvest Strategy (04.B_{msy}). While it appears that the decline has been arrested in the last decade, rebuilding may require a significant reduction from the current annual catches of about 150 t.

The bocaccio assessment includes a description of the methodology for estimating an informative Bayesian prior on the catchability of the surveys based partly on the results of interviews with 12 trawl captains. Similarly, the assessment used the results of interviewing 12 salmon troll fishermen to attempt to reconstruct bycatch of bocaccio in the salmon troll fishery from 1930-2008. Results of this work are provided in the stock assessment (Stanley et al. in press) and will be published as a primary paper (McAllister in prep).

a. Research activities planned for 2009

Staff are participating Dr. Murdoch McAllister on a study of the adequacy of the current survey array. Using the a Recovery Strategy for bocaccio as a case example, the study attempts to determine if the precision of the planned set of survey indices will provide adequate indexing to support a Recovery Strategy, or, stated differently, how precautionary does the management control have to be within the Recovery Strategy given the imprecision of survey indices that will be used to monitor the recovery.

b. Stock assessments in 2009

Shelf rockfish staff will take a lead role in 2009 in developing a new process for prioritizing, scheduling and project managing groundfish stock assessment.

2c. Rockfish – inshore

a. Research programs in 2008 and planned for 2009

Since 2003, an observer has been deployed on the International Pacific Halibut Commission (IPHC) Area 2B setline survey to collect hook-by-hook catch data and conduct biological sampling of non-halibut catch (Yamanaka et al. 2004, 2007, Lochead et at. 2006, Obradovich et al. 2008). This program has been partially or wholly funded by industry prior to 2007. Since 2007, due to the Larocque decision, the Department has funded the staffing of a third technician by the IPHC.

A longline survey, conducted in 2003 and 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 (Lochead and Yamanaka 2004, 2006, 2007). Survey locations were selected using a depth stratified (41 – 70 m and 71 – 100 m) random design. The longline survey is designed to cover the "inside" waters of Vancouver Island (4B) over three years starting in the north (SAs 12 and 13) in 2007, followed by the central areas in 2008 and the southern areas in 2009. Three weeks of ship time are allocated between August 15 and September 15 for this survey.

A Phantom HD2 remotely operated vehicle (ROV) was acquired by the Department and used in 2006 and 2007 to develop visual survey methods for inshore rockfish. A DIDSON sonar unit was mounted on the ROV in 2007. Through cooperation with Dr. S. Elizabeth Clark (National Marine Fisheries Service) and Hanu Singh (Woods Hole Oceanographic Institute, WHOI), gear trials with the WHOI's autonomous underwater vehicle (AUV) and DFO's ROV were conducted in April 2007 aboard the *CCGS Vector*. Visual surveys to assess the new Rockfish Conservation Areas (RCAs) will commence in February 2009.

In collaboration with the halibut industry, a new longline survey was designed and conducted in the outside BC coastal waters with the northern half surveyed in 2006 and the southern half in 2007. Hard bottom areas were identified through bathymetry analyses, inshore rockfish fishing records and fishermen consultations. The hard bottom survey areas were then overlain with a 2 km by 2 km grid (matched with the adjacent trawl survey grid) and survey blocks were stratified by area and depth and chosen at random. Approximately 200 survey sets are targeted annually. In 2008, the first re-survey in the northern portion of BC was completed and in 2009, a survey in the southern portion will complete two full cycles of the BC survey.

Three years of NSERC funding has been awarded to Dr. Jon Shurin of the University of British Columbia, in collaboration Parks Canada, Pacific Halibut Management Association (PHMA) and DFO, to conduct research to assess the effectiveness of RCAs in maintaining and enhancing inshore rockfish stocks in BC. Two MSc students and a PhD student will begin field work on projects related to the assessment and management of RCAs for inshore rockfish in BC in the summer of 2009.

b. Stock assessment

The National Advisory Process (NAP) and Committee On the Status of Endangered Wildlife In Canada (COSEWIC) status reports were prepared for yelloweye and quillback rockfishes (Yamanaka et al. 2006a, 2006b). COSEWIC reviewed the status of yelloweye rockfish in November 2008 and recommended a special concern status. Quillback rockfish is scheduled for COSEWIC review in the fall of 2009. http://www.cosewic.gc.ca/eng/sct5/index_e.cfm

Work towards a yelloweye rockfish stock assessment is underway with Dr. M. McAllister at the University of British Columbia Fisheries Centre.

c. Management

In 2007, the RCA strategy was completed with 20% of rockfish habitat closed outside 4B and 30% of rockfish habitat closed within 4B. RCAs are used as a spatial management tool to protect inshore rockfish. Fishing activities likely to catch rockfish are prohibited within these areas (http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/fisheriesmgmt/rockfish/default_e.htm

3. Sablefish

a. Stock assessment activities in 2008

Sablefish stock assessment and management in British Columbia was conducted collaboratively in 2008 by Fisheries and Oceans Canada (DFO) and Wild Canadian Sablefish (formerly the Canadian Sablefish Association). 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. Annual survey activities are conducted using fishing vessels chartered from the sablefish longline trap fleet.

Catch rates from the fall standardized survey (see item c. below) have declined by about 39% since 2003. The 2008 stratified random survey ~30% from 2007 to 2008 following a decrease of ~30% from 2006 to 2007 and now indicates a modest linear decline since its inception in 2003. Since 2003, declines in these indices suggest that the stock may be approaching conditions experienced in 2001 to 2002 when a quota reduction from 4,000 t to 2,450 t was implemented. Subsequent to this reduction, the quota was increased to 3,000 t for the directed sablefish

2003/2004 fishing year (Aug 1-Jul 31) and reached 4,600 t for the 2005/2006 fishing year as trap fishery and survey catch rates increased. The quota for the 2006/07 fishing year was reduced to 3,900 t and was similarly reduced to 3,300 t for the 2007/08 fishing year mainly as a result of declining survey indices of abundance and tagging estimates of exploitable biomass. Since 2006, the Science Committee under the DFO-CSA Joint Project Agreement has been developing a management strategy evaluation (MSE) approach aimed at identifying a consistent procedure for setting annual quotas. This work was reviewed in May/June of 2008. Of the "admissible" management procedures (those that met stated fishery objectives), several show the capability to halt the current stock decline within 3-7 years with 90% certainty even under the most pessimistic scenario for the stock. TAC levels for 2008 under these admissible procedures range from 1,500 to 2,700 tonnes, however, most will decrease TACs rapidly between 2009 and 2014 if the current stock decline continues. The TAC was reduced to 2,450 t for the 2009/2010 fishing year which, incidentally, was shifted to a February 21 start date to coincide with all other groundfish fisheries in British Columbia.

b. Stock assessment activities planned for 2009

No stock assessment for B.C. sablefish is scheduled at this time for 2009. Nevertheless, management strategy evaluation for B.C. sablefish initiated in early 2006 will continue to be developed in preparation for the next assessment.

c. Research activities in 2008

The Sablefish Research and Assessment Survey has included the following program components since at least 2003:

> A **Traditional Standardized Program** (1990-2008) that includes standardized sets at nine (9) offshore fishing localities and biological sampling. Starting in 1990, one set was made in each of 5 depth intervals in each locality. Since 1999, additional shallower and deeper depth intervals have been added, removed and changed. However, the 5 core intervals have remained the same. Catch rates from these core sets extend a stock abundance index series and sablefish are sampled for data on size and growth.

> A **Traditional Tagging Program** (1991-2007, hiatus in 2008) that captures sablefish for tagging and release at historical tagging locations. Sets are made in the 9 traditional standardized program localities as well as 5 tagging-only localities. The protocol for this program is to release a specified number of tagged fish in each locality. Low catch rates in some areas in previous years have resulted in survey vessels being required to re-set additional strings in an area. Tag-recoveries from these sets can be used for studying movement, obtaining estimates of gear selectivity, and deriving an index of tagging-based abundance.

> **A Randomized Tagging Program** (2003-2008) that captures sablefish for tagging and release following a depth and area stratified random survey design. The catch rate data

can be used to derive an index of stock abundance. Tag-recoveries can be used for deriving estimates of gear selectivity, studying movement, and deriving an index of tagging-based abundance. The survey also provides biological samples. These sets were introduced in 2003 and are being assessed for their ability to serve as a replacement for the traditional standardized survey and tagging programs.

An **Inlets Program** (1995-2008) that includes standardized sets at four (4) mainland inlet localities. Sablefish are tagged and released from inlet sets and are sampled for biological data.

d. Research activities planned for 2009

Research in 2009 will be focused on evaluating the stratified random survey as a replacement for the legacy standardized survey in the context of the MSE framework. If the standardized survey can be discontinued without compromising fishery objectives then more effort can be allocated to the stratified random survey as well as achieving greater cost-effectiveness. The annual research and stock assessment survey will be conducted in the fall of 2009.

4. Flatfish

Jeff Fargo stepped down as section head for groundfish early in 2008 and returned to the Flatfish Program Head position. Since resuming his responsibilities as program head the majority of his time in 2008 was spent representing the department at IPHC stock assessment and apportionment meetings throughout the fall of 2008 and spring of 2009. Dr. Jackie King has returned from maternity leave and will resume her duties as a commissioner for the IPHC allow in Jeff to return to flatfish research full time.

In 2009-10 the flatfish program includes the addition of Brian Krishka and Bill Andrews. The program was unsupported for the last several years due to a shortage of resources. The program head will retire in 2010 and it is important to provide continuity for the program and train a new program head.

a. Stock Assessment in 2008

No new flatfish stock assessments were prepared in 2008

b. Research programs planned for 2009

Age composition data will be assembled for all flatfish species. Samples for ageing in 2009/10 will need to be selected for the ageing lab. Unit staff will participate in the Groundfish Synoptic trawl surveys in Hecate Strait and Queen Charlotte Sound. Biological data will be collected for all groundfish species caught. This amounts to 2-6 weeks (in 2 week stretches) in the field primarily in May- June. Vessels involved are the W.E. Ricker in Hecate Strait and a commercial vessel in Queen Charlotte Sound. In preparation for stock assessment, data from the commercial fishery and research surveys will be compiled for all commercial flatfish species. Biological data will be analyzed and life history characteristics including maturity growth and age composition estimated. This will be a summary to enable work on flatfish to continue after the unit head retires. Data for commercial flatfish species in the Strait of Georgia need to be compiled for analysis for future stock assessments.

5. Pacific hake

a. Stock Assessment in 2009

The 2009 stock assessment was prepared jointly by Canadian and US scientists. There was one model reviewed, Stock Synthesis 3 (SS3). The model's best fit occurred when selectivity was allowed to be dome shaped. As was the case in previous years, a major source of uncertainty was the value of the catchability coefficient (q) and selectivity for the acoustic survey. In 2009, historical CalCOFI larval hake production index (1951-2006) data were introduced, their influence on the model explored, and discarded due to their presence causing large, unpredictable swings in likelihood values. Also this year, ageing error was included; these data were based on 1000 cross read otoliths (AFSC and PBS). As was done in previous years, the Canadian and U.S. fisheries were modelled separately.

The change in temporal and spatial distribution of Pacific Hake has continued this year, with the majority of catch taking place in the third quarter (July-Sept) in Queen Charlotte Sound (areas 5A and 5B). Traditionally, the Canadian fishery has been mainly conducted off the west coast of Vancouver Island (areas 3C and 3D) and although there was some catch there, the numbers are much smaller than in the years preceding 2007 and also later in the year. Additionally, in the fourth quarter the catch of age 2 Hake was greater than that of age 9 Hake, which is the strongest year class on record. Many vessels were fishing in the Strait of Juan De Fuca during the fourth quarter, targeting these smaller fish, due to a lack of 1999 cohorts.

Scientists from Canada were invited to attend the SSC meeting in Seattle, WA to present an overview of the TINSS model (S. Martell - UBC Fisheries Science Center), which was reviewed in a special PSARC process in Canada. They voiced the Canadian point of view on the subject and presented the committee with results showing that this stock should be closely watched and that a precautionary approach is more reasonable at this point where the stock is at its lowest biomass.

6. Elasmobranchs

a. Research programs in 2008

A tag/recapture program to examine stock discreteness of big skate was initiated in 2003. In February 2008, 1400 big skate were tagged off the west coast of Vancouver Island. As of

December 2008, the total number of skates tagged and released is 18,368 fish, while 1,795 skates have been recaptured.

Basking sharks have been listed as endangered off the coast of British Columbia by Committee On the Status of Endangered Wildlife In Canada (COSEWIC), and efforts to coordinate the collection of sightings information were begun in 2007. Aerial surveys for basking sharks were conducted in May, September and October 2008 off the west coast of Vancouver Island and in September over Rivers Inlet (Queen Charlotte Sound) in order to document the occurrence (if any) of basking sharks in BC waters in areas of historic high densities. A phone-in and web-based sightings network was implemented in 2007 and is on-going. In 2008, we received one reliable sighting in the Strait of Georgia through this network.

b. Stock assessment in 2008

A Recovery Potential Assessment for basking sharks was conducted.

c. 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 is monitored by species and area in order to ensure that the 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 2006/2007. Out of this cap, 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.

d. Research activities planned for 2009

Basking shark aerial surveys will continue in 2009, with flights to occur in May – September off the west coast of Vancouver Island and over Rivers Inlet (Queen Charlotte Sound).

7. Lingcod

a. Research programs in 2008

No research was conducted in 2008.

b. Stock assessment

No assessment was conducted on lingcod stocks in 2008.

c. Research activities planned for 2008

No research activities are planned for lingcod in 2009. An assessment for outside lingcod stocks is planned for 2009.

D. Other related studies

Statistics and Sampling

a. Database work in 2008

Principal Statistics and Sampling activities in 2008 included the ongoing population of the groundfish biological database (GFBio). This database now includes over 8,000,000 specimens. Data entry activities continue to concentrate on the input of current port sampling and observer biological data and recent research cruises. The groundfish trawl fishery continues to be covered by 100% dockside and virtually 100% observer coverage. These observers also provided 193 length/sex/age samples and 77 length samples in 2008. Port samplers provided an additional 115 samples, 104 samples with ageing structures (length/sex/age/weight) and 11 without structures (length/sex/weight). The focus of their sampling efforts was from those fisheries not covered by at-sea observers.

The Groundfish Integrated Pilot Project continued in year 3 in 2008. The process, which includes 100% at-sea monitoring and dockside monitoring for hook and line vessels, is being successful in monitoring all catch, both landed and discarded. An examination of the quality of catch estimation in this program was presented to a California Sea Grant Program in December 2008. Results are submitted for publication in Fisheries Research (Stanley et. al. in press).

Staff continued to play a key role in development of a new Regional Catch Monitoring information system. They also took lead role in development of a data profiling study of the data quality in the FOS (Fishery Operating System) (Stanley et al. 2008).

b. Field work in 2008

Staff participated on various bottom trawl surveys including the West Coast Vancouver Island, West Coast Queen Charlotte Island, West Coast Vancouver Island and Queen Charlotte Sound shrimp trawl surveys. This group also included the port sampling activity (1.8 person-years) in the Vancouver and Prince Rupert areas. Staff also finished development of the automated data captured system for groundfish surveys. This system was demonstrated to DFO staff from the East Coast as well as at the TSC sponsored workshop on electronic data capture hosted by Mark Wilkins in March 2009.

c. Proposed field work for 2008

Port sampling will continue in 2009, as will staff participation in the bottom trawl surveys to Hecate Strait, Queen Charlotte Sound and the shrimp trawl surveys in Queen Charlotte Sound and the west coast of Vancouver Island.

d. Proposed catch monitoring research and development in 2009

Staff will continue to participate in implementation of the Electronic monitoring system for the hook and line fisheries and organize a 1-day groundfish workshop on the overall survey and sampling activities of groundfish.

APPENDIX 1. REVIEW OF CANADIAN GROUNDFISH FISHERIES

1. Commercial fisheries

All catch figures for 2008/2009 are preliminary. Canadian domestic trawl landings of groundfish (excluding halibut) in 2007 were 98,407 mt, this is virtually unchanged from the 2007 catch. The major species in the trawl landings were Pacific hake (71 %), Pacific ocean perch (5 %), yellowtail rockfish (5 %), arrowtooth flounder (3 %), and Dover sole (2 %).

Canadian landings of groundfish caught by gear other than trawl in 2008/2009 totalled 12,165 mt. Landings by sablefish (K license) vessels using trap or longline gear accounted for 3,777 t, approximately 92 % by trap, and 8 % by longline gear. Sablefish accounted for slightly more than 74 % of the landed amount. Landings by halibut vessels (L license) amounted to 5472 mt of which 65 % was halibut; other species landed include sablefish, lingcod, dogfish, redbanded, yelloweye and rougheye rockfishes. Landings by other hook and line sectors included dogfish: 1965 mt, 85 % dogfish; lingcod, 447 mt, 95 % lingcod; and rockfish, 503 mt, principally quillback, rougheye and Yelloweye rockfishes.

2. Recreational fisheries

Each year, Fisheries and Aquaculture 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. There are also estimates of catch produced from fishing lodge reports.

3. Joint-venture fisheries

In 2008/2009, 14 Canadian catcher vessels delivered Pacific hake and incidental species to a single processing vessel in a co-operative fishing arrangement. This fishery took place in Queen Charlotte Sound (Areas 5A and 5B).

4. Foreign fisheries

There were no national or supplemental fisheries for Pacific hake off British Columbia in 2008.

APPENDIX 2. GROUNDFISH RELATED REPORTS PUBLISHED IN 2007/08.

1. Primary Publications

Edwards, A.M. 2008. Using likelihood to test for Lévy flight search patterns and for general power-law distributions in nature. *Journal of Animal Ecology*, **77**: 1212-1222.

2. Other Publications

Haigh, R. and Starr, P. 2008. A review of yellowmouth rockfish *Sebastes reedi* along the Pacific coast of Canada: biology, distribution, and abundance trends. *Canadian Science Advisory Secretariat, Research Document* 2008/055. 97 pp.

Haigh, R. and Starr, P. 2008. A review of darkblotched rockfish *Sebastes crameri* along the Pacific coast of Canada: biology, distribution, and abundance trends. *Canadian Science Advisory Secretariat, Research Document* 2008/056. 88 pp.

Obradovich, S.G., Yamanaka, K.L., Cooke, K., Lacko, L.C. and Dykstra, C. 2008. Summary of non-halibut catch from the standardized stock assessment survey conducted by the International Pacific Halibut Commission in British Columbia from June 4 to July 7, 2007. Can. Tech. Rep. Fish. Aquat. Sci. 2807: x + 84 p.

Workman, G.D., N. Olsen, J. Fargo, and R.D. Stanley. 2008. West Coast Vancouver Island groundfish bottom trawl survey, May 25 to June 10, 2004. Can. Man. Rep. Fish. Aquat. Sci. 2826.

Yamanaka, K.L., Obradovich, S.G., Cooke, K., Lacko, L.C. and Dykstra, C. 2008. Summary of non-halibut catch from the standardized stock assessment survey conducted by the International Pacific Halibut Commission in British Columbia from May 29 to July 22, 2006. Can. Tech. Rep. Fish. Aquat. Sci. 2796: vii + 58 p.

Yamanaka, K.L. and Lacko, L.C. 2008. 2004 Research Catch and Effort Data on Nearshore Reef-fishes in British Columbia Statistical Area 12. Can. Tech. Rep. Fish. Aquat. Sci. 2803: ix + 45 p.

APPENDIX 3. GROUNDFISH STAFF IN 2007/08

S. Acheson	Groundfish port sampling
W. Andrews	Flatfish, Elasmobranchs
K. Anderson	Groundfish port sampling
K. Cooke	Database technician
A. Edwards	Statistical and mathematical modeling, stock assessment
J. Fargo	Program Head, Flatfish stock assessment and biology
C. Grandin	Biologist, Hake
R. Haigh	Statistical and exploratory data analysis
G. Jewsbury	Data technician
J. King	Lingcod, elasmobranchs, climate studies
B. Krishka	Biological data control and analysis, thornyhead and slope rockfish
R. Kronlund	Sablefish, analytical programs
L. Lacko	Database and GIS specialist, inshore rockfish
W. Mitton	Sablefish
N. Olsen	Biologist/programmer/GIS, Shelf rockfish
K. Rutherford	Biologist/database manager, Shelf rockfish
A. Sinclair	Pacific cod assessment and ecosystem research
R. Stanley	Shelf rockfish stock assessment and biology, groundfish statistics.
G. Workman	A/Section Head, Groundfish Surveys, Observer program
M. Wyeth	Groundfish surveys, Port sampling, Sablefish program
L. Yamanaka	Inshore rockfish stock assessment and biology

Committee of Age-Reading Experts

2008 Committee Report

Prepared for the Fiftieth Annual Meeting
of the Technical Subcommittee
of the Canada-U.S.A. Groundfish Committee

5-6 May 2009

Prepared by
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CARE 2008 Report to the Technical Subcommittee of the Canada-USA Groundfish Committee

A. CARE Overview

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 operating within the Terms of Reference approved by the TSC in 1986 and the CARE Charter developed in 2000 and approved by the CARE in 2004.

CARE Workshop
CARE meets biennially at the "CARE Workshop" with workshops typically comprising a "business" day and generally 1.5 days for hands-on calibration at microscopes to review and standardize age reading criteria. The last biennial CARE Workshop was hosted by and held at the CDFO's Pacific Biological Station 1-3 April 2008 at Nanaimo, B.C., Canada. The next CARE workshop is scheduled for 21-23 April 2009, hosted by AFSC to be held at Sand Point, Seattle, WA, U.S.A.

Report Period
This report covers the work period 1 January – 31 December 2008. However, to promote timely reporting of work and recommendations occurring during the recent CARE workshop (April 2009), a separate Executive Summary of the 2009 CARE workshop is included in Appendix I.

B. CARE Subcommittee (Working Group) Reports

1. CARE Manual/Glossary Committee – MacLellan (2008 out-going), Kamikawa (2008 in-coming), Goetz, Munk
   The Manual/Glossary working group members develop age reading chapter sections or definitions for age-reading terms suggested by CARE members, which are subsequently approved by CARE members and added to the CARE Manual/Glossary.

   2006-2008 manual activity reported at the 2008 CARE meeting:
   The lingcod and Dover sole CARE manual sections were inserted to the on-line manual at the CARE website December 2006.
   New wording for the term "dark/light boundary" was inserted in the CARE Manual glossary section and updated to the CARE website December 2006.
   No progress was made on developing the hake section.

   MacLellan requested to be replaced as working group lead. Kamikawa succeeded MacLellan on 1 July 2008.

No additions to the manual were proposed at the CARE 2008 meeting and the Committee was not active for the rest of 2008.

2. CARE Website Committee - Short (2008 co-chair & webmaster), Atkins (2008 in-coming co-chair), Anderl
The CARE website working group administers to the appearance, operation, and access to the site, through the cooperation of the PSMFC website and webmaster. The CARE web page is located at http://www.psmfc.org/care/.

2006-2008 activity reported at the CARE 2008 meeting:
2.1 The CARE website was changed from HTML to a program called "Joomla".
2.2 The Ageing Methods table was updated and/or changed to improve presentation, collation and access to information. The website was upgraded to include user-modifiable linked tables in a relational database that also retains data history/succession. The table "Summary of Age Reading Methodology", previously EXCEL-based and passed from one administration to the next, now resides on the CARE website under "Species Info" that links to a database that can be searched. It will be updated on an annual basis.

Post-meeting 2008 update:
2.3 The CARE website content was updated:
2.3.1 The 2008 CARE minutes were posted to the website in record time.
2.3.2 Photos from Nanaimo CARE 2008 meeting were posted.
2.3.3 The blank CASE invoice is available on site for CARE members to download for exchange reporting.

Short requested to be replaced as the working group lead. Atkins will commence as co-chair with Short, and specifically be responsible for content.

3. Charter Committee – Munk (chair), MacLellan, Anderl/Goetz.
The Charter, initiated in 2000, provides a framework within which the original intent of CARE may continue. It also expedites familiarization of new CARE Members to the responsibilities and function of CARE. The committee is responsible for facilitating changes and updates to the Charter.

The Charter Committee, previously disbanded, was reconvened to draft new sections and to make some minor edits/updates to the CARE Charter to enhance organizational and operational information to CARE officers and new members. The working group was tasked with providing the recommended updates for approval at the 2009 CARE Workshop.
3.1 Drafting of updates ("CASE Invoice Protocol section, "Edit Log" section along with several minor edits) was completed in 2008 ready to present at the 2009 meeting.

4. Forum Working Group – Atkins (Moderator), Short
This working group was created in response to a 2008 CARE to CARE recommendation. The Moderator was tasked to work with the Webmaster to create a three-year trial CARE

forum for the discussion of age reading topics by the CARE community and other age-reading personnel.

4.1 The forum was up and running successfully in 2008, with some activity.

5. Sablefish ad hoc Working Group- NMFS-NWFSC/PSMFC, ADFG, AFSC, CDFO

The sablefish age readers convened an ad hoc working group to expand documentation of sablefish age-reading criteria and fundamental differences between stocks from southern to northern extent of the species range. The goals for this group are outlined in Appendix I-B.

5.1 Samples of age zero and age-1y otolith samples from each agency were measured in 2008.

C. CARE Agency Structure Exchanges

Age structure exchanges periodically occur to assess calibration among age-reading facilities, following which specimens with widely varying age estimates are reviewed and discussed. Exchanges are tracked by the CARE vice-chair. Data from exchanges are available upon request of the originator of the sample.

Three age structure exchanges were initiated and completed in 2008. Species exchanged were sablefish and yelloweye rockfish. An updated summary of these and other age structure exchanges made from 2008 thru 2009 (May) are covered in Appendix I – Executive Summary, Table 2.

F. Recommendations CARE ~ TSC

1. 2008 CARE to CARE
    - 1.1. 2008CC-01 “Move CARE workshop to off-year from Western Groundfish Conference”: The CARE recognizes that their biennial workshop coincides with the biennial Western Groundfish Conference, and that this co-occurrence creates competition for same-year travel money. This can prevent attendance to one or both, and where off-year travel budgets might be underutilized. CARE proposes to move their workshop out of phase to the Western Groundfish Conference. CARE will next convene in 2009, the adjustment year. This will begin the new biennial sequence of 2009, 2011, 2013, etc.
    - 1.2. 2008CC-02 “Add CARE website disclaimer and citation information”: CARE recommends adding site and citation information to the CARE website. A new link in the sidebar entitled “Site information” will open a page with the following information:
        - 1.2.1. “This website is subject to periodic update and data may not have been formally peer reviewed. If you have specific questions please contact the contributing agencies.”
        - 1.2.2. “If you wish to cite the webpage the following format is suggested: Committee of Age Reading Experts (CARE). “Title of Page.” Date accessed: <access date> <URL>”.
            - 1.2.2.1. CARE 2008 Response: Both posted to the test website.

1.3. 2008CC-03 “Create CARE trial forum”: CARE recommends creating a three-year trial forum for the discussion of age reading topics by the CARE community and other age-reading personnel. Users of the forum would be required to set up a user name and password; anonymous commenting would be disabled. Specific categories would be created for different areas of discussion: Specific species (with Flatfish, Rockfish, Roundfish, Elasmobranches, and Invertebrates as sub-categories), Preparation Methods, Digital Imaging, Equipment, Other and Off Topic. Each user will be able to choose whether they receive e-mail notifications of posts for the entire forum, specific categories/sub-categories, individual discussions, or none at all. Nikki Atkins (NMFS-NWFSC/PSMFC) will act as Moderator of the forums.

1.3.1. CARE 2008 Response: Forum was up and running.

1.4. 2008CC-04 “Expedite approval of meeting-minutes”: CARE recommends expediting their approval of meeting-minutes. The CARE Chair will send an email to workshop participants asking to approve the minutes: Yes or NO. Workshop participants will be given 2 weeks to reply; if “out of office” emails are received by the Chair, the time frame will be extended per their discretion. Prior to approval, meeting-minutes will be sent out for editing/corrections to members (see Charter protocol). Meeting-minutes will not go out for approval until all edits are complete, and, will not be posted without approval.

1.4.1. CARE 2008 Response: CARE 2008 minutes were posted in record time.

2. 2008 CARE to TSC (none made)
3. 2007 CARE to CARE (none made)
4. 2007 CARE to TSC (none made)
5. 2007 TSC to CARE

5.1. 2007TC-01 TSC will rely on fishery managers and stock assessment authors to interact directly with their ageing lab supervisors to communicate with CARE for ageing exchanges. TSC appreciates the work of CARE and recognizes that a direct link between the assessment biologist and the ageing lab is the most efficient means of requesting species ageing exchanges.

5.1.1. CARE 2008 Response: Acknowledged and accomplished.

6. 2006 CARE to CARE

6.1. 2006CC-01 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.

6.1.1. CARE 2008 Response: Mostly done. The CASE invoice form is accessible, but completed invoices are yet to be posted to the website.

6.2. CARE recommends making changes to the Summary of Age Reading Method, 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 and 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.”

6.2.1. CARE 2008 Response: Mostly done. Underlined elements are incomplete or have been dropped. Discussed options to cite validation and related age and growth literature to the website at 2008 meeting.

7. 2006 CARE to TSC

7.1. The biennial CARE meetings have been held traditionally 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 policies can prohibit 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.

7.1.1. CARE 2008 Response: Accomplished.

8. 2006 TSC to CARE (none made)

APPENDIX I

EXECUTIVE SUMMARY
2009 CARE Workshop

This Executive Summary of the recent 2009 CARE Workshop is appended to the '2008 CARE Annual Report to the TSC' in order to promote timely reporting of work that would otherwise not be reported till the end of 2009, and to facilitate work and action to occur over the remaining year.

Overview

The 2009 CARE Workshop was held 20-23 April in Seattle, Washington at the Sand Point AFSC facility, hosted by Delsa Anderl and the Age and Growth staff. This was the first CARE "odd year" meeting since inception. CARE had voted to shift to a rotation opposite to the even year Western Groundfish Conference schedule during the 2008 meeting. A total of 36 individuals representing eight agencies plus a retired CARE member attended (Table 1). An agenda from this workshop follows under Appendix I-A. This was a very active and ambitious workshop, highlighted by: general and working group discussions on varied topics; 5 scientific presentations; notable accomplishments made by the working groups; involvement by more and new CARE members volunteering to participate in committee/working/discussion groups. The CARE officers remain the same for the CARE 2011 meeting, as agreed at CARE 2008. The Sablefish ad hoc working group participated in a mini-workshop with their own ambitious agenda. Two new working groups were convened to: produce an abstract and subsequent poster for the 2009 International Otolith Symposium outlining CARE's history/accomplishments and to draft some optional recommendations when non-agency researchers request to make use of archival otolith samples. There were no Recommendations made by CARE to the TSC; however, there were seven 2009 Recommendations made from CARE to CARE

Working Groups and Reports

There were four working groups (Charter, Website, Forum, Sablefish ad hoc) active prior to and reporting at the 2009 Workshop. Two new working groups were organized. The first drafted a CARE abstract (content was accepted by the membership) to be submitted to the 2009 International Otolith Symposium in Monterey, CA. They will collaborate to refine the abstract text and create the poster after the CARE meeting. The second group was convened, for the duration of the workshop, to produce some guidelines that agencies might want to consider when non-agency researchers request access to use of archival otolith samples. Six working groups (Forum, Website, Charter, Manual, Sablefish ad hoc, IOS 2009 CARE poster abstract) will be active during the next rotation.

1. Manual/Glossary Committee (<u>Kamikawa</u>, Goetz, Munk): There was no activity expected or reported for 2008. During the 2009 CARE meeting, the committee put forth an ambitious recommendation that the membership considers reviewing and updating the current manual on a regular basis, as well as drafting sections to include new species, quality assurance and age validation techniques. Two additional people (Barb Campbell - CDFO, Lou Taylor - NWFSC) volunteered to become new members of the working group.

2. Web Committee (Short, Atkins, Anderl): Short reported on the committee's activity in 2008: Atkins updated content; the 2008 CARE minutes were up on the website in record time, photos from the Nanaimo CARE 2008 meeting were posted and the blank CASE invoice was on site. Short decided to go the manual route with putting CASE's on the website instead of a database page. At the 2009 CARE meeting, the following tasks were outlined for the next interval: update both the Structure Exchange Table (add completed CASE invoices and link to table) and the Charter (edits from Charter Committee) and change the Charter introductory page on the website table to clarify contents.

3. Charter Committee (Munk, MacLellan, Goetz): The Charter Working Group, previously disbanded, reconvened in 2008 to make updates to the CARE Charter that, in particular, were aimed at improving and providing more organizational information to CARE officers and new members. The group made the recommended updates and submitted these at the 2009 CARE Workshop for approval. Updates submitted at the 2009 Care meeting included minor rewording to major additions such as: the CASE Invoice Protocol section, the Charter Edit Log (documents, changes or additions since the Charter was accepted by CARE membership in 2004) and Appendices A. CARE Meeting Minutes Format, B. Annual Report to the TSC and C. CASE Invoice are available for inclusion. Appendix D. Precision Test Statistics and Formulation is yet to be drafted.

4. Sablefish Age Readers Ad hoc Working Group: The sablefish age readers (AFSC, ADFG-Juneau, CDFO, NWFSC, lead: Munk [outgoing Jan 2009], MacLellan [incoming Jan 2009]) convened an ad hoc working group during the 2008 Nanaimo workshop to expand documentation of sablefish age-reading criteria and identify fundamental differences between stocks from southern to northern extent of the species range. The goals for this group outlined in the agenda Appendix I-B developed in April 2008 were:

1. Document and report current age-reading standards with a comprehensive age structure exchange
2. Calibrate interpretation of sablefish patterns
3. Document and report size differences for up to age-1y (1+[June]) sablefish stocks from south to north

Goal three was addressed in 2008, with each agency supplying samples of known-age zero to one year otoliths to ADFG for length measurement.
Munk gave an overview of the project to the general membership at CARE 2009. To meet goal two, each agency provided a 20-24 fish sample for a round robin exchange that was completed for the 2009 meeting. At least five otoliths from each sample were imaged and annotated by all participants for comparison at the 2009 meeting. See Sablefish mini-workshop in Workshop and Hands-on session below for more details.

5. Forum Working Group (Atkins, Short): Atkins constructed, and acted as Moderator for, the proposed 3 year trial forum that would facilitate discussion of age reading topics by the CARE membership. The forum came on line with a few postings in 2008. At the 2009 CARE meeting a recommendation was made to the membership to support the forum and post general CARE communications.

Age Structure Exchanges (Vice-chair: Rosenfield)

There were three structure exchanges initiated and completed in 2008. Two were sablefish involving AFSC, CDFO, NWFSC and ADFG and one was yelloweye involving CDFO, WDFW and ADFG-Juneau. Eight age structure exchanges were conducted in the early part of 2009. All but two were complete by the 2009 Care workshop. Four of these originated from the Sablefish ad hoc Working Group, NWFSC and CDFO each exchanged a hake sample with the other and ADFG worked with AFSC on two Pacific cod samples. These data are available upon request of the "Coordinator" of the specific exchange sample. Table 2 lists the 2009 exchanges.

Business Session Highlights and Discussion:

- A working group was convened to produce an abstract and subsequent poster for the 2009 International Otolith Symposium outlining CARE's history and accomplishments.
- Another working group met and provided the membership with recommendations to consider when approached by non-agency researchers to use archival otolith samples (Appendix I-C).
- There were five scientific presentations: Known-age sablefish research (Anderl), Ad hoc Sablefish Group results (Munk), Lingcod fin/otolith comparison (Dunne), Overview of recent research at AFSC (Kastelle) and Image cataloguing and photo-merging (Short).
- Additional workshop discussion details will be forthcoming upon completion of the 2009 CARE Workshop Meeting Minutes.
- "Recommendation working groups" focused on wording of CARE recommendations.

Workshop and Hands-on Session Highlights and Discussion:

- A total of 27 readers reviewed 12 species during the hands-on session of CARE 2009. Session summaries will be transcribed and appended to the 2009 meeting minutes.
- Readers from all eight agencies worked together during the hands on session to calibrate ageing of 14 species: Pacific cod, hake (Figure 1.) rockfish (black, greenstriped, shortraker, Pacific ocean perch), shortspine thornyhead, skates, pollock, Atka mackerel, capelin/eulachon, market squid, sardine and sablefish (mini-workshop).
- Differences generated from pre-workshop exchanges for hake, Pacific cod and sablefish were reviewed.
- Sablefish mini-workshop: The Sablefish ad hoc working group participated in a mini-workshop with its own agenda (Appendix I-D) that ran concurrent to other species hands-on session (Figure 2). Atkins provided a summary of the otolith measurement data. Even when month of capture data was taken into consideration, preliminary analysis of the measurements suggested a general north-south gradient in size. The CDFO agreed to provide ages for their samples (length was used to assign age for some) to further refine analysis of measurement data. Each agency had collated the data generated from their own samples and presented this to the group. Precision results are yet to be collated for the entire exchange. Difficult patterns were identified and documented. Standard criteria application was discussed. Known-age samples were used to facilitate assessment of criteria. The group was able to work through to agenda item 2b during the workshop and made plans to continue with item 2c in 2009 via exchange. AFSC will circulate a sample of known-age sablefish otoliths to test lessons learned at CARE 2009. The group submitted a CARE to CARE recommendation to investigate the possibility of meeting in a year to complete their agenda.
- Short provided a demonstration of AFSC's new Isomet 5000 saw used to cut otolith thin sections from multiple otoliths. Some modifications were necessary to the chuck to hold the

multiple specimen block, he changed the cutting action to the top of the blade and moved the water cooling hose out of the way to the back of the machine (Figure 3).

Recommendations C.A.R.E.~TSC

A. 2009 CARE to CARE
   1. 2009CC-01 "Check the CARE forum on a regular basis to continue trial assessing usefulness, post general CARE announcements/emails to the forum for membership reference and investigate a notification mechanism."
   2. 2009CC-02 "A focus for CARE 2011 meeting on digital imaging is proposed." Digital imaging is a useful tool for documenting agency methodologies and for sharing images for the purpose of structure exchanges. Review and discuss optimal use of digital imaging technology for age readers. Topics of interest include equipment, software, image acquisition/storage, processing and cataloguing. Industry reps would be a benefit to present equipment and software.
   3. 2009CC-03 "Submit CARE poster abstract to the International Otolith Symposium 2009"
   4. 2009CC-04 "Add the latest Charter updates, revise Charter introduction page to clarify contents with links to sections and add Working Group section to highlight purpose and current activities with a link to a past achievements "archive" to the website.
   5. 2009CC-05 "Work towards posting all CASE invoices from structure exchanges as PDF's on the website by linking each to respective line on the Exchange Table."
   6. 2009CC-06 "We recommend that CARE review the current CARE manual and that any changes or updates be submitted to the CARE Manual Committee lead (Kamikawa) by April 2010. Specifically, we wish to complete or initiate sections on hake, lingcod otoliths, skates, halibut, quality assurance and age validation techniques, and increase resolution to the existing rockfish ageing section. The Manual Committee will submit all changes and updates to CARE for consideration at the 2011 CARE workshop. In addition, we recommend that the CARE Manual Committee review and update the CARE manual at least once every 3rd workshop.
   7. 2009CC-07 "The Sablefish ad hoc Working Group will conduct an exchange of AFSC known-age samples to test lessons learned from the CARE 2009 mini-workshop and explore the possibility of meeting again in 2010 to complete the mini-workshop agenda."

B. 2009 CARE to TSC (none made)

C. 2008 CARE to CARE
   1. 2008CC-01 "Move CARE workshop to off-year from Western Groundfish Conference": The CARE recognizes that their biennial workshop coincides with the biennial Western Groundfish Conference, and that this co-occurrence creates competition for same-year travel money. This can prevent attendance to one or both, and where off-year travel budgets might be underutilized. CARE proposes to move their workshop out of phase to the Western Groundfish Conference.

CARE will next convene in 2009, the adjustment year. This will begin the new biennial sequence of 2009, 2011, 2013, etc.

i. CARE 2009 Response: CARE met in Seattle 21-23 April 2009.

2. 2008CC-02 "Add CARE website disclaimer and citation information": CARE recommends adding site and citation information to the CARE website. A new link in the sidebar entitled "Site information" will open a page with the following information:
"This website is subject to periodic update and data may not have been formally peer reviewed. If you have specific questions please contact the contributing agencies."
"If you wish to cite the webpage the following format is suggested: Committee of Age Reading Experts (CARE). "Title of Page." Date accessed: <access date> <URL>".
    i. CARE 2009 Response: The disclaimer and citation will be posted to the working CARE website soon after the CARE 2009 meeting.
3. 2008CC-03 "Create CARE trial forum": CARE recommends creating a three-year trial forum for the discussion of age reading topics by the CARE community and other age-reading personnel. Users of the forum would be required to set up a user name and password; anonymous commenting would be disabled. Specific categories would be created for different areas of discussion: Specific species (with Flatfish, Rockfish, Roundfish, Elasmobranches, and Invertebrates as sub-categories), Preparation Methods, Digital Imaging, Equipment, Other and Off Topic. Each user will be able to choose whether they receive e-mail notifications of posts for the entire forum, specific categories/sub-categories, individual discussions, or none at all. Nikki Atkins (NMFS-NWFSC/PSMFC) will act as Moderator of the forums.
    i. CARE 2009 Response: The CARE 2009 meeting participants agreed to continue supporting the forum and make some additions (See 2009CC-01).
4. 2008CC-04 "Expedite approval of meeting-minutes": CARE recommends expediting their approval of meeting-minutes. The CARE Chair will send an email to workshop participants asking to approve the minutes: Yes or NO. Workshop participants will be given 2 weeks to reply; if "out of office" emails are received by the Chair, the time frame will be extended per their discretion. Prior to approval, meeting-minutes will be sent out for editing/corrections to members (see Charter protocol). Meeting-minutes will not go out for approval until all edits are complete, and, will not be posted without approval.
    i. CARE 2009 Response: Accomplished.

D. 2008 CARE to TSC (none made)

E. 2007 TSC to CARE

1. 2007TC-01 TSC will rely on fishery managers and stock assessment authors to interact directly with their ageing lab supervisors to communicate with CARE for ageing exchanges. TSC appreciates the work of CARE and recognizes that a direct link between the assessment biologist and the ageing lab is the most efficient means of requesting species ageing exchanges.
    i. CARE 2009 Response: Acknowledged and encouraged.

F. 2006 CARE to CARE

1. 2006CC-01 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.
    i. CARE 2009 Response: Mostly done. From 2009-2010, CARE will work towards posting all CASE invoices from structure exchanges as PDF's on website by linking each to respective line on the Exchange Table (2009CC-05).
2. CARE recommends making changes to the Summary of Age Reading Method, 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 and 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."
    i. CARE 2009 Response: Mostly done. A table developed at CARE 2008 for the purpose of listing validation and other age determination related publications associated with the Species Aged database on the website will be retrieved and put forward to membership for consideration at the next meeting (2011).

Table 1. Attendees of the 2009 CARE Workshop, 21-23 April 2008, Seattle, Washington, U.S.A.

Attendee	Agency	City, State/Province
Kristen Munk	ADFG	Juneau, Alaska
Jodi Neil	ADFG	Juneau, Alaska
Sonya el Mejjati	ADFG	Kodiak, Alaska
Willy Dunne	ADFG	Homer, Alaska
Elisa Russ	ADFG	Homer, Alaska
Delsa Anderl	AFSC	Seattle, Washington
Betty Goetz	AFSC	Seattle, Washington
Craig Kastelle	AFSC	Seattle, Washington
Jon Short	AFSC	Seattle, Washington
Irina Benson	AFSC	Seattle, Washington
Charles Hutchinson	AFSC	Seattle, Washington
Chris Gburski	AFSC	Seattle, Washington
Charlie Piston	AFSC	Seattle, Washington
Chris Johnston	AFSC	Seattle, Washington
John Brogan	AFSC	Seattle, Washington
Beth Matta	AFSC	Seattle, Washington
Barb Campbell	CDFO	Nanaimo, British Columbia
Karen Charles	CDFO	Nanaimo, British Columbia
Darlene Gillespie	CDFO	Nanaimo, British Columbia
Shayne MacLellan	CDFO	Nanaimo, British Columbia
Cal Blood	Retired (IPHC)	Seattle, Washington
Steve Wischniowski	IPHC	Seattle, Washington
Joan Forsberg	IPHC	Seattle, Washington
Linda Gibbs	IPHC	Seattle, Washington
Robert Tobin	IPHC	Seattle, Washington
Nikki Atkins	NWFSC	Newport, Oregon
Betty Kamikawa	NWFSC	Newport, Oregon
Patrick McDonald	NWFSC	Newport, Oregon
Omar Rodriguez	NWFSC	Newport, Oregon
Louis (Lou) Taylor	NWFSC	Newport, Oregon
Jenny McDaniel	SWFSC	La Jolla, California
Sandy Rosenfield	WDFW	Olympia, Washington
Jennifer Topping	WDFW	Olympia, Washington
Lance Campbell	WDFW	Olympia, Washington
Lucinda Morrow	WDFW	Olympia, Washington
Josie Thompson	ODFW	Newport, Oregon

Table 2. CARE age structure exchanges and status from 2008 - 2009 (May)

Case No.	Originating Agency	Coordinator	Cooperator(s)	Date Initiated	Species	Sample n=	No. Readers	Status
08-001	CDFO	S. MacLellan	CDFO, NWFSC, ADFG-Juneau	Jan-08	Sablefish	20	3	complete
08-002	NMFS-PSMFC	P. McDonald	NWFSC, ADFG-Juneau, DFO	Jan-08	Sablefish	20	3	complete
08-003	ADFG-Juneau	K. Munk	ADFG-Juneau, CDFO, WDFW	Mar-08	Yelloweye Rockfish	24	3	complete
09-001	ADFG	J. Niel	ADFG, CDFO, NWFSC, AFSC	09-Dec-08	Sablefish	24	4	complete
09-002	CDFO	S. MacLellan	ADFG, CDFO, NWFSC, AFSC	15-Jan-09	Sablefish	24	4	complete
09-003	NWFSC	P. McDonald	NWFSC, AFSC, CDFO, ADFG	21-Jan-09	Sablefish	24	4	complete
09-004	AFSC	D. Anderl	AFSC, NWFSC, CDFO, ADFG	15-Jan-09	Sablefish	20	4	complete
09-005	CDFO	J. Groot	CDFO, NWFSC	17-Feb-09	Hake	?	2	complete
09-006	NWFSC	O. Rodriguez	NWFSC, CDFO,	15-Nov-08	Hake	100	2	complete
09-007	ADFG	S. Emlejjati	ADFG, AFSC	08-Apr-09	Pacific Cod	?	2	in process
09-008	ADFG	S.Emiejjati	ADFG, AFSC	08-Apr-09	Pacific Cod	?	2	in process

Figure 1. Sablefish ad hoc Working group mini-workshop CARE 2009.

Figure 2. CARE members review samples from a hake otolith exchange to resolve differences in their interpretation.

Figure 3. Close up of AFSC's new Isomet 5000 saw used to produce otolith thin sections.

APPENDIX I - A

C.A.R.E. Agenda
(Committee of Age Reading Experts)
Canada-US Groundfish Committee
April 21-23, 2009
Sand Point, Seattle, WA, USA
Traynor Room

Tuesday, 21 April

I. Call to Order [8:30 am] – Shayne MacLellan (Chair)

II. Host Statement
1. Welcome statements (Dan Ito)
2. Host info: safety/security orientation, social, t-shirts etc (Delsa Anderl)

III. Introductions
1. Round-table intros (name, agency, location)
2. Attendance, address, phone, email sheet – electronic on dedicated laptop

IV. Approval of 2009 Agenda

V. Working Group Reports [9 -9:30 am] Activity since CARE 2008 & initiate discussion for future activities (5 min each). Can discuss further through out meeting & resolve Thursday am.
1. TSC Meeting/2008 CARE report (Kris Munk)
2. CARE Manual (Betty Kamikawa)
3. Age Structure Exchanges (Vice Chair: Sandy Rosenfield)
4. Charter Committee (Kris)
5. Website (Jon Short)
6. Forum (Nikki Atkins)

VI. **CARE recommendations**: [9:30 – 10 am]
1. 2008 CARE to CARE status
    a. 2008CC-01: Move CARE meetings to odd years beginning 2009.
    b. 2008CC-02: Add disclaimer & citation info to CARE website.
    c. 2008CC-03: Create trial CARE forum.
    d. 2008CC-04: Approval of CARE meeting minutes via email.
2. New for CARE 2011? Can craft through out meeting.

---Break --- 10– 10:15 am ---

VII. Agency reports [10:15-10:45 am] ~3 min each – no PPT please (bring electronic version for secretary). Brief update (staffing, organizational, new species/projects)

1. ADFG – (Kris summarize all sites)
2. WDFW – (Lance Campbell)
3. AFSC – (Betty Goetz)
4. ODFW – (Josie Thompson)
5. NWFSC-PSMFC (Patrick McDonald)
6. California – (?)
7. IPHC (Joan Forsberg)
8. MLML (?)
9. CDFO (Shayne)

VIII. Topics for Discussion/New Business [10:45 am – noon]

1. Symposia/Conferences since CARE 2008 & upcoming:
    a. ICES Workshop for Age Determination of Redfish (Shayne) 5 min
    b. CARE presentation at IOS 2009 Monterey (Shayne) 15 min
2. Topics:
    a. Defining working groups, roles, purpose & activities. Right now some are buried in Charter & others nowhere – post more obviously on website to see accomplishments? (Shayne) 10 min
    b. IPHC non-halibut 1960's samples (Steve Wischniowski) 10 min
    c. Use of digitized otolith reference sets (Steve) & agency protocols for outside use of archival samples 10 min
    d. Need for standard age reader ID that could be used in the state/federal/provincial(?) databases (Patrick McDonald) 10 min
    e. Non-agenda items:

--- Lunch --- noon -1 p.m. ---

IX. Scientific Presentations 10 min each [1 -2 pm]

1. Known-age sablefish research (Delsa)
2. Ad Hoc Sablefish group results (Kris)
3. Lingcod fin/otolith comparison (Willy Dunne)
4. Overview of recent research at AFSC (Craig Kastelle)
5. Automating image cataloguing & photo-merging using Excel macros & Photoshop (Jon)

---Break --- 2:00 - 2:15pm ---

X. Working groups [2:15 - 2:45] – Meet, discuss & formulate written recommendations through out rest of workshop. Prepare electronically for Thursday morning.

XI. Hands-On Workshop [3:00 – 5:00] Depending on time we finish business we can get a head start on scope work.

Wednesday, 22 April

XII. Hands-On Workshop [9 am – 5 pm]

A. Hands on scope work
   a. Sablefish focus group mini-workshop (mini-agenda attached)
   b. All other species – Traynor Room

XIII. Demonstration: Isomet 5000 saw (Jon) - during Wed. afternoon sometime.

Thursday, 23 April

XIV. Concluding CARE business [9 – 10:30 am]

A. Recommendations 2009
B. Other activities finalization
C. Administration nominations
D. Schedule and location of 2011 Meeting
E. Closing -adjourn

XV. Continue hands-on [rest of day as needed]

APPENDIX I – B

DRAFT AGENDA

Sablefish Age Readers Ad hoc Working Group
Convened April 3, 2008 by the Pacific Northwest Sablefish Age Readers

Purpose:
The Sablefish Age Readers Ad hoc Working Group first met April 3, 2008 to discuss interest in and goals to firmly document age reading criteria and fundamental differences between stocks originating from southerly to northerly latitudes.

Goals:
1. Document and report current age-reading standards with a comprehensive age structure exchange
2. Calibrate interpretation of sablefish patterns
3. Document and report size differences for up to age-1y (1+[June]) sablefish stocks from south to north

I. Document interpretation of sablefish patterns
    a. Exchange
        i. Each agency provides sample n~24 (exchange begin Oct 1,'08)
            1. Samples made up of Jan-May(June) sample dates, if possible
            2. Select proportions in age pools, for ex 1/3 ea: 1-15y, 16-30y, >30y
        ii. Each specimen should have 4 halves
            1. Each AGENCY new-burns ONE (1) otolith half
                a. "Designated Ager" responsible for maintaining integrity of sample, for remaining participating agency age-readers
                b. Emphasize use of photographs, used by additional agency age-readers (to retain sample integrity)
        iii. Capture month, day, and location (general) will be reported with sample
        iv. Data sheet – a single data sheet used by all
            1. Mockup due by Aug 1 (Neil)
            2. Will include reference images for learning of identified parameters (for ex transition zone, growth rate, margin)
        v. Age
            1. Transition zone(s)
            2. Gage "growth rate" (per pattern)
            3. Classify marginal growth (edge)
            4. Each agency provides one data set per sample (due Jan 31,'09)
    b. Images
        i. Images accompany data sheet to calibrate to data terms
        ii. Each exchange sample will be accompanied by photographs of ~6 or more specimens, where each specimen has a full complement of images showing the usual interpretation areas and needed level of magnification

            iii. Each agency will annotate an unmarked image with their annuli
                1. format to be determined (ppt 1 slide per image, agency files named: "<Sample name>_<agency name>"?

II. Calibrate interpretation of sablefish patterns
    a. Group discussion/scope work[simultaneous with 2009 CARE Workshop]
    b. Assessment
        i. Age data precision (McDonald)
        ii. Resolution
        iii. Image comparison
    c. Calibration report (<author>)

III. Document and report size differences for age-1y sablefish stocks from south to north
    a. Identify regional samples of known-age sablefish, 0 to 1y (group, due <date>)
        i. n~50
        ii. emphasize "late zeroes" through "early one-plusses" (thru June)
        iii. One to multiple samples
            1. Intra and interannual
            2. Single location, for ex: "Southeast Alaska, 1999 (June, Aug), 2000 (Aug), 2001 (Aug)
    b. Measure all agency otoliths (ADFG-ADU, send to Munk by "early July" 2008)
    c. Summarize statistics (Atkins, due ~Oct '08)
    d. Develop reference data and table (Atkins, due ~Oct '08)

IV. Workshop reports
    a. Report of the working group (Munk, 2009 CARE Workshop)
    b. Scientific report of variation in known-age (0 to 1y) sablefish (~2009 or tbd)

Sablefish Working Group Participants (will add to as advised):

ADFG: Kristen Munk, Jodi Neil
CDFO: Shayne MacLellan, Karen Charles, Darlene Gillespie, Barb Campbell
NMFS-AFSC: Delsa Anderl, others?
NMFS-NWFSC/PSMFC: Patrick McDonald, Nikki Atkins, others?

APPENDIX I – C

Considerations for requests of archived age structures

The following are considerations CARE member agencies/ageing laboratories may wish to use when handling outside requests for accessing archived age structures. This list was prepared by a CARE working group, and submitted to CARE on April 23, 2009, and are not proposed as agency guidelines.

1. The requesting individual/agency must have demonstrated an ability to complete scientific projects;
2. The applied methods, including requisite sample sizes, must be rigorous enough to support the proposed analyses;
3. Products (i.e., prepared specimens and data) are returned;
4. The study conclusions may not necessarily reflect the position of the agency or cooperators; and
5. The proposed use should not deplete the archive for any internal use (i.e., geographically, by year, or age class).
6. Requests should be accompanied by a written proposal.

APPENDIX I – D

CARE 2009: Objectives and Agenda for Sablefish Focus Group Mini-Workshop

Objectives:

1. Identify & record difficult/easy to interpret sablefish otolith patterns
2. Establish standard criteria – measurements, patterns
3. Document criteria – CARE manual update, publish

Agenda:

1. Review results of measured and exchanged otoliths
    a. Measurement results (presented during general meeting)
        i. Discuss/decide if a practical application
    b. Exchange (results presented during general meeting)
        i. Kris highlight key differences/agreements for discussion
        ii. Group image session to illustrate specific examples
        iii. Scope time to review & key into patterns of concern
    c. Identify/document easy & common difficult patterns
2. Known-age samples
    a. Delsa to chose some demonstrative examples to illustrate interpretation of key difficult and easy patterns
    b. Confirm/establish common easy/difficult patterns & standard way to interpret
    c. Test participants with small number of known-age to measure lessons learned
3. Document standard criteria
    a. Cobble an outline & assign work to group
        i. Written
        ii. Photographic
    b. Publication?

IPHC Research Program:

Review of 2008 Projects and Proposals for 2009

The International Pacific Halibut Commission Staff

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 in 2008. The second section presents the preliminary staff research proposals for 2009. 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 direct financial support from the Commission is possible under the basic 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 2008, and/or carry-over from 2007;
2) **Contracts 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 without direct 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 2008

Research conducted by the IPHC staff during 2008 continued in three basic areas: life history, fish movements, and general biology. 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.

2008 Research Highlights

The PIT tag dockside detection program continued in 2008, with samplers in eight Alaskan and four B.C. ports. Additionally, IPHC received state and tribal assistance in scanning in nine ports in Washington and Oregon. Through 2 November, almost 23 million pounds (40% of total landings) have been scanned. The number of tags recovered in 2008 totals 255 from the 2003 primary experiment and 159 from the 2004 experiment. Once again, very few tags were recovered by the fishery in Area 4. Achieving desired scanning goals for Area 4B trips was a challenge in 2008, as many vessels shifted their landings to unstaffed ports. Overall, the number of recoveries continued to decline from the previous year, which is typical as natural mortality affects the remaining fish at large. 2009 is the last year of scheduled scanning for tags released in this experiment.

Effort on the Genetics project continued in 2008 with additional sample analysis under the supervision of Dr. Lorenz Hauser at the University of Washington's Marine Molecular Biology Laboratory. The project was initiated in 2002 to investigate the genetic population structure in the northeast Pacific using non-selected nuclear microsatellite markers, and in 2004 the study was expanded to spawning groups from British Columbia, the central Gulf of Alaska, and southeast Bering Sea. Although initial analysis suggested population differentiation, interpretation of results was complicated by very low F_{ST} values and the fact that genetic studies conducted without temporal replicates are in danger of detecting false positives. In February 2007, winter charters were conducted to resample the locations visited in 2004, and analysis of those samples continued through December, 2007. Increasing the number of microsatellites analyzed and filling gaps in the data set resulted in little change from prior work, although increasing sample sizes did result in increased levels of significance. At the end of 2007 we deemed the microsatellite work to be largely complete, with the conclusion that these markers may simply not be very powerful for detecting population structure in a species, such as halibut, with large amounts of larval mixing. At the same time, we lost our project technician. However, in May of 2008 we were fortunate to find a full-time post-doctoral researcher (Dr. Heather Galindo, formerly at Stanford University) to dedicate herself to the program. During the relatively short period of her employment, she has managed to make considerable progress investigating some other genetic markers that may be more powerful than microsatellites. She has screened 25 "expressed sequence tags", found in regions of DNA that are responsible for coding proteins and that may therefore be driven by evolution in different directions in different ocean basins. She has also sequenced four mitochondrial DNA (mtDNA) regions, which are maternally-inherited and have proven useful in other species for investigating sex-biased migration and demographics in relation to climate change. This work is expected to continue through this fall and winter.

A PAT-tagging project was initiated in 2008 to investigate why so few PIT tags were recovered from Area 4 and investigate the possibility that eastward migration is higher south of Unimak Pass than north of it. Of particular importance is the fact that PAT tags do not need to be physically recaptured in order to generate accurate endpoint locations, thereby eliminating spatial recovery biases arising from regional differences in reporting, or tag detection. In addition, archived depth data broadcast along with the endpoint locations can be used to determine the timing and duration of seasonal migratory phases between shallow and deep-water habitats, and fine-scale depth data downloaded from physically-recovered tags can be used to define periods of presumed active spawning (that is, egg release). These data can be useful for assessing match-mismatch between commercial fishery season opening and closing dates and the actual timing of seasonal migration and spawning periods, on a regional basis. The latter represents a geographic extension of PAT tag studies conducted in Areas 2 & 3 and recently expanded via external archival tagging. During the 2008 setline survey, 115 halibut were tagged throughout the Bering Sea and Aleutian Islands with tags programmed to report location exactly 365 days after tagging. At the beginning of October, one tag had been recovered by the targeted fishery and another ten had released prematurely, leaving a total of 104 tags still in the water.

The pilot study on use of archival tags on halibut, which began in 2006, continued in 2008 with the release of 162 archival tags in Area 2B during August-September. The tags utilized an external mount which allows for easier detection and recovery than internally-implanted tags. Veterinary ultrasound was used to determine gender of fish prior to tagging and proved to be a rapid (approximately 6 seconds per fish) and highly accurate method (0% error in a 45-fish test) of noninvasive sex-determination. An equal number of males and females, ranging from 71-151 cm fork length, were tagged in three regions with temperature-depth logging archival tags: 42 off northwestern Vancouver Island, 60 off the southern Queen Charlotte Islands, and 60 off the northwestern Queen Charlottes. Four fish (all female; 74-108 cm FL) were internally-implanted with temperature-depth-light logging tags that were left over at the end of the 2007 holding experiment. By the end of September, a single tag had been recovered in northern BC (near the Whaleback) by a commercial trawl vessel.

Conducted in tandem with the release of archival tags was a gear experiment examining relative catch rates on swivel and non-swivel gear. This experiment sought to determine whether the presence of swivels on setline gear has an effect on the catch of halibut or bycatch species. With a new charter vessel, the F/V *Van Isle*, we completed 36 gear sets, with each set comprised of 4 pairs of swivel and non-swivel skates. Fishing was conducted in Area 2B, during August and September 2008. The non-swivel gear was the standard gear used on the assessment surveys. The swivel gear used 24-inch gangions made of 400-lb test monofilament with swivels attached to the hook. These in turn were tied to the mainline with a short nylon becket. Both gears used 16/0 hooks. Preliminary analysis suggests that there is no catch difference in terms of weight of legal-sized halibut caught, but there may be a difference in the catch rate of sublegals. We are still conducting the analysis of catches of rockfish and other bycatch species.

Removal sampling can be a useful technique for directly estimating catch probability, so a pilot field experiment was conducted in 2008 to examine the effectiveness for halibut. Sampling was done at 20 setline survey stations in the eastern part of Area 3A. At each station, a sequence of five sets was made on consecutive days following the general setline survey protocol, with the first set being the standard survey set. The expectation was that catch would decrease over the five days of fishing, and the rate of decrease would provide information on catch probability. While standard removal models assume a closed population during the sample period, we anticipated some movement into and out of the catchable population during the five days, and developed models that allowed for some degree of local migration. A formal analysis is in progress, but the raw data show that, on average, catch did not decrease over the five days as had been expected. Possible explanations are that the local populations were so large that each set removed only a very small fraction of the population, or that local migration was such that the removed fish were replaced with new migrants on a daily basis. Whatever the cause, with no decline in catch, distinguishing catchability from other factors affecting catch size becomes extremely difficult. Although final conclusions will await the results of a formal analysis, the raw data imply that removal sampling is not a promising approach for estimating catchability of Pacific halibut.

A study to verify, by direct observation, the halibut hooking success curve for halibut on setlines took place in 2008 in Area 3A as a follow-up to work conducted in 2007. The goal in this latest experiment was to derive a similar curve for the smaller 14/0 hooks. We completed 65 deployments with the 14/0 hooks, and completed another 40 with the 16/0 hooks. This represents over 64 hours of viewing hooks on bottom. The 2008 data are currently being reviewed and edited, and results from the combined studies will be published next year. Combined with observations on mouth dimensions, the comparison of the two hook sizes should give us valuable insights to the physical parameters which can be used to describe the halibut selectivity curve.

The ability to use electronic (video) monitoring in the halibut fishery off Alaska was the focus of Project 654.11-84. The long term focus of this research is to improve the understanding of the ecosystem impacts of halibut fishing through improved monitoring of longline fishery bycatch and to provide data on mortality of bycatch species for input to stock assessments. In this study, we compared and evaluated the effectiveness of electronic monitoring (EM) and the current North Pacific Groundfish Observer Program (NPGOP) monitoring methods to operate effectively in a commercial longline (hook-and-line) setting in Alaskan waters. This was a cooperative study with the commercial fishing industry, IPHC, NMFS, and PSMFC, and relied on our ability to sample on various vessel configurations. The project was not as successful in getting as many vessels to participate as expected. Only four vessels, three in the Area 3A and 1 in Area 4, took an observer and accompanying video system. Over 230 sets were monitored among the four vessels. Archipelago Marine Research (Victoria BC) is currently analyzing the video data for the subsequent comparison with the observer sampling. We have gained agreement from the NPRB to extend the field activities into 2009, so that additional vessels deployments can be accomplished, which should result in a more complete data set for analysis of applicability of the technology to different vessel size classes. Analytical results should be available in early 2009.

IPHC has been involved in several cooperative studies which utilize the summer assessment survey and the catch of non-halibut species. Since 2002, the IPHC has worked cooperatively with both the Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) to collect rockfish (*Sebastes* spp.) bycatch data. All rockfish caught on operations in 2A are retained and marked externally with a Floy T-bar anchor tag and the tag number is recorded with the set (and recently the skate number) information. All marked fish are retained so state biologists can collect additional data shore-side. Marketable fish are sold. IPHC then provides each agency with the effort information collected as part of the normal survey data collection.

In 2008, IPHC worked with WDFW and ODFW to fish supplemental stations designed to further enhance the understanding of rockfish status in these areas. In each state, the stations' locations and design were specified by the state agency involved. Eighteen stations were fished off Washington (a continuation of similar studies from the previous 2 years) and twenty stations off Oregon. Three skates of gear were fished at each station as a precautionary approach due to the exploratory nature of these stations and concerns about overfishing yelloweye rockfish (*Sebastes ruberrimus*). Activities at each station were identical to those on standard IPHC stations except that halibut were only sampled for length and prior hooking injury and then released alive; rockfish were handled as described above. A summary of this project was submitted to each state by the end of November 2008. Depending on those results, there may be similar cooperative work conducted in future years.

In 2008, IPHC worked with the Department of Fisheries and Oceans Canada (DFO) to provide a third biologist on IPHC survey vessels to collect hook by hook occupancy information for all species, and otoliths, maturities, and lengths for rockfish except thornyheads. This is the sixth year of this cooperative program and continued collaboration is anticipated.

In 2008, IPHC worked cooperatively with Alaska Department of Fish and Game (ADFG) to provide a third biologist on IPHC survey vessels in the Fairweather, Sitka, Ommaney and Ketchikan charter regions to collect hook by hook occupancy information for all species, and otoliths, sex, and lengths for yelloweye rockfish. This project built upon cooperative work started with ADFG in 2007.

IPHC collected length frequency data on incidentally caught Pacific cod (*Gadus macrocephalus*) in the 4A Edge and 4D Edge charter regions. This project was initiated at the request of NMFS-AFSC Pacific cod assessment team and part of a developing effort to collect bycatch information on Pacific cod in the western regions of our survey, where it makes up the largest component of our survey bycatch.

Finally, IPHC hired an intern in 2008. The intern program generally includes various pre-determined office tasks as well as being assigned a research project which the intern designs and executes. A final report and presentation are given at the conclusion of the employment term and results are included in that year's RARA. In 2008, we went a different direction and hired a film student from the University of Montana to make a port sampling training video. The student constructed a story board, traveled to several ports for footage, conducted interviews, and then put it all together. The project was a success. For 2009, we plan to go back to the traditional science student format, but may seek out specialties in the future if a particular project requires expertise not available on the staff.

2008 Grants & Contract Research

NMFS Auke Bay Lab (ABL) has had a sablefish data collection program for several years and IPHC has assisted NMFS with the program. In 2003/2004, the program was reviewed and modified 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 contracts IPHC to collect and review information on sablefish catches during the IPHC port sampler's logbook interview. Sablefish data are entered by IPHC staff, edited, and an electronic summary provided to the ABL scientists. Vessels are assigned a unique code in the summarized data to preserve confidentiality. The SOW was renewed for 2009.

IPHC also received several grants in 2008. NMFS provided a grant for the incremental increase in port sampling costs due to the IFQ program. IPHC also received a grant from NPRB to partially cover its costs associated with the study examining the use of electronic monitoring (video) of the halibut fishery off Alaska. Additional payments from the NPRB grant are expected as the project continues. IPHC also received funds from APICDA and CBSFA to offset a potion of the cost of the large release of PAT tags in Area 4 in 2008.

2008 Research Publications

IPHC staff noted in **Bold** type.

Kaimmer, S.M. and Stoner, A.W. 2008. Field investigation of rare-earth metal as a deterrent to spiny dogfish in the Pacific halibut fishery. Fish. Res. 94(1):43-47.

Loher, T. 2008. Homing and summer feeding site fidelity of Pacific halibut (*Hippoglossus stenolepis*) in the Gulf of Alaska, established using satellite-transmitting archival tags. Fish. Res. 92:63-69.

Loher, T. and Seitz, A.C. 2008. Characterization of active spawning season and depth for eastern Pacific halibut (*Hippoglossus stenolepis*), and evidence of probable skipped spawning. J. Northw. Atl. Fish. Sci. 41:23-36.

McElderry, H.I., Reidy, R.D. and Pahti, D.F. 2008. A pilot study to evaluate the use of electronic monitoring on a Bering Sea groundfish factory trawler. Int. Pac. Halibut Comm. Tech. Rep. 51:29p.

Moukhametov, I.N., Orlov, A.M., and **Leaman, B.M.** 2008. Diet of Pacific halibut (Hippoglossus stenolepis) in the northwestern Pacific Ocean. Int. Pac. Halibut Comm. Tech. Rep. 52:24p.

Seitz, A.C., **Loher, T.**, and Nielsen, J.L. 2008. Seasonal movements and environmental conditions experienced by Pacific halibut along the Aleutian Islands, examined by pop-up satellite tags. Int. Pac. Halibut Comm. Sci. Rep. 85, 24p.

Stoner, A.W., and **Kaimmer, S.M.** 2008. Reducing elasmobranch bycatch: Laboratory investigation of rare earth metal and magnetic deterrents with spiny dogfish and Pacific halibut, Fish. Res. 92(2-3):162-168.

Valero J.L., Lee, B., Armstrong, D., Orensanz, L., Parma, A., Hilborn, R., Sizemore, B., and Palzer, T. 2008. Population dynamics and historic trends of geoduck clams under episodic low dissolved oxygen conditions in Hood Canal. J. Shellfish Res. 2:462-463.

Valero, J.L. and Lasta, M.L. 2008. Estimating survival of discarded scallops in the Patagonian scallop fishery: Comment on "Survival of Patagonian scallop (Zygochlamys patagonica, King and Broderip, 1832) after the size selection process on commercial fishing vessels", by Bremec et al. 2004. Fish. Res. 90: 313–315.

Webster, R.A., **Clark, W.G.** and **Forsberg, J.** (in prep) Truncated discrete distribution models for migration distance in tag-recovery studies. Trans. Amer. Fish. Soc.

Webster, R.A., Pollock, K.H., and Simons, T.R. 2008. Bayesian spatial modeling of data from bird surveys. Journal of Agricultural, Biological and Environmental Statistics 13, 121--139.

Webster, R.A., Pollock, K.H., Ghosh, S.K. and Hankin, D.G. 2008. Bayesian spatial modeling of data from unit-count surveys of fish in streams. Trans. Amer. Fish. Soc. 137:438-453.

Yoshizaki, J., Pollock, K.H., Brownie, C., and **Webster, R.A**. (in press), Modeling misidentification errors in capture-recapture studies using photographic tags of evolving marks. Ecology.

Section II:
Research Proposed for 2009

Continuing Research

Project 413.00: PIT tagging study: Year 6 of tag recovery and scanning
Start Date: 2003
Anticipated ending: 2009
Personnel: J. Forsberg, G. Williams, S. Hare, A. Ranta, scan samplers

Scanning for PIT tags will continue in 2009. IPHC will hire samplers for Alaskan ports (including an expansion into scanning in Sand Point, AK), 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 604.00: NMFS trawl survey: At-sea data collection
Start Date: 1996
Anticipated ending: Continuing
Personnel: L. Sadorus, A. Ranta, S. Hare

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 2009, NMFS will be conducting both the Bering Sea and Gulf of Alaska shelf surveys and the IPHC plans to have one biologist aboard each survey.

Project 610.11: Water column profiler project (General survey)
Project 610.12: Water column profiler project (Oregon)
Start date: 2000, 2007 (respectively)
Anticipated ending: Continuing
Personnel: L. Sadorus, S. Hare, P. Stabeno (NMFS PMEL)

The IPHC maintains one of the most extensive sampling platforms in the north Pacific. This platform provides 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. Since 2001, IPHC has successfully deployed a SeaBird SBE-19 water column profiler during the annual stock assessment survey (#610.11). A second profiler was added to the program in 2007 (#610.12). Annual costs are directed towards maintenance and calibration of the profilers.

Project 618.00: Undergraduate Internship
Start Date: 2002
Anticipated duration: Continuing
Personnel: L. Sadorus, T. Loher, 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 621.00: Genetic population structure of Pacific halibut assessed via nuclear microsatellite diversity – lab work by UW
Start: 2002
Anticipated Ending: Continuing
Personnel: T. Loher, L. Hauser (UW-MMBL), other staff as needed

The eastern north Pacific halibut resource is presently managed under the assumption that a single fully mixed population exists from California through the eastern Bering Sea. This belief rests largely upon studies that indicate that drift of larvae to the northwest is balanced by migration of juveniles and adults to the southeast, over broad geographic expanses. In 2002, a project was initiated to investigate genetic population structure in the northeast Pacific using non-selected nuclear microsatellite markers, and in 2004 the study was expanded to spawning groups from British Columbia, the central Gulf of Alaska, and southeast Bering Sea. Although initial analysis suggested population differentiation, interpretation of results was complicated by very low F_{ST} values and the fact that genetic studies conducted without temporal replicates are in danger of detecting false positives. In February of 2007, winter charters were conducted to resample the locations visited in 2004, and analysis of those samples continued through December, 2007. Increasing the number of microsatellites analyzed and filling gaps in the data set resulted in little change from prior work, although increasing sample sizes did result in increased levels of significance. At the end of 2007 we deemed the microsatellite work to be largely complete, with the conclusion that these markers may simply not be very powerful for detecting population structure in a species, such as halibut, with large amounts of larval mixing. At the same time, we lost our project technician. However, in May of 2008 we were fortunate to find a full-time post-doctoral researcher (Dr. Heather Galindo, formerly at Stanford University) to dedicate herself to the program. During the relatively short period of her employment, she has managed to make considerable progress investigating some other genetic markers that may be more powerful than microsatellites. She has screened 25 “expressed sequence tags”, found in regions of DNA that are responsible for coding proteins and that may therefore be driven by evolution in different directions in different ocean basins. She has also sequenced four mitochondrial DNA (mtDNA) regions, which are maternally-inherited and have proven useful in other species for investigating sex-biased migration and demographics in relation to climate change. This work is expected to continue through this fall and winter.

Project 622.12: PAT tagging: summer 2008 releases (Area 4)
Start: 2008
Anticipated Ending: 2010
Personnel: T. Loher, A. Seitz (UAF), sea samplers

A PAT-tagging project was initiated in 2008 to investigate why so few PIT tags were recovered from Area 4 and investigate the possibility that eastward migration is higher south of Unimak Pass than north of it. During the 2008 setline survey, 115 halibut were tagged throughout the Bering Sea and Aleutian Islands with tags programmed to report location exactly 365 days after tagging. At the beginning of October, one tag had been recovered by the targeted fishery and another ten had released prematurely, leaving a total of 104 tags still in the water. Project costs in 2009 are for anticipated satellite transmission time when the tags pop to the surface 365 days following release.

Project 636.00: Histology: Analysis of gonad staging
Start: 2004
Anticipated Ending: Continuing
Personnel: T. Geernaert, C. Dykstra, 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.

Project 642.00: Assessment of mercury and contaminants in Pacific halibut
Start Date: 2002
Anticipated ending: Continuing
Personnel: C. 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. The Alaska Division of Public Health updated their advice on fish consumption in 2007 with some restrictions on the number of meals of halibut for women of child bearing age and young children with respect to methyl mercury levels. 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.

Since 2002 the IPHC has submitted 981 samples for testing by ADEC. The mean level of total mercury for these samples has been 0.340 ppm (for comparison the FDA limit of concern for methyl mercury is 1.000 ppm, the EPA and the CFIA level of concern is 0.500 ppm) ranging from non-detectable to 1.947 ppm. 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 robust.

Sampling will continue in 2009 with a targeted collection of 60 samples (15 fish between 10-20 lbs, 15 fish between 20-40 lbs, 15 fish between 40-100 lbs, and 15 fish greater than 100 lbs.) from each of three regions (Sanak, Yakutat, and Chignik) during the setline survey.

Project 650.12: Archival tagging: Pilot studies (Area 2B releases)
Start Date: 2006
Anticipated ending: Continuing
Personnel: T. Loher

This study is investigating migratory behavior and environmental conditions experienced by two components of stock: small adult (primarily male) and late pre-recruit halibut, as well as larger adults including reproductive females. The work is a complement to PAT (satellite) tagging studies and seeks to expand our knowledge to components of the population that have not been studied with PAT tags due to apparent size constraints (i.e., males and pre-recruits) and to obtain multi-year data for larger fish. The objectives for each stock component are slightly different, but do not require separate studies. Externally attached, rather than surgically implanted, archival tags are being used. The tags were applied to all females above 90 cm and all fish above 100 cm during August-September, 2008 in Area 2B. Project costs in 2009 are for the anticipated recoveries. Premium rewards are being offered to encourage recoveries.

Project 653.00: Species identification of amphipods frequenting Pacific halibut
Start Date: 2006
Anticipated ending: Continuing
Personnel: B. Leaman, E. 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, 2005, and 2006 stock assessment surveys as part of standard protocol, recording incidence of sand flea predation, and the extent and virulence of the predation. The 2006 was the last year of data collection for this stage of the project. The 2007 summer intern performed initial analysis of interannual occurrence and virulence. Additional work will be directed at correlated variables.

Project 654.11-84: Alaska fishery electronic monitoring – pilot study
Start Date: 2008
Anticipated ending: 2009
Personnel: G. Williams, B. Leaman, B. Karp and J. Cahalan (NMFS Observer Program)

Bycatch rates of other species in the Pacific halibut fishery are not well estimated, so electronic monitoring has been suggested as one option to collect such information. The majority of vessels operating in this fishery are not required to have observer monitoring due to their size. The long term focus of this research is to improve the understanding of the ecosystem impacts of halibut fishing through improved monitoring of longline fishery bycatch and to provide data on mortality of bycatch species for input to stock assessments. In this study, we will be comparing and evaluating the effectiveness of electronic monitoring (EM) and the current North Pacific Groundfish Observer Program (NPGOP) monitoring methods to operate effectively in a commercial longline (hook-and-line) setting in Alaskan waters. This was a cooperative study with the commercial fishing industry and relied on our ability to sample on various vessel configurations.

The project was not as successful in 2008 in getting many vessels to participate as expected. Only four vessels, three in the Area 3A and 1 in Area 4, took an observer and accompanying video system. Over 230 sets were monitored among the four vessels. Archipelago Marine Research (Victoria BC) is currently analyzing the video data for the subsequent comparison with the observer sampling. Additional vessel monitoring has been approved for spring 2009, which should provide a more complete data set for analysis during 2009.

Proposed New Research

1. Coastwide deployment of water column profilers
Start date: 2009
Anticipated ending: Continuing, although the grant ends in Sept., 2010
Personnel: L. Sadorus, S. Hare, P. Stabeno (NMFS PMEL)

In 2008, IPHC was awarded a grant from NOAA which for the purchase of water column profilers for each survey vessel and therefore coastwide collection of oceanographic data. The profilers will measure temperature, salinity, dissolved oxygen, pH, and florescence at each station. These data will provide an annual snapshot of near shore oceanic conditions as well as valuable observational data for modeling and biological studies on recruitment and growth variability. IPHC staff will be working with the Pacific Marine Environmental Lab (PMEL) on data processing and storage. The grant provides funding through FY2010 and covers the costs for acquiring and maintaining the devices as well as editing and publishing the data.

2. Bering Sea age validation study utilizing ^{14}C radiocarbon
Start Date: 2009
Anticipated ending: 2010
Personnel: S. Wischniowski, T. Loher, NMFS personnel

Radiocarbon, or ^{14}C bomb carbon, has been used successfully in the past on several fish species as a validation of absolute age assignment. This project would be a collaborative study between IPHC and the NMFS Alaska Fishery Science center as a follow-up to the 2003 aging study conducted on Gulf of Alaska halibut otoliths.

3. Archival tags: Holding tank experiments examining mounting protocols
Start Date: 2009
Anticipated ending: 2010
Personnel: T. Loher

This study will investigate alternate mounting protocols for the externally-mounted archival tags. The 2008 releases in Area 2B were our first experience with using an external mount, and that process suggested some revisions and improvements could be possible which would reduce any effect the tags may have on the fish's behavior. Additional improvements to tag design may also be helpful in creating a different mounting device. A total of 30 halibut ranging from 75-90 cm FL will be captured via hook-and-line and transported live to an appropriate holding facility. The IPHC staff is anticipating utilizing facilities and staff at the Oregon Coast Aquarium, as was done in 2006. Following tagging, fish will be reared for 12-18 months, treated regularly for parasites, examined regularly to assess healing and/or relative infection rates among mounting types, and behavior monitored. At the end of the holding period, fish will be measured to assess relative growth among treatment groups, and tags will be removed to examine the effects of the tag mounts on the tissue and musculature at the attachment site, or internal interactions in the case of an internal-external-streamer modification. The results would support the anticipated use of this type of technology in subsequent years.

4. POST Study: IPHC participation
Start Date: 2009
Anticipated ending: Continuing
Personnel: B. Leaman, other staff as needed, ADF&G, NMFS

The Pacific Ocean Shelf Tracking (POST) Project, part of the Census of Marine Life and flagship for the international Ocean Tracking Network, provides a tool for scientists to track the movement of marine animals along the West Coast of North America. POST uses acoustic transmitters implanted in various species and a series of receivers running in lines across the continental shelf to provide movement data.

A recent call for proposals by the North Pacific Research Board for an Integrated Ecosystem Research Program (IERP) creates a funding opportunity for a collaborative effort by IPHC with NMFS and ADF&G to become participants in the Pacific Ocean Shelf Tracking (POST) initiative. The POST program seeks agencies to purchase the receivers to equip a sensor track, or lines, with matching funds available. For IPHC, the idea is to conduct a proof-of-concept study, to see if the receivers can indeed pick up a demersal fish like a halibut. ADF&G and NMFS are interested in the applications to sablefish. The agency group agreed the benefits were sufficient to move forward with a range test - as a first step - focused primarily in the area around Cape Ommaney. Funding would be used for purchase of acoustic tags and/or deployment of receivers. If this concept proves sound, a joint proposal by the three agencies to the NPRB and POST would occur for 2010.

Other 2009 Research – Contracts and Grants

Project 300.00-81:Alaska port sampling
Start Date: 2002
Anticipated ending: Continuing
Personnel: H. Gilroy, M. Larsen, L. 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 628.00: Alaska catcher vessel logbook and sablefish data collection
Start Date: 1999
Anticipated ending: Continuing
Personnel: L. Hutton, H. Gilroy, A. 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. Logbook data are entered by IPHC staff, matched with landings records, and provided electronically with a summary to the ABL scientists. In the summarized data, the vessels are assigned a unique code to preserve confidentiality.

Research Conducted Without Direct Funding

1. The 2008 stock assessment
Personnel: S. 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.

2. Development of IPHC harvest policy
Personnel: S. Hare, J. Valero

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.

3. Development of a robust management procedure

Personnel: S. Hare, B. Leaman, J. Valero

Staff catch limit recommendations are derived from the annual stock assessment by applying a constant harvest rate to the estimates of exploitable biomass, in the belief that the assessment model is correctly specified and the estimates are accurate. In fact there are a number of structural uncertainties about the model, and the assessment itself has become highly complicated, so it is vulnerable to any small error in data compilation or programming. The aim of this project is to develop a procedure for deriving catch limit recommendations that would achieve the desired harvest policy, potentially relying on much simpler calculations and at the same time be effective across a range of uncertainties about stock, fishery and management behavior. Such procedures have been developed for other fisheries and it is appropriate to investigate their application to halibut management.

4. Estimation of halibut abundance from mark-recapture data

Personnel: R. Webster, B. Leaman, S. Hare

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. Recoveries in 2005-2007 followed a similar pattern. The 2008 recoveries will be added to the analysis this year.

5. Whales sightings by the commercial fishery off Alaska while hauling gear

Personnel: L. Hutton, port samplers
Start: 2007
End Date: Under review

Beginning in 2007, IPHC U.S. commercial fishery logbooks were modified to facilitate the collection of whale sightings while hauling gear. This is a pilot project to determine if sighting information can be collected and if accurate information can be obtained. This information could help to set a baseline for sightings. A review of other programs will be conducted to see where information is collected, available, and stored. Additionally whale sighting data collected during the grid survey can be reviewed along with known depredation activity on the grid survey sets. Data will be reviewed and results provided in the 2009 RARA.

6. Seabird occurrence project

Start Date: 2002
Anticipated ending: Continuing
Personnel: T. Geernaert

During the stock assessment surveys, sea samplers count the number of seabirds in the vicinity of the vessels following gear retrieval. Sampling after the haul addresses the question of where and when certain seabird species occur. These data have been used to identify appropriate seabird deterrent requirements in certain geographic locations. Data have also been collected, using the same protocol, on the NMFS and ADF&G sablefish surveys. IPHC has developed a database to store seabird occurrence data and the collection project is ongoing.

7. Seabird data repository (Project 643.00)

Start Date: 2005
Anticipated ending: Continuing
Personnel: T. 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.

8. Estimates of bycatch on the assessment surveys

Start Date: 2003
Anticipated ending: Continuing
Personnel: C. Dykstra, Survey Team, DFO, ADF&G, WDFW and ODFW personnel

Area 2A

Since 2002, the IPHC has worked cooperatively with both the Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) to collect rockfish (*Sebastes* spp.) bycatch data. All rockfish caught on operations in 2A are retained and marked externally with a Floy T-bar anchor tag and the tag number is recorded with the set (and recently the skate number) information. All marked fish are retained so state biologists can collect additional data shore-side. Marketable fish are sold. IPHC then provides each agency with the effort information collected as part of the normal survey data collection.

In 2008, IPHC worked with WDFW and ODFW to fish supplemental stations designed to further enhance the understanding of rockfish status in these areas. In each state, the stations' locations and design were specified by the state agency involved. Eighteen stations were fished off Washington (a continuation of similar studies from the previous 2 years) and twenty stations off Oregon. Three skates of gear were fished at each station as a precautionary approach due to the exploratory nature of these stations and concerns about overfishing yelloweye rockfish (*Sebastes ruberrimus*). Activities at each station were identical to those on standard IPHC stations except that halibut were only sampled for length and prior hooking injury and then released alive; rockfish were handled as described above. A summary of this project was submitted to each state by the end of November 2008. Depending on those results and various state authority budgets, there may be similar cooperative work conducted in future years.

Area 2B
In 2008, IPHC worked with the Department of Fisheries and Oceans Canada (DFO) to provide a third biologist on IPHC survey vessels to collect hook by hook occupancy information for all species, and otoliths, maturities, and lengths for rockfish except thornyheads. This is the sixth year of this cooperative program and continued collaboration is anticipated.

Area 2C and eastern 3A
In 2008, IPHC worked cooperatively with Alaska Department of Fish and Game (ADFG) to provide a third biologist on IPHC survey vessels in the Fairweather, Sitka, Ommaney and Ketchikan charter regions to collect hook by hook occupancy information for all species, and otoliths, sex, and lengths for yelloweye rockfish. This project built upon cooperative work started with ADFG in 2007. This project will not continue in 2009.

Area 4
IPHC collected length frequency data on incidentally caught Pacific cod (*Gadus macrocephalus*) in the 4A Edge and 4D Edge charter regions. This project was initiated at the request of NMFS-AFSC Pacific cod assessment team and part of a developing effort to collect bycatch information on Pacific cod in the western regions of our survey, where it makes up the largest component of our survey bycatch.

9. Electronic reporting project for commercial landings in Alaska

Start Date: 2002
Anticipated ending: Continuing
Personnel: H. Gilroy, L. Hutton, T. Kong, A. Tesfatsion, H. Tran

IPHC, ADF&G, and NMFS staffs have continued to refine the web-based Interagency Electronic Reporting System (IERS). For halibut, the system reduces duplicative reporting resulting from the current requirements of completing ADF&G fish tickets, NMFS/RAM quota share reports, and has been operational since May 2006. The application (eLandings) records data elements required by regulations, prints fish tickets, and connects with the NMFS quota share database.

The appropriate data from IERS is being sent to the agencies for their internal databases. Industry personnel and agency staff have provided feedback on the operation and the application is continuously being modified including incorporation additional fisheries and tender landings. Agency staffs have been to yearly trainings or workshops on the program. In 2009, the focus will be on continued training with the processors. Costs represent system maintenance costs, software purchase and development, steering committee and travel costs.

10. Electronic logbooks
Start: 2009 (postponed from 2008)
End Date: Pilot project
Personnel: H. Gilroy, L. Hutton, K. MacTavish

IPHC and NMFS/AKR are collaborating to determine the feasibility of an electronic logbook and establish the specifications needed for contractors. The Commission will also be reviewing other programs to decide if another geographic location (Area 2B or 2A) is an appropriate place to start an electronic logbook program.

Research Topics for 2010

1. Design of experiment to examine coastwide catchability of longline survey gear
Personnel: B. Leaman, S. Hare, R. Webster, J. Valero

The issue of common catchability for IPHC setline survey gear across all areas of the coast is a key component of the use of survey data for biomass apportionment. While we have no indication that catchability is highly biased in any area, we acknowledge that the existing data comparisons with which catchability has been assessed are highly variable. This high variance contributes to questions about the validity of the assumed commonality of catchability across the coast. Historical evaluations of catchability have employed trawl-setline comparison fishing. However, those experiments produced the high variance noted, plus the fact that trawls cannot be used in all areas where longline fishing occurs and that trawls have their own separate gear selectivity by halibut size. Thus, the trawl-setline comparisons are both spatially and selectivity compromised. It therefore is highly unlikely that any experiment using a trawl-setline comparison will produce results that will be either convincing or spatially inclusive.

The staff believes that a different approach to estimating setline catchability is required. Its fundamental feature must include a method to obtain an unbiased estimate of halibut density, wherever halibut are fished, so that fishing using IPHC survey gear can then be evaluated coastwide. At present, we do not know what that method might be. It could include, among other approaches, remote sensing, short-term tag-recapture fishing, acoustic tagging, or other technology-based methods. We believe that such an experiment demands careful planning and may include pilot studies of candidate methods. In any event, the results of such a coastwide experiment are important to the Commission's management process and it should be only be conducted after adequate planning, and using methods with a higher probability of producing accurate results than those methods presently available.

Northwest Fisheries Science Center

National Marine Fisheries Service

NOAA Fisheries

Agency Report to the Technical Subcommittee

of the Canada - U.S. Groundfish Committee

April 2009

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 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.

FRAMD consists of a multi-disciplinary team with expertise in fishery biology and ecology, stock assessment, economics, mathematical modeling, statistics, computer science, and field sampling techniques. Members of this program are stationed at the NWFSC facilities in Seattle and in Newport, Oregon, with some Observer Program staff located in California. 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 multi-species 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 assessments.

During 2008, FRAMD continued to: implement a West Coast observer program; build a survey program that conducts West Coast groundfish acoustic and trawl surveys previously conducted by the AFSC; develop new technologies for surveying fish populations, particularly in untrawlable areas; and expand 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.

Other Divisions at the NWFSC are:

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 bio-monitoring 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. Multi-species Studies

1. Research

a) Demersal fish abundance in relation to an offshore hypoxic zone along the U.S. West Coast

In September 2008, as part of the West Coast Groundfish Trawl Survey, FRAMD examined the abundance of benthic organisms in a known hypoxic area off the Oregon coast. Since 2002, seasonal hypoxia has been observed extending over an area greater than 700 km^2 offshore of Newport, Oregon. Although observed each summer, the intensity of hypoxia has varied with the greatest temporal and spatial extent noted in 2006. The Northwest Fisheries Science Center annually conducts the West Coast Groundfish Trawl Survey from Washington to California (55 to 1,280 m) using a stratified random design. A few stations generally fall within the hypoxic area and in 2006 FRAMD observed exceedingly low fish biomass here. Consequently in September 2008, FRAMD dedicated 2-days of the groundfish survey to examining the abundance of demersal fish and invertebrates within the hypoxic zone in greater detail, as was initially done in 2007. Working collaboratively with colleagues from Oregon State University, we identified the geographic extent of the 2008 hypoxic zone. We sampled 13 stations along 2 depth contours (50 and 70 m) within the area. A Seabird SBE19-plus was attached to the trawl gear to monitor oxygen concentration during each tow. All catch was identified and weighed with stomach and tissue samples taken from selected species. Dungeness crabs from each tow were measured, weighed and assigned a condition code. During the 2-day survey, bottom oxygen concentrations at all stations were elevated relative to 2007 and rarely were hypoxic levels encountered. Mean bottom dissolved oxygen concentrations along the tow tract ranged from 1.26 to 1.69 ml l^{-1}. Preliminary results indicate that total CPUE (ln, kg $hectare^{-1}$) and bottom dissolved oxygen (DO, ln ml l^{-1}) levels for 2008 were not significantly related; however when the data from 2007 and 2008 were combined a significant relationship was seen for all depths combined and when data were separated by depth contour (Figure 1).

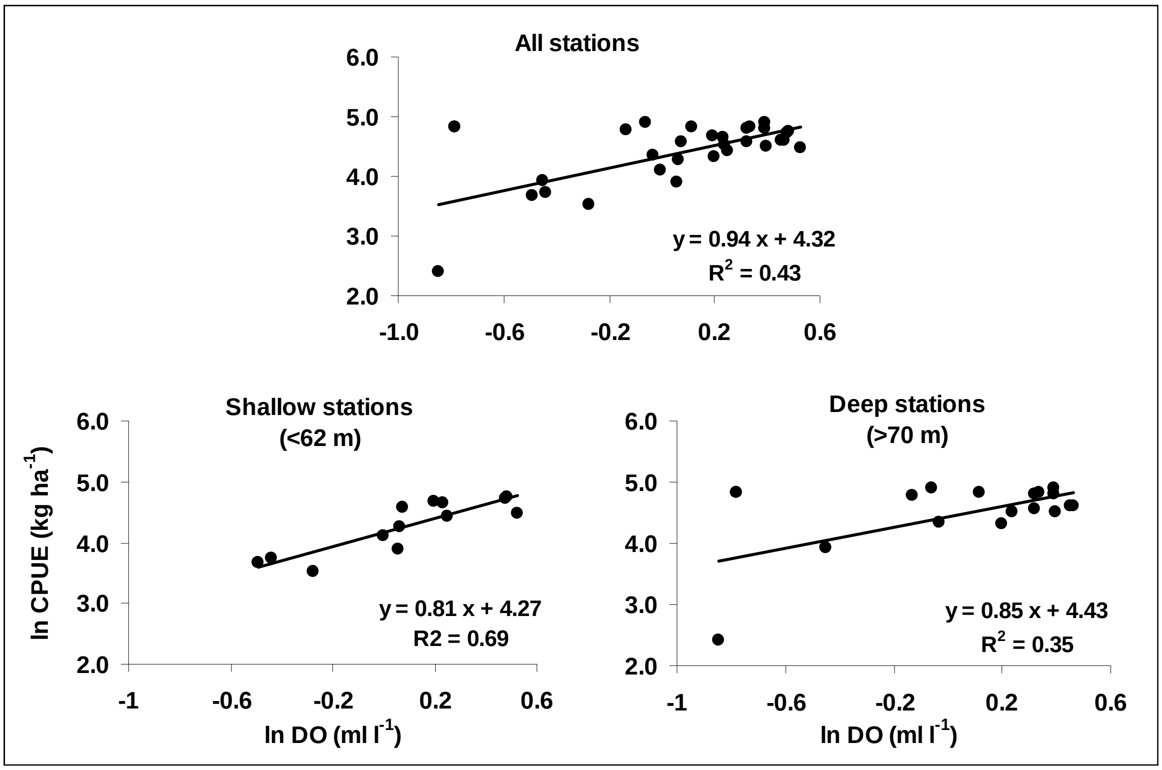

Figure 1. Relationship between catch per unit effort (CPUE, ln kg $hectare^{-1}$) and mean bottom oxygen concentration (DO, ln ml l^{-1}) along the tow track within the hypoxic zone.

For more information please contact Dr. Aimee Keller at Aimee.Keller@noaa.gov.

b) Evaluating the estimation of fishery management reference points in a variable environment

There is strong evidence that low frequency between-year environmental variability, in addition to fishing, is able to affect fish population abundance via recruitment. However, scientific advice regarding catch limits is often based on control rules that depend on the estimation of biomass reference points which typically do not explicitly consider the affect of trends over time in reference points caused by environmental variability.

Harvest rates based on commonly-used biological reference points such as the level of unfished spawning biomass (B_0), the current size of the stock in relation to B_0, and B_{MSY} that are sustainable under current environmental conditions may be unsustainable under different environmental conditions. Although several methods exist for estimating biomass reference points, it is unclear which of these are most robust to the affect of long term, low frequency environmental variability. Therefore, simulation is used to evaluate alternative estimators, which differ in terms of how the stock-recruitment relationship is modeled, and whether explicit estimators or proxies are used for B_0, the steepness of the stock-recruitment relationship, and current spawning biomass relative to B_0. The simulations consider three life histories: a long-lived unproductive rockfish, a moderately long-lived and productive flatfish, and a moderately long-lived and productive hake with highly variable recruitment. Results indicate that in the presence of low frequency autocorrelated forcing of recruitment, biomass reference points should be based on average recruitment and/or dynamic B_0 if catch and survey data are available for at least one full period of the environmental variable. In contrast, previous analysis suggests that in the absence of autocorrelated environmental forcing of recruitment, and if the available catch and survey data do not span at least, in this case, 50 years which is one full period of the environmental variable, biomass reference points should be based on the fit of the stock-recruitment relationship. Life history affects the estimability of biomass reference points, which are more difficult to estimate for species with more rapid dynamics such as hake. The method used to calculate the reference points given the results of a stock assessment has a larger affect on estimability than the configuration of the stock assessment method, for the three stock assessment model configurations investigated in this study.

For more information please contact Dr. Melissa Haltuch at Melissa.Haltuch@noaa.gov

c) Construction of a habitat map for Heceta Bank, Oregon, USA for use in estimates of groundfish assemblages on the bank

Heceta Bank, (offshore Oregon), is one of the largest rocky banks along the US west coast and contains a diverse array of habitats supporting numerous species of commercially important groundfish, including a diverse assemblage of rockfishes (*Sebastes* sp.). In 1998 we collected high-resolution bathymetry and backscatter imagery of the bank using a *Simrad* EM 300 multibeam echo sounder, and returned in 2000 and 2001 to conduct strip transect video surveys of habitat, fish, and invertebrates using the remotely operated vehicle *ROPOS*. These *in situ* data have been analyzed for fish habitat relationships. One of the critical elements of this project was to create the first comprehensive lithological habitat map of the bank. Polygons of uniform habitat were constructed by analyzing the image data (bathymetry, backscatter, topographic position index and slope) and reconciling with the video data. Habitat areas identified include: high relief ridge sediment complex, heavily eroded ridge complex, pinnacle, boulder/cobble, and unconsolidated sediment (mud and sand). This map, combined with the fish observations made in the ROV video, may be used as a tool to extrapolate groundfish abundances for the entire bank and adjacent areas surveyed by dive transects.

For more information please contact Julia Clemons at Julia.Clemons@noaa.gov.

d) Day and night activity patterns in demersal fishes on Heceta Bank, Oregon
Diel activity patterns for demersal fish inhabiting Heceta Bank, OR were examined via ROV. Most shallow-dwelling tropical marine fishes exhibit differences in activity patterns from day to night, showing similar transition behavior among sites despite dissimilar species assemblages. Few studies have examined day-night changes in species abundance, distribution, and activity patterns in temperate deepwater habitats, where day to night differences in light intensity are extremely low. Changes in species assemblages due to time of day have profound management implications for the monitoring and assessment of groundfish species because stock assessment surveys are typically conducted during daylight hours. Direct-observation surveys were conducted on Heceta Bank, the largest rocky bank off of Oregon, during day and night periods using a remotely operated vehicle (ROV) deployed over several habitat types. Habitat-specific abundance and activity were determined for 31 taxa or groups that were seen frequently enough to comprise ≥0.1% of the total day and night fish density. General patterns observed were similar to shallow temperate day-night studies, with an overall increase in the abundance and activity of fishes during the day versus night, particularly in shallower cobble, boulder and rock ridge habitats. Most taxa did not exhibit distinct diurnal or nocturnal activity patterns. Rosethorn rockfish (*Sebastes helvomaculatus*) and hagfish (*Eptatretus sp.*) showed the clearest diurnal and nocturnal activity patterns, respectively. Since day-night activity patterns in demersal fishes are likely to influence catchability and observability in bottom trawl and direct count in situ surveys, the patterns observed in the current study should be taken into account in survey design and interpretation.

For more information please contact Dr. Waldo Wakefield at
Waldo.Wakefield@noaa.gov

e) Reproductive parasitism of lithodid crabs by snailfishes off the western U.S.
The FRAM Division has conducted annual bottom-trawl surveys along the West Coast since 1998. Though the primary mission of the surveys is to collect data for the management of groundfish resources, the surveys are also a highly effective means of conducting other scientific research, from addressing basic life-history questions to more advanced research such as helping to establish genetic databases for deep-sea corals. These projects often feature collaborations with other government agencies and universities, resulting in thesis dissertations, technical memoranda, and peer-reviewed papers. Here we describe results on reproductive parasitism by snailfishes of lithodid crabs.

Snailfish (Family Liparidae) are probably the most broadly distributed family of marine fishes, occurring in temperate and cold ocean waters from intertidal to depths below 7700 m. Some snailfishes of the genus *Careproctus* have the unique reproductive strategy of depositing their eggs in the branchial chambers of large lithodid crabs, probably via an ovipositor. The relationship has been described as parasitic, with effects on crabs ranging from no obvious damage to major gill compression and necrosis of half (an entire side) of the gills. Records of carcinophily consist of observations of eggs (and/or larvae) in crabs, but generally the fish involved are unidentified because the eggs have no distinguishing features, and snailfish are too similar in morphology to allow identification of embryos. West Coast U.S. occurrences have been reported.

We initiated a pilot study during the 2007 and 2008 NWFSC groundfish trawl surveys to collect data on the presence of snailfish eggs in the branchial chambers of crabs captured in the survey trawls, to identify adult snailfishes collected on the survey, to use genetic methods to match eggs to adults, and to initiate further studies of carcinophily. In 2007, we included a non-lithodid group of crabs with potential commercial value, tanner crabs of the genus *Chionoecetes*, but 807 crabs were checked for the presence of snailfish eggs and none were found. Snailfish eggs were found in four different lithodid species in 2007 and five different species in 2008. At least seven different species of snailfish in three genera were collected during the 2007 survey, including one (*Paraliparis pectoralis*) that is rare in collections. Visual analysis of the egg masses suggests there are at least two different liparid species depositing their eggs in crabs. The most common species collected was *C. melanurus.* Females collected had ovarian eggs ranging from undeveloped to 4.9 mm in size, suggesting that spawning may be protracted, even if periodic. Genetic analysis of egg masses and tissue samples taken from adult snailfish to identify which species laid the eggs is underway. Information on the relative frequency of occurrence of parasitism will be determined. This work will both help clarify the natural history of two groups of species distributed worldwide: snailfishes and lithodid crabs, and, we hope, lead to clarification of the evolution of this unique behavior.

For more information please contact Keith Bosley at Keith.Bosley@noaa.gov

f) Estimates of Pacific halibut bycatch and mortality in IPHC Area 2A in 2007

During 2008, the estimate of Pacific halibut bycatch and mortality in the bottom trawl fishery was updated through the calendar year 2007. The estimate of halibut bycatch and mortality in the bottom trawl fishery is based upon the method developed in the report for 1999 (Wallace, 2000). This analysis used halibut bycatch rates observed during the 2007 calendar year from West Coast Groundfish Observer Program. These rates are stratified by season, depth, latitude, and level of arrowtooth flounder catch; then multiplied by the amount of trawl effort in each stratum, which was derived from the 2007 Oregon and Washington trawl logbooks. Additional updates will occur as data become available.

For more information please contact John Wallace at John.Wallace@noaa.gov

g) The challenge of managing rocky reef resources

Nearshore temperate reefs are highly diverse and productive habitats that provide structure and shelter for a wide variety of fishes and invertebrates. Recreational and commercial fisheries depend on nearshore reefs, which also provide opportunities for non-extractive recreational activities such as diving. Many inhabitants of nearshore temperate reefs on the west coast of North America have very limited home ranges as adults, and recent genetic evidence indicates that the dispersion of the larval stages is often restricted to tens of kilometers. Management of temperate reef resources must be organized on very small spatial scales in order to be effective, offering unique technical challenges in terms of assessment and monitoring. New enabling legislation could assist in specifying mandates and adjusting institutional design to allow stakeholders and concerned citizens to formulate management policies at local levels, and to aid in implementing and enforcing these policies.

For more information please contact Dr. Jason Cope at Jason.Cope@noaa.gov

h) Integrating genetic data in marine resource management: how can we do it better?

Molecular genetic data have found widespread application for identification of population and conservation units for aquatic species. However, integration of genetic information into actual management has been slow, and explicit and quantitative inclusion of genetic data into fisheries models is rare. In part, this reflects the inherent difficulty in using genetic markers to draw inferences about demographic independence, which is generally the information of greatest short-term interest to fishery managers. However, practical management constraints, institutional structures, and communication issues have also contributed to the lack of integration. This paper identifies some of the organizational, conceptual, and technical barriers that have hampered full use of genetics data in stock assessment and hence fishery management and outlines how such use could be enhanced.

For more information please contact Dr. Jason Cope at Jason.Cope@noaa.gov

i) When do adverse conditions dictate a weather day?

Fishermen and field biologists work routinely under difficult conditions. It is natural in this setting to continue fishing during bad weather as long as safety is not compromised. However, as conditions deteriorate, the effectiveness of trawl survey gear may be reduced well before safety considerations force the cessation of sampling activity. Through comparison of 1,754 hauls performed on chartered vessels between 2003 and 2005 on the shelf and slope of the U. S. West Coast, we show a significant reduction in catch rates of bottom dwelling fish and invertebrates as a function of visually-estimated wave height. Comparing randomly located trawl sets that occurred fortuitously close to one another, we conclude that to reduce the estimated effect of wave height on benthic species catch rates (and potentially relative biomass estimates) survey trawl activities on these vessels should be halted when wave heights reach six feet. Only 41 hauls from the 2003-2005 data were conducted when wave heights exceeded six feet, however their exclusion reduces the maximum expected bias in any single tow due to wave height by ~31%. Further reductions in maximum wave height for routine sampling would begin to exclude geographic areas of the survey introducing a new bias to the randomized design. We further encourage the routine measurement of vertical motion due to wave action during sampling so that future analyses can improve our understanding of its effect on trawl survey catch rates.

For more information please contact Dr. Aimee Keller at Aimee.Keller@noaa.gov.

2. Stock Assessment

a) Stock assessment model development

Stock Synthesis (SS) is an assessment model in the class termed integrated analysis. SS is built with a population sub-model operating by forward simulation. SS has an observation sub-model to estimate expected values for various types of data, and a statistical sub-model to characterize the data's goodness of fit and to obtain best-fitting parameters with associated variance. It includes a rich feature set including age- and size-based population dynamics and the ability to specify observational phenomena, such as ageing imprecision. Model parameters can vary randomly or across time blocks or can be specified as functions of environmental data. SS includes routines to estimate MSY and exploitation levels that correspond to various standard fishery management targets. It supports assessments spanning several geographic areas and can use tag-recapture data. A customizable harvest policy is used to conduct a forecast in the final phase of running the model. The model is coded in ADMB (www.admb-project.org). SS is now in version 3 (SS_v3) and is included in the NOAA Fisheries Assessment Toolbox (http://nft.nefsc.noaa.gov/) incorporating a graphical user interface developed by Alan Seaver (NEFSC).

In 2007, version 2 of SS was used to assess the status of about 20 groundfish stocks off the U.S. West Coast. In 2008, SS2 was used to assess: Pacific cod in Alaska, about 6 stocks in SE Australia, Pacific sardine, albacore, bigeye and other Pacific tunas and billfish, and exploratory analyses were conducted on king mackerel in the SE Atlantic and for several groundfish stocks in the Northeast US. In October 2008, a talk based on SS was presented at the World Fisheries Congress in Yokohama, Japan. In November 2008, Dr. Methot was awarded the Department of Commerce Gold Medal for the development of SS.

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

b) Rebuilding depleted west coast groundfish species: management actions and early results

The Sustainable Fisheries Act of 1996 established a new mandate for NOAA Fisheries Service to identify and rebuild depleted fish stocks under its jurisdiction. Since 1996, seven rockfish and two other groundfish stocks that inhabit waters off Washington, Oregon, and California have been declared "overfished". In response to these declarations, a variety of measures have been implemented in an effort to rebuild the depleted stocks to target biomass levels. These responses have included dramatic reductions in Optimum Yields, new restrictions on gear usage, designation of closed areas, and the development of a comprehensive, scientific observer program. The two non-rockfish species that were listed as "overfished" have since been declared "rebuilt" and two of the rockfish stocks are expected to reach target biomass levels within the next few years. For some rockfish species, however, rebuilding is expected to take more than 60 years. Assessments were conducted during 2007 for all of the depleted rockfish species, as well as several others. The progress toward rebuilding is evaluated through examination of biomass trends reported in these assessments (Figure 2).

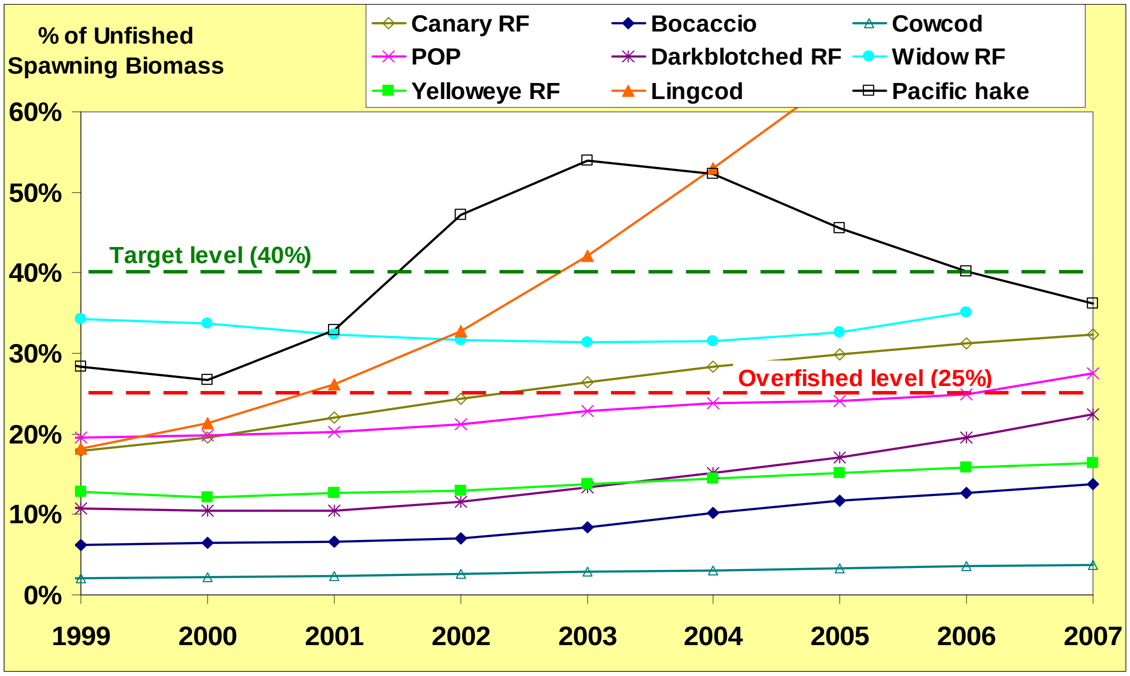

Figure 2. Changes in spawning stock biomass (%) since 1999 for species declared overfished.

For more information please contact Dr. Jim Hastie at Jim.Hastie@noaa.gov

c) Deriving objective data weighting for age- and length-composition data in stock assessments using post-model and simulation results

Integrated age-length structured stock assessment models derive estimates of management quantities by fitting to multiple sources of observed data, including indices of abundance, and age and length compositions. The relative weighting of these likelihood components is often an important contributor to uncertainty, but there is currently no clear objective approach to determine these weights. Model "tuning" is often applied, with the goal of achieving internal consistency between assumed data weighting and model fit. Tuning relies on reasonable starting values for input sample sizes to appropriately allocate lack of fit to process and observation error. Focusing on age- and length-composition observations from trawl survey data, we compare the effective sample sizes derived from assessment models fit to actual data in 2005 and 2007 with theoretical effective sample sizes based on simulation. We find that effective sample size is best represented as a function of both the number of fish and the number of hauls sampled. We develop guidelines for tuning of these data sources that should increase objectivity and reliability of stock assessment model results.

For more information please contact Dr. Ian Stewart at Ian.Stewart@noaa.gov

d) The promise and pitfalls of using climate data in fish stock assessment

Concurrent declines in demersal fish stock abundances and shifts in long term average environmental conditions in the Pacific have been well documented. Furthermore, highly variable stock-recruitment curves indicate environmental or other factors probably affect recruitment to fisheries. Thus, management advice that ignores environmental forcing of recruitment may cause stocks to be over- or under-harvested. The efficacy of including environmental impacts on recruitment in management models needs to be evaluated to move single species stock assessment methods towards taking account of ecosystem considerations. Simulation testing is used to determine the statistical power of currently-used stock assessment methods to correctly identify long term decadal scale environmental forcing of recruitment. The ability of the stock assessment methods to balance type I and type II error rates suggests that methods used most commonly in practice tend to produce lower total error rates. In this study, the promise of integrating environmental data directly into stock assessments is outweighed by the pitfall of high type I error rates, suggesting that the conventional means of avoiding spurious correlation are not sufficient.

For more information please contact Dr. Melissa Haltuch at Melissa.Haltuch@noaa.gov

e) A descriptive example of applying vulnerability evaluation criteria to California nearshore species

In light of ongoing crises in fisheries and marine ecosystem management, a growing body of literature has highlighted the need for biologists and resource managers to develop and apply methodologies that are capable of identifying species or populations at greater risk of overexploitation and extirpation. One increasingly popular approach is a productivity and susceptibility analysis (PSA), originally developed for Australian prawn fisheries, in which the vulnerability of a given stock is based on a combination of the estimated or perceived productivity of the stock plotted against the susceptibility to overfishing. The authors developed an example of this type of analysis using 19 species included in the California Nearshore Fishery Management Plan (NFMP). The methodology is based on a version of the PSA approach being developed by the NOAA Fisheries Vulnerability Evaluation Working Group (VEWG), which is currently in the process of preparing draft technical guidance for conducting vulnerability assessments for species managed under Fishery Management Plans implemented by the regional Fishery Management Councils. Results of this case study in particular indicate that the more vulnerable species in the NFMP include China, copper, quillback and blue rockfishes, of which only the latter has been evaluated in a formal stock assessment. More importantly, the authors suggest that additional and more rigorous analysis of these or of other species managed by either (or both) the State of California and the Pacific Fishery Management Council, may aid managers and stakeholders in setting research and assessment priorities, considering management alternatives and strategies, developing or revising species assemblages for multispecies management systems, and evaluating how precautionary catch limits should be based.

For more information please contact Dr. Jason Cope at Jason.Cope@noaa.gov

f) Drawing the lines: Resolving fishery management units with simple fisheries data

The task of assessing marine resources should begin with defining management units. Often this step is overlooked or defined at temporal scales irrelevant to management needs. Additionally, traditional methods to define stock structure can be data intensive and/or cost prohibitive and thus not available for emerging or data-limited fisheries. The investigators developed an approach that uses commonly available fisheries data (catch and effort) to delineate management units for dynamically independent populations. Spatially-explicit standardized indices of abundance are grouped using a two-step partitioning cluster analysis that includes abundance index uncertainty. This 'management unit estimator' (MUE) is tested via simulation and found generally to recover the true number of management units across data of different temporal length, sample size, and quality. Management units are then determined for four species with varying ecologies, fishery histories, and data issues that exemplify the challenges of applying this method to messy data sets. Defining management units via relative abundance incorporates changes in population connectivity in relation to current removals and environmental conditions, and creates consistency of index use within assessments. The two-step clustering approach is simple and widely applicable to situations wherein the clustering metric contains uncertainty.

For more information please contact Jason Cope at Jason.Cope@noaa.gov

g) Length-based reference points for data-limited situations: applications and restrictions

Current fisheries management policies often require assessing stock status, a difficult task when population and fisheries data are limited. Froese (2004) offered three simple metrics (P_{mat}, P_{opt}, P_{mega}) based on catch length compositions by which to monitor population status relative to exploitation that avoids growth and recruitment overfishing. However, it is unknown how these measures relate to stock status and thus, how to apply them to inform future catches. We attempt to make this connection by exploring the relationship of these measures (collectively referred to as P_x) to fishing mortality and spawning biomass. The relationships are compared specifically to current target (0.4 SB_0) and limit (0.25 SB_0) reference points used for the U.S. west coast groundfish fishery using simulations based on a deterministic age-structured population dynamics model. Sensitivity is explored to fishery selectivity, life history traits and recruitment compensation (steepness). Each P_x measure showed a wide range of possible values depending on fishery selectivity, steepness, and the ratio of the length at maturity (L_{mat}) to the optimal fishing length (L_{opt}). The values of P_x suggested by Froese (2004) as being compatible with sustainable fishing are not always sufficient to insure stock protection from overfishing. Moreover, values for P_x cannot be interpreted adequately without knowledge of the selectivity pattern. A new measure, P_{obj} (the sum of P_{mat}, P_{opt}, and P_{mega}) is introduced to distinguish selectivity patterns and construct a decision tree to develop indicators of stock status. Heuristic indicator values are presented to demonstrate the utility of this approach. Although several caveats remain, this approach builds on the recommendations of Froese (2004) by giving further guidance related to interpreting catch length composition data under variable fishery conditions without collecting additional information. It also provides a link to developing harvest control rules to inform proactive fisheries management under data-limited conditions.

For more information please contact Dr. Jason Cope at Jason.Cope@noaa.gov

C. By Species, by Agency

The PFMC currently operates under a biennial schedule for the development of stock assessments and management guidance. For all groundfish species except Pacific hake, stock assessments are scheduled for review only during odd-numbered years. A schedule for Stock Assessment Review (STAR) panels for full assessments of species conducted in 2009, is shown in Table 1. Updates are also shown.

Table 1. 2009 Review Schedule for Full Groundfish Assessment

STAR PANEL	STOCK	AUTHOR(S)	STAR PANEL DATES	STAR PANEL LOCATION
Whiting	Pacific whiting	Owen Hamel Ian Stewart	February 3 - 6	Seattle, WA
1	Petrale sole Splitnose rockfish	Melissa Haltuch Vlada Gertseva	May 4-8	Hatfield Marine Science Center Barry Fisher Bldg., Room 101, 2032 SE Oregon State University Drive, Newport, OR 97365
Updates	Pacific Ocean Perch Canary Rockfish Darkblotched rockfish Cowcod	Owen Hamel Ian Stewart John Wallace E. J. Dick	June 10-11	PFMC Council Meeting Spokane, WA
2	Bocaccio Widow	John Field Xi He	July 13-17	Southwest Fisheries Science Center 110 Shaffer Road Santa Cruz, CA 95060
3	Lingcod Cabezon	Owen Hamel Jason Cope	July 27-31	Seattle, WA
4	Yelloweye rockfish Greenstriped rockfish	Ian Stewart Alan Hicks	August 3-7	Seattle, WA

1. Shelf Rockfish – West Coast

a) Stock Assessments

No shelf rockfish assessments were conducted during 2008. Full assessments of yelloweye rockfish, widow rockfish, bocaccio and greenstriped rockfish will be conducted in 2009. Updates of the 2007 canary rockfish and cowcod rockfish assessments will also be conducted in 2009.

Yelloweye rockfish: The complete version of: Update to the status of yelloweye rockfish (*Sebastes ruberrimus*) off the U.S. West Coast in 2007 can be viewed online at: http://www.pcouncil.org/bb/2007/0607/Groundfish_Assessments_E6/Yelloweye_Update_2007_Final.pdf

For more information on the yelloweye rockfish assessment please contact Dr. Ian Stewart at Ian.Stewart@noaa.gov

Widow rockfish: The complete version of: Status of the widow rockfish resource in 2007: an update can be viewed online at: http://www.pcouncil.org/groundfish/gfsafe1008/WidowStockAssessment_Update_2007_Final_Oct_2007.pdf

Bocaccio: The complete version of: Status of bocaccio off California in 2007 can be viewed online at: http://www.pcouncil.org/groundfish/gfsafe1008/bocaccio2007final.pdf

Greenstriped rockfish: The first assessment of greenstriped rockfish will occur in 2009. For more information on the greenstriped rockfish assessment, contact Dr. Allan Hicks at Allen.Hicks@noaa.gov

Canary rockfish: The complete version of: Status of the U.S. canary rockfish resource in 2007 can be viewed online at: http://www.pcouncil.org/groundfish/gfstocks.html

Cowcod: The complete version of: Status of cowcod, *Sebastes levis*, in the Southern California Bight can be viewed online at: http://www.pcouncil.org/groundfish/gfsafe1008/certified_cowcod_Dec_2007.pdf

2. Slope Rockfish

a) Stock assessments

No slope rockfish assessments were conducted during 2008. A full assessment of splitnose rockfish and updates of the darkblotched rockfish and Pacific ocean perch assessments will be conducted in 2009.

Splitnose Rockfish: Although a preliminary assessment of splitnose rockfish was conducted in 1995 the assessment did not provide sufficient quantitative information to establish a numeric allowable biological catch and harvest guidelines. This will be the first assessment to fully describe the condition of the stock.

For more information on splitnose rockfish please contact Dr. Vlada Gertseva at Vlada.Gertseva@noaa.gov.

Darkblotched rockfish: The complete version of: Status and Future Prospects for the Darkblotched Rockfish Resource in Waters off Washington, Oregon, and California as Assessed in 2007 can be viewed online at:
http://www.pcouncil.org/groundfish/gfsafe1008/Darkblotched_2007_Final.pdf

For more information on Pacific Ocean perch please contact John Wallace at John.Wallace@noaa.gov

Pacific Ocean perch: The complete version of: Status and Future Prospects for the Pacific Ocean Perch Resource in Waters off Washington and Oregon as Assessed in 2007 can be viewed online at:
http://www.pcouncil.org/groundfish/gfsafe1008/POP2007AssessmentFinal.pdf

For more information on Pacific Ocean perch, contact Dr. Owen Hamel Owen.Hamel@noaa.gov.

3. Thornyheads

a) Stock assessment

No thornyhead assessments were conducted during 2008, and none are scheduled for 2009.

4. Sablefish

a) Stock assessment

A full sablefish assessment was conducted in 2007 but none is scheduled in 2009.

Sablefish: The complete version of: Status of the Sablefish Resource off the Continental U.S. Pacific Coasts in 2007 can be viewed online at:
http://www.pcouncil.org/groundfish/gfstocks.html

5. Flatfish

a) Stock assessment

No assessments for flatfish were conducted during 2008. A full assessment of petrale sole is planned for 2009.

Petrale sole: The complete version of the 2005 assessment of petrale sole: Stock Assessment of Petrale Sole: 2004 can be viewed online at:

http://www.pcouncil.org/groundfish/gfsafe0406/Final_Petrale_102405.pdf

For more information, please contact Dr. Melissa.Haltuch at Melissa.Haltuch@noaa.gov

6. Pacific Hake

a) Stock assessment

The status of Pacific hake was assessed in early 2009. The assessment was conducted by a team from the U.S., while the review was conducted with representation from the U.S. and Canada. The coastal stock of Pacific hake is currently the most abundant groundfish population in the California Current system. Smaller populations of hake occur in the major inlets of the north Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California. However, the coastal stock is distinguished from the inshore populations by larger body size, and seasonal migratory behavior. The population is modeled as a single stock throughout U.S. and Canadian coastal waters, however fishing fleets from each country are treated separately in order to capture some of the spatial variability in Pacific hake distribution, latitudinal gradient in size and age distribution, as well as differences in selectivity between the fleets.

Coast-wide fishery landings of Pacific hake averaged 222 thousand mt from 1966 to 2008, with a low of 90 thousand mt in 1980 and a peak of 361 thousand mt in 2006. Recent coast-wide landings have continued to be above the long term average, at approximately 297 and 322 thousand mt in 2007 and 2008, respectively. Landings were predominately comprised of fish from the large 1999 year class in 2007, and from that year class along with the emergent 2005 year class in 2008. The United States has averaged 166 thousand mt, or 74.7% of the total landings over the time series, with Canadian catch averaging 56 thousand mt. The 2007 and 2008 landings had similar national distributions, with 75.6% and 77.0%, respectively, harvested by the United States fishery. The current model ignores discarding of Pacific hake outside of the target fishery, where discard has been included in landings estimates; the terms catch and landings are therefore used interchangeably; total discard is estimated to be less than 1% of landings and therefore is likely to be negligible.

The acoustic survey catchability coefficient (q) has been, and continues to be, one of the major sources of uncertainty in the model. From 2004 to 2007, assessments presented two models (which were assumed to be equally likely) in an attempt to bracket the range of uncertainty in q. In 2008, an effort was made to include the uncertainty in q as well as additional uncertainty regarding the acoustic survey selectivity and the natural mortality rate of older fish within a single model. This 2009 assessment model incorporates further uncertainty in the degree of recruitment variability as well as more flexible time-varying fishery selectivity. Uncertainty in acoustic survey catchability remains large, and is included in the base case model. Further refinements include updated age-reading error matrices, and the use of cohort specific age-reading error matrices for strong year classes.

Pacific hake spawning biomass declined rapidly after a peak in 1984 (4,020,000 mt) until 2000 (580,000 mt). This long period of decline was followed by a brief increase to 1,390,000 mt in 2003 as the 1999 year class matured. In 2009 (beginning of year), spawning biomass is estimated to be 430,000 mt and approximately 32% of the unfished spawning biomass (SB_{zero}). Estimates of uncertainty in relative depletion range from 15%-49% of unfished biomass, based on asymptotic confidence intervals. The 2009 estimates of spawning biomass are considerably lower than the assessment result for 2008. The reason is that survey *q* was freely estimated to be 0.85 (vs. 0.46 in the 2008 assessment) due to a number of factors, including: the assessment included more blocks for time-varying selectivity and incorporated cohort-specific age-reading error matrices, which lowered estimates of SB_{zero} (through a reduction in mean log recruitment). Recent spawning biomass levels and depletion relative to SB_{zero} are presented in Figure 3.

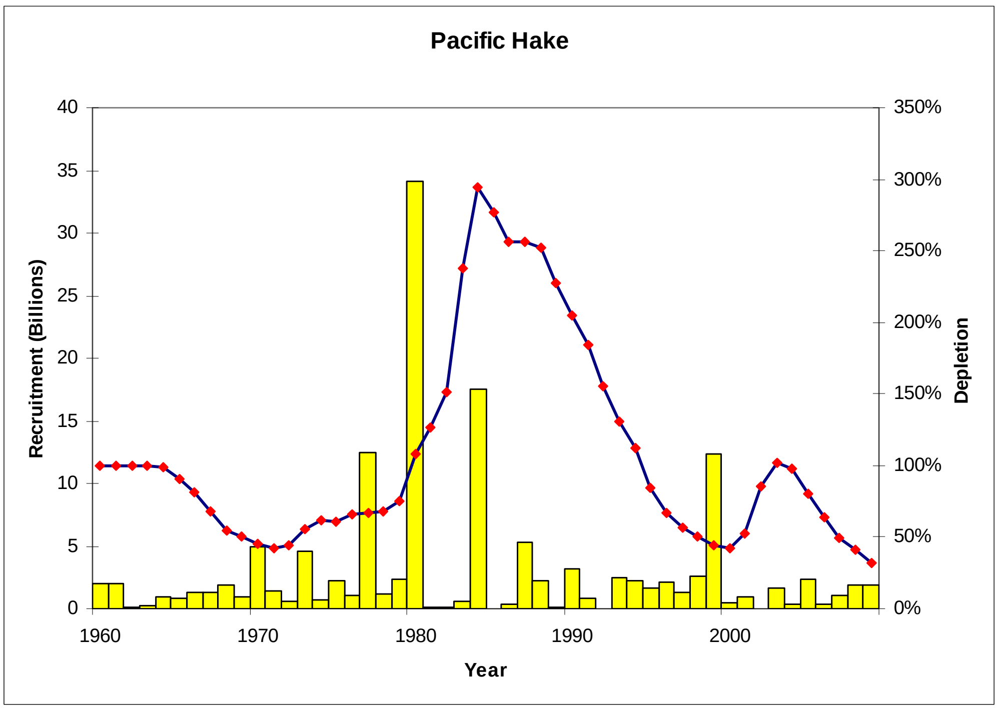

Figure 3. Level of depletion and recruitment for Pacific hake, 1966-2009.

The 2007 assessment for Pacific hake is available online at: ftp://ftp.pcouncil.org/pub/Hake07. The 2008 assessment is available online at: http://www.pcouncil.org/groundfish/gfstocks.html. The 2009 assessment is currently not available online.

For more information please contact Dr. Owen Hamel at Owen.Hamel@noaa.gov

7. Other species

a) Stock assessments

Cabezon: The complete version of: the 2005 assessment for cabezon is available online at: http://www.pcouncil.org/groundfish/gfsafe0406/Cabezon05_FINAL.pdf

For more information, please contact Dr. Jason Cope at Jason.Cope@noaa.gov

Lingcod: The complete version of: the 2005 assessment for lingcods is available online at:
http://www.pcouncil.org/groundfish/gfsafe0406/ALL_Lingcod_PFMC_Final_2005.pdf

For more information, please contact Dr. Owen Hamel at Owen.Hamel@noaa.gov

D. Other Related Studies

1. The PaCOOS, West Coast habitat data portal

The PaCOOS Marine Habitat Data Portal was conceived in 2005 as a Local Data Access Center (LDAC) of the Integrated Ocean Observing System (IOOS). Funding for its development was provided by the NOAA IOOS Program through the FRAM Division of the Northwest Fisheries Science Center. The database and GIS system had its origin the data collected together for the West Coast Essential Fish Habitat Environmental Impact Statement, which was completed in 2005/2006. Maintained jointly by FRAM and Oregon State University, College of Oceanic and Atmospheric Sciences Seafloor Mapping Laboratory and in collaboration with PSMFC, the portal provides access to data (search, connection, and download), a visualization environment, and integrated navigation tools. The data portal houses an ever expanding array of information including but not limited to geological and geophysical data, benthic habitat maps, fisheries survey datasets, and ocean climatologies. Data access, which includes data searching and metadata harvesting, is provided through IOOS Data Management and Communications (DMAC) compliant pathways such as OPeNDAP, OGC WMS, and ESRI ArcIMS map services. The portal's centerpiece is its unique map viewer environment (http://pacoos.coas.oregonstate.edu/), an online application that provides a map interface to data holdings with custom tools for data downloads and queries. There is a growing user base that includes local, state, and federal agencies within the California Current Large Marine Ecosystem.

The functionality of the PaCOOS data portal is continually being improved and new data sets are being added. NWFSC personnel working with colleagues at OSU are making significant additions and improvements to one component, the Habitat Use Database (HUD). For those unfamiliar with this database, the HUD began its life as an accounting of species, their life stages, and habitat associations for the 82 west coast groundfish species. The HUD was developed from the primary literature, and distribution and abundance information contained in the NMFS bottom trawl survey. The current revision to the HUD is focused on a set of key nearshore species identified in the Oregon Department of Fish and Wildlife "Oregon Nearshore

Strategy", expanding its taxonomic scope to include invertebrates, and non-FMP fishes (both demersal and pelagic), and marine mammals. In addition, a group of eight rockfishes, not previously listed in the groundfish FMP, will be included. This update, along with numerous other additions, will enhance the data portal's utility as a decision support tool and in ecosystem management.

For more information, contact Elizabeth.Clarke@noaa.gov (206-860-3381) or Chris Goldfinger at gold@coas.oregonstate.edu (541-737-5214)

2. Groundfish species associations with distinct oceanographic/climatological habitats in the Northern California Current

Ecosystem-based management places a strong emphasis on habitat, but little work has been done to examine how water column properties may influence the distribution, abundances and structure of groundfish assemblages. We identified and described oceanographic habitats in the northern California Current based on temperature, salinity, chlorophyll-a and the inherent variability in these factors. We then examined the distribution and the abundance of groundfishes in relation to these oceanographic habitats and conditions with the long-term goal of improving science for ecosystem-based management of the groundfish fishery of the west coast of the USA. Five summertime oceanographic habitats with distinct physical and biological characteristics were identified in the northeast Pacific Ocean off the northwest Coast of the USA: Offshore Habitat, Upwelling Habitat, Highly Variable Upwelling Habitat, River Plume Habitat, and Highly Variable Habitat. Overall, the species composition differed among the five oceanographic habitats, with certain groundfish species being highly indicative of some habitats; however, the majority of the associations were weak due to overlap of species distributions in the nearshore oceanographic habitats. In contrast, groundfish species showed strong associations with individual oceanographic factors, primarily depth, surface chlorophyll-a, and bottom salinity and temperature. In addition, latitudinal variations in upwelling intensity, river discharge and productivity led to the identification of three regions where high chlorophyll-a concentrations were associated with large abundances of specific groundfish species. The combined oceanographic datasets and data products that we produced have the potential to be a powerful tool for improving our knowledge of the west coast ecosystem. This work was published in 2009 in Fisheries Oceanography (Juan Jordá et al. 2009).

For more information please contact Dr. Waldo Wakefield at Waldo.Wakefield@noaa.gov, (541) 867-0542

3. West Coast bycatch reduction research: fish behavior during interactions with bottom trawls at the Northwest Fisheries Science Center

The Pacific Coast groundfish fishery is subject to bycatch reduction requirements under the Magnuson-Stevens Conservation and Management Act (Magnuson-Stevens Act) and Endangered Species Act (ESA). Species that have been identified as overfished (depleted) under the Magnuson-Stevens Act must be rebuilt. Because Pacific Coast groundfish species are so intermixed, the harvest of healthy stocks has been constrained so that the overall catch of groundfish stocks is reduced, with the intent that the total catch of depleted stocks that co-occur with healthy stocks is reduced. These catch reductions have placed an economic hardship on fishers and fishing communities. NMFS has also identified concerns over potential bycatch of ESA-listed endangered or threatened salmon in the whiting fishery and bottom trawl fisheries.

The Northwest Fisheries Science Center (NWFSC) sought funding to support staffing for a fishing gear technician in the NWFSC's Habitat and Conservation Engineering (H&CE) group within the NWFSC's Fishery Resource Analysis and Monitoring Division. Working with our fisheries research partner, the Pacific States Marine Fisheries Commission (PSMFC), the Center has completed a job search for a technician (Mark Lomeli, PSMFC) who will be stationed in at the NWFSC's field station in Newport, Oregon, and focus on gear research, assist the group coordinator in the continued development of the NWFSC's bycatch reduction research, and collaborate with other NMFS and regional gear researchers. Continued funding will ensure support for a series of pilot projects to test several new promising trawl modifications to reduce fish bycatch and habitat impacts from mobile fishing.

On Going Developments in Gear Technology

The NWFSC has continued work on an ongoing bycatch reduction research project and initiated a new pilot project. The ongoing project is collaboration with the gear research group at the Oregon Department of Fish and Wildlife (ODFW) and is focused on observations of fish behavior in the vicinity of the bycatch reducing selective flatfish trawl footrope using a dual-frequency identification sonar (DIDSON) ultrasonic camera. Reducing bycatch in commercial fishing gear requires an understanding of the behavior of fish interacting with the gear. The use of lights may confound observations of fish behavior in the proximity of fishing gear, submersibles, or remotely operated vehicles. The DIDSON uses only ultrasound to form images of fish, as well as the gear, surrounding structures, and the seafloor. We used DIDSON to examine diel behavior differences in roundfish along a 12-meter section of the footrope on the starboard wing of the flatfish trawl. The DIDSON was mounted looking forward along the starboard wing of the net out to a range of 12 meters. We tracked the movements of individual roundfish, continuously measuring the distance from the footrope. Analysis of fish tracks revealed that during the day, roundfish remained farther from the footrope, maintained a relatively constant distance, and showed less variation in direction. At night, fish approached the footrope at a sharper angle and displayed a more abrupt change in speed and direction. These behavioral differences suggest that herding efficiency and gear selectivity is different between day and night fishing.

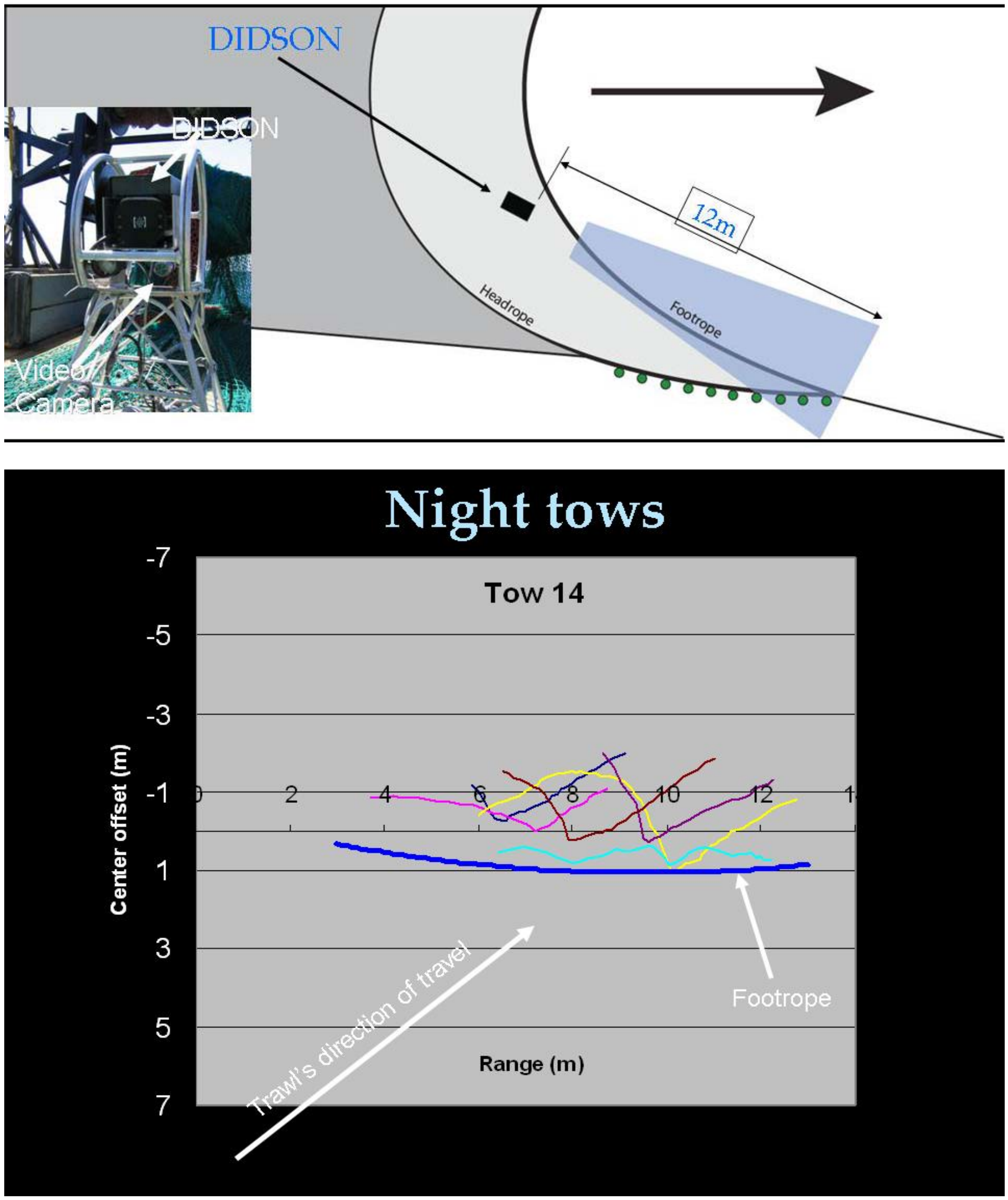

Figure 4. Position of the DIDSON ultrasonic camera in the selective flatfish trawl, providing a view along a large portion of the starboard footrope, from the tip of the wing to a point approximately 9 meters back along the footrope (top panel). Representative tracks of individual groundfish – night time tracks (shown here) as compared to day time tracks often showed a sharp angular change in direction as the fish approached the footrope (bottom panel).

The NWFSC initiated a pilot project in spring 2008 to integrate seabed classification with commercial fishing activities to investigate whether this type of information would be useful in reducing bycatch in west coast groundfish fisheries. This project is being conducted in the vicinity of Morro Bay, California, as collaboration between the NWFSC's Habitat and Conservation Engineering group and West Coast Groundfish Observer Program, The Nature Conservancy, and Oregon State University's Active Tectonics and Seafloor Mapping Lab. The goal of the project is to capture bottom type using a Quester Tangent QTC VIEW simultaneously with bottom trawling. Questions to be considered include: can high-quality data be collected during normal fishing operations to inform NMFS about bottom type with minimal impact on fishing operations, and, will patterns in bycatch relate to specific seafloor classifications?

For more information, contact Dr. Waldo Wakefield at Waldo.Wakefield@noaa.gov

4. Cooperative Ageing Unit

The Cooperative Ageing Project (CAP) provides direct support for U.S. West Coast groundfish stock assessments by providing ages derived primarily from otoliths. In 2008, CAP aged the following species: canary rockfish, Pacific ocean perch, darkblotched rockfish, splitnose rockfish, greenstriped rockfish, Pacific hake, sablefish, Dover sole, and petrale sole.

For more information, please contact Dr. Jim Hastie at Jim.Hastie@noaa.gov

5. Cooperative Resource Surveys

a) U.S. West Coast Groundfish Bottom Trawl Survey

The NWFSC conducted its eleventh annual bottom trawl resource survey for groundfish off the coasts of Washington, Oregon, and California. The objective of the 2008 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 ten 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 area was partitioned into ~12,000 adjacent cells of equal area (1.5 nm long. by 2.0 nm lat., Albers Equal Area projection) with each vessel assigned a primary subset of 188 randomly selected cells to sample. An Aberdeen-style net with a small mesh (1 1/2" stretch) liner in the codend was used for sampling. The survey followed a stratified random sampling scheme with 15-minute tows within 2 geographic strata (80% N of Pt. Conception, CA and 20% S) and 3 depth strata. The depth strata were: shallow (30-100 fms), middle (100-300 fms), and deep (300-700 fms). The sample design consisted of 752 sampling locations, with a minimum of 30 tows per strata.

In 2008, 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.

Additional data were collected during the trawl survey for collaborative research projects with several NMFS/academic colleagues: 1) Maternal effects on larval quality in rockfishes - Southwest Fisheries Science Center; 2) Establishing a DNA sequence database for the marine fish fauna of California- Scripps Institution of Oceanography; 3) Tissue samples and whole specimens of spiny dogfish (*Squalus acanthias*) from three geographic areas along the coast - Moss Landing Marine Laboratories; 4) Feeding ecology of the roughtail skate, *Bathyraja trachura*.; 5) Collection of all unusual or unidentifiable skates, sharks, or chimaeras - Moss Landing Marine Laboratories; 6) Collection of biological data and specimens of the deepsea skates, *Bathyraja abyssicola*, and broad skates, *Amblyraja badia* - Moss Landing Marine Laboratories; 7) Collection of *Raja stellulata* - Moss Landing Marine Laboratories and 8) Forensic voucher specimen collection for species identification of commercially important marine species – Northwest Fisheries Science Center.

Several other research initiatives were undertaken by the Survey Team including: 1) use of stable isotopes and feeding habits to examine the feeding ecology of rockfish (genus *Sebastes*); 2) fin clip collection for various shelf rockfish species; 3) collection of stomachs for selected species including: Pacific hake, sablefish and various rockfish; 4) identification and density-estimation of seabirds along the U.S. West Coast; 5) collection and identification of cold water corals; 6) Comparison of skate total length with disc width for California Skate *Raja inornata* and Starry Skate *Raja stellulata*; 7) a preliminary determination of sexual parasitism of crabs (carcinophily) in the northeast Pacific Ocean; 8) Rockfish collection North and South of Mendocino – a preliminary examination of the population structure of four rockfishes in the coastal region centered on Cape Mendocino: *Sebastes elongatus* (greenstriped rockfish), *Sebastes flavidus* (yellowtail rockfish), *Sebastes goodei* (chilipepper rockfish), and *Sebastes diploproa* (splitnose); 9) Fish distribution in relation to bottom dissolved oxygen concentration in the Santa Barbara basin; and 10) Video Plankton Recorder (VPR) deployment in the CA Bight.

The Northwest Fisheries Science Center's Fishery Resource Analysis and Monitoring Division (FRAMD) again investigated the composition and abundance of benthic marine debris collected during the 2008 West Coast Groundfish Trawl Survey from May to October 2008. Marine debris was recorded in 267 tows; 134 tows during pass 1 and 133 tows during pass 2. Total debris recorded from all tows in 2008 weighed 1,515 kg. The largest item taken during the survey was a fishing net (2,200 kg) retrieved by the F/V Ms. Julie off CA in 2007. Debris was subdivided into 6 categories (plastic, metal, clothing, glass, toxic and other). For 2007 and 2008 combined, plastic and metal debris were encountered most frequently with 484 kg of plastic taken in 218 tows and 984 kg of metal taken in 208 tows. Clothing (346 kg) was present in 146 tows while glass debris (100kg) was present in 123 tows. Results indicate that marine benthic debris is more frequently encountered in the southern portion of the survey, occurring in 65% of the southernmost tows versus 25% overall.

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b) Development of Survey Techniques for Areas Not Accessible by Bottom Trawl surveys

1) The Seabed AUV

The Northwest Fisheries Science Center (NWFSC), in collaboration with researchers at Woods Hole Oceanographic Institution (WHOI), and the Pacific Islands Fisheries Science Center is developing the SeaBED AUV to overcome the difficulty of monitoring fish populations in rocky areas. Rocky, untrawlable areas are not well surveyed by traditional trawl gear, yet these areas are important habitat for a variety of commercially important fish stocks including rockfish.

Traditional fish monitoring techniques, such as trawl surveys and ship borne acoustics, are of limited applicability in these areas due to the rugged nature of the terrain. Thus, to enhance our ability to adequately assess fishery species that use these habitats alternate technologies must be identified and evaluated for augmenting current fishery-independent assessment techniques. Hover-capable AUVs offer a unique tool that is appropriate for work in these types of habitat. In addition, AUVs allow other simultaneous shipboard data collections that will greatly enhance the data available for integrated ecosystem assessments.

A forward-looking high resolution camera has been added to the AUV. Images from the forward looking camera will be used in combination with those from the downward looking camera to improve the ability to identify groundfish. In Spring 2007 in collaboration with DFO Canada mapping of rockfish and their habitat off Vancouver Island, B. C. was conducted off CCGS Vector using both the DFO Canada ROV and the Seabed AUV. A comparison of the results is underway. In spring 2009 the new camera configurations are being tested in Hawaii and California.

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2) Southern California hook-and-line survey

In early Fall 2008, FRAM personnel conducted the fifth hook and line survey for shelf rockfish in the Southern California Bight (SCB). This project is a cooperative effort with Pacific States Marine Fisheries Commission (PSMFC) aimed at developing an annual index of relative abundance and time series of other biological information for structure-associated species of rockfish (genus *Sebastes*) such as bocaccio (*S. paucispinis*), greenspotted rockfish (S.

chlorostictus), and the vermilion rockfish complex (e.g., *S. miniatus* and *S. crocotulus*) within the SCB.

The F/V Aggressor (Newport Beach, CA) and F/V Mirage (Port Hueneme, CA) were each chartered for 12 days, with nine biologists participating throughout the course of the survey. The two vessels sampled a total of 121 sites ranging from Point Arguello in the north to 60 Mile Bank in the south. Approximately 3,000 lengths, weights, fin clips, and otolith pairs were taken representing 31 different species of fish.

Several ancillary projects were also conducted during the course of the survey. This includes the deployment of non-lethal genetic tagging hooks designed by FRAM personnel. These hooks remove a small piece of tissue from a fish's mouth during a strike without bringing the animal to the surface, limiting mortality associated with barotrauma stress. Genetic microsatellite analysis uniquely "tags" each fish which can then be "recaptured" during subsequent deployments of the tagging hooks. In 2007, 306 of these hooks were used during the course of the survey. An underwater video system was deployed at seven sites to gather imagery of the seafloor for future analyses correlating catch rates of key species with specific habitat types. Other projects included the collection of tissue samples from bocaccio for stable isotope analysis to compare trophic feeding levels inside and outside of marine reserves and the preservation of several rockfish and flatfish specimens for a genetic voucher program conducted by the University of Washington and for species identification training for the West Coast Observer Program.

NOAA Technical Memorandum NMFS-NWFSC-95 "The 2004-2007 hook and line survey of shelf rockfish in the Southern California Bight: estimates of distribution, abundance, and length composition" was published in October of 2008, and the manuscript "A fishery-independent estimate of recent population trend for an overfished west coast groundfish species, bocaccio rockfish (*Sebastes paucispinis*)" is currently in the final stages of preparation for submission to a journal. Fishery-independent surveys are an important source of information for stock assessment and management worldwide. Research surveys often use trawl gear to capture commercially valuable species and calculate indices of relative abundance or density. However, many species of interest do not occur in direct contact with the bottom, or occur in areas where high-relief habitat precludes trawl operation. This analysis introduces a standardized hook-and-line survey for rockfish conducted by the Northwest Fisheries Science Center in the Southern California Bight. The survey uses rod-and-reel fishing gear similar to that used in many recreational fisheries to sample nearly 100 locations covering a wide range of depths and habitats. To provide an example of how these data can be analyzed for direct inclusion in stock assessments, we standardize catch rates of bocaccio rockfish from 2004 – 2007 using a Bayesian Generalized Linear Model to account for site, fishing time, survey vessel, angler, and other effects. Results are more precise than other indices of abundance that are currently available and indicate the bocaccio stock in the southern California Bight has shown a relatively flat trend over recent years. Length-frequency distributions indicate the presence of several strong cohorts that should be detectable in the upcoming stock assessment of bocaccio for use in U.S. West Coast groundfish management. This survey is likely to be the only available tuning index for recent years as historically-used recreational catch per unit effort indices have been largely compromised due to changes in bag-limits and other management restrictions.

For more information please contact John Harms at John.Harms@noaa.gov

3) Using acoustics and a cod-end video camera system for monitoring midwater fish including hake and rockfish (widow, canary, and yellowtail)

Several species of rockfish, including widow rockfish (*Sebastes entomelas*) live in areas that are not accessible by bottom trawl surveys. In the case of widow rockfish there is no reliable abundance index for this rockfish species due to lack of information from both commercial sources and fishery-independent surveys. A survey method using acoustics and underwater video is one potential way to assess these fish. To this end a cod-end video camera system was tested in August/September 2008 on a Pacific hake research cruise on the NOAA FSV Oscar Dyson. These tests were successful.

For more information please contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

c) Joint PWCC-NMFS hake pre-recruit survey

A joint Pacific Whiting Conservation Cooperative and FRAMD pre-recruit survey was conducted in 2008 to determine the spatial distribution and abundance of young-of-year (YOY) Pacific hake along the U.S. West Coast. The survey occurred in May-June 2008 and covered the area from 34º 30' N to 48º N at 30 nm intervals. A minimum of 5 trawl stations were sampled on transects located at 30 nm intervals with stations located over waters between approximately 50 m and 1200 m depth. The survey was conducted using the research gear and survey protocol developed by the NMFS Santa Cruz laboratory for surveys of juvenile rockfish (*Sebastes* spp.). Trawling was done at night at a speed of 2.7 kt for 15 minutes duration at target depth. All fish and invertebrates captured were identified to the lowest taxonomic level and enumerated. All hake caught were counted and measured and data summarized and transferred to the NWFSC within 3 months of the end of the survey. Rockfish collected were bagged, labeled, frozen and delivered to the NWFSC for identification. YOY Pacific hake numbers were found to be low, suggesting a relatively weaker year class than in recent years. Additionally, spawning appears to have returned to a more southerly distribution.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

6. NOAA Program: Fisheries And The Environment (FATE)

FATE SSC Summary:
The Fisheries and the Environment (FATE) program is a research program that develops and evaluates ecological and oceanographic indicators to be used to advance an ecosystem approach to management by improving fishery stock assessments and integrated ecosystem assessments. This information is necessary to effectively adapt management to mitigate the ecological, social, and economic impacts of major shifts in the productivity of living marine resources.

Melissa Haltuch currently serves as the NWFSC representative on the FATE SSC. Members of the SSC provide guidance and oversight for the program. The chair of the SSC rotates every two years to ensure representation of each Fisheries Science Center. The SSC develops annual calls for proposals, reviews and selects projects, and chairs the annual science meeting.

FATE Project Title: Incorporating environmental forecasts into stock assessments and stock assessment decision tables

Investigators: M. J. Schirripa and C. P. Goodyear

Goals: Recruitment of the U.S. west coast sablefish (*Anoplopoma fimbria*) has been shown to be influenced by changes in the environment (Schirripa and Colbert 2006). Attempts to model this influence were made in most recent sablefish stock assessment (Schirripa 2007). The objective of this study was to use simulation techniques to test the efficacy of two competing methods of including the observed environmental influence into the sablefish stock assessment and determine the accuracy and precision of each. Our overall goal to arrive at an objective evaluation of the two methods and to make a determination as to which should be used in future assessment. We also proposed to develop decision tables in which the various states of nature are represented not by various parameter values, but by various assumptions with regard to the future productivity of the ocean environment. We were to assume the “base case” model for each state of nature as the best choice to represent the stock dynamics and utilize forecasts from the time series analysis to develop the various assumptions regarding the possible future productivity of the U.S. west coast as represented by SSH . Where possible, we were to investigate using other existing forecasts and/or leading indicators to formulate assumptions of the states of nature. Ultimately we wanted to use forecasts of the states of nature that we can assign some sort of quantitative probability to, a value that is often difficult to arrive at when using various parameter values as is currently done. Furthermore, rather than assigning one probability to an entire assumed state of nature, we were to make attempts at finding ways of assigning annual probabilities based on the confidence of the forecast values. In the end, we did not intend for this work to replace the existing decision table design, but rather to compliment them by offering a different perspective on how to view the forecasts.

Approach: We used simulation techniques to create a population of fish whose recruitment was modulated by a known environmental effect; "assessed" the population using the two methods described above, and compared the estimated productivity values and management benchmarks to the true values in an effort to discover if any biases and/or inaccuracies were associated which of the two methods. We simulated a simple fishery system consisting of a single fishery with data available annually on total catch and age, length, and size-at-age composition; and a single survey that provided estimates of annual stock biomass and age, length, and size-at-age compositions. In all cases the data were generated the simulated random data in such a manner that they would be unbiased and we gave the SS2 program the true parameter values as the initial values with which to begin its iterative search for the set of maximum likelihood parameter estimates. The resulting estimates of parameter values and management benchmarks were compared to known values from the simulations. We used the age-structured population model described in Goodyear (1989); its application in the context of MSY estimation is described in (Goodyear 1996); and other tests of estimation methods (e.g. Prager, et.al. 1996, Prager and Goodyear 2001, Goodyear, 2007). We added a variable to simulate cyclical variability in survival from egg to recruitment associated with temporal variations in the environment. The simulation model is implemented monthly with one sex and includes environmental effects on the mean survivorship of age-0 recruits.

Work Completed: We successfully completed the population simulation portion of this work. We found that, under the circumstances simulated in this study, the particular method (scheme 6) that resulted in the most accurate estimations of the selected parameters (the details of "scheme 6" are too extensive to include here, please refer to the manuscript). Scheme 6 also resulted in the greatest overall percent error in the estimation of spawning stock biomass; however this error was only about 5 percent. There are circumstances where the "data" method is more clearly superior to the "model" method. For instance, in situations where the environmental data may be incomplete the years of missing values would necessarily need to be assumed to have a value of zero, which will be interpreted as a valid data point representing no deviation for that year. The data method, on the other hand, would merely skip this year and allow that year's recruitment deviation to be fit to the remaining observation data sources. In this regard, the best modeling approach would be dictated by the data at hand rather than the model. There was one major caveat that should be noted. This study was designed to simulate the particular biology and assessment of sablefish of the Pacific west coast of the continental United States, an eastern boundary upwelling system. As such, the results may be associated the particular annual patterns of the sea surface index of this system and may not be fully applicable to all situations. To arrive at a more universal recommendation with regard to which scheme was truly the best, a more extensive study that includes various annual environmental patterns, which is beyond the scope of this work, would need to be conducted. It is likely that, even with a more extensive examination of environmental patterns, that one singles scheme may not be found to the best choice for all situations. For this reason we conclude that in order to find the best scheme for a particular assessment problem, a set of simulations similar to those outlined here be conducted, using the actual data sets being considered within that particular assessment problem. Nonetheless, it is quite possible that the climatological and oceanographic processes indexed by the actual sea surface height could index the productivity of the California Current System in general and thus modulate other important biological process that could modulate recruitment success in other commercially important species in this ecosystem, either directly or indirectly.

The simulation portion of this work took longer than expected. This was due, mostly, to our CIMRS research assistant unexpectedly vacating their position with us early in the process. Attempts were made at refilling the position but the available applicants were few and did not immediately possess the skills necessary to carry out the proposed work. Consequently, the principal investigator was left to complete the vast majority of the work on their own. For this reason, the work proposed with regard to the decision tables and environmental forecasts was not completed.

Applications: This work has lead to improvements and modifications to both the FSIM simulation model as well the SSv3 operating model. These methods will be discussed and used in the next sablefish stock assessment due in 2011. However, results will be applicable to all other stock assessments using environmental data due in 2009. Furthermore, we now have a completely seamless connection between a detailed, independent simulator and the most used stock assessment model on the west coast. This tool will enable countless similar simulation studies that should continue to result in improvements to the Stock Synthesis model. We have already passed this work on to the Stock Synthesis post-doc that in turn has modified our code to work with the most recent version of Stock Synthesis (SSv3).

Publications/Presentations/Webpages:
1. Western Groundfish Conference. Feb. 2008 (oral presentation)
2. National Stock Assessment Workshop. May, 2008 (oral presentation)
3. Climate Change and its Effects on the World's Oceans. June 2008 (oral presentation with a manuscript submitted to ICES Journal as proceedings)

For more information on the FATE program please contact Dr. Melissa Haltuch at Melissa.Haltuch@noaa.gov

7. Ecosystem Studies

a) Identification of ecosystem indicators for marine food webs

Successful ecosystem-based management (EBM) requires the selection and use of informative indicators of ecosystem status. We performed a meta-analysis of seven marine food web models (Aleutian Islands, Baltic Sea, Northern British Columbia, Northern California Current, Southeast Alaska, Strait of Georgia, and West Coast Vancouver Island) in order to evaluate the robustness of candidate indicators of ecosystem structure and function. Our approach consisted of four steps. First, we selected 22 ecosystem attributes, or structural and functional properties that are relevant to a number of stakeholder groups but are typically difficult to measure directly (diversity, community energetics, food web structure, nutrient cycling, and resilience). Second, we generated a list of 27 empirically-tractable candidate indicators of the status or trend of the ecosystem attributes. The indicators consisted of biomass groups categorized by foraging guild, spatial distribution, and ecotype or taxonomic group, along with indices of integrated ecosystem state and ratios of community-level biomass groups with the potential to interact strongly. Third, we used the food web models to simulate varying levels of perturbation to the ecosystem, and measured the response of the attributes and indicators to those perturbations. Finally, we tested for correlations between the attributes and indicators within each of the models, searched for consistency in indicator performance across the models, and identified indicators that tracked complementary ecosystem attributes. Our analysis suggests that no single indicator or indicator type is sufficient to describe all of the ecosystem attributes, but at the same time highlights broad, catch-all indicators (e.g., detritivores, jellyfish, and phytoplankton) and distinguishes the strongest attribute-indicator relationships for these food webs. Complementary indicators, such as phytoplankton, zooplanktivorous fishes, and piscivorous fishes showed strong or weak associations with different attributes, but together captured changes in nearly all of them. Quantitative approaches such as this one will enable managers to make informed decisions about ecosystem-scale monitoring in the ocean.

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b) Effects of temperature change on demersal fishes in the California Current: a bioenergetics approach

Diverse fish assemblages such as West Coast groundfish should feature a wide range of biological and ecological responses to temperature change. This is borne out by bioenergetics modeling: when temperatures were varied around historic annual means, three groundfish species (yelloweye rockfish, sablefish, spiny dogfish) responded with different intensities across several key variables (age-1 mass, age at 50% maturity, and prey consumption). Translating such results to a field setting is a challenge: temperature change may directly affect fish bioenergetics, cause range shifts related to behavioral thermoregulation, or produce complex ecological interactions, all of which can affect fish populations and influence management decisions. Future research priorities are to quantify temperature sensitivity among species and anticipate temperature-mediated changes in populations and diverse communities.

For more information please contact Dr. Chris Harvey at Chris.Harvey@noaa.gov

c) Linking ecology, economics, and fleet dynamics to evaluate alternative management strategies for US West Coast trawl fisheries

This project provides West Coast fisheries managers with a tool to test the efficiency and robustness of alternative fishery management strategies in a holistic ecosystem framework. We augment a well developed Atlantis ecosystem simulation (Brand et al. 2007, NOAA Tech Memo. NMFS-NWFSC-84) of the US West Coast marine ecosystem with fleet dynamic models that are consistent with the economic incentives created by the current and anticipated fishery management system for the West Coast groundfish fishery. The simulation model is used to evaluate alternative policies for setting total allowable catch (TACs) under different management systems including cumulative catch limits (i.e., status quo strategy), and a variety of individual transferable quotas options (ITQs). These ITQ options include alternative schemes for leasing quota, and penalties for quota overages. The model, which is spatially explicit, allows us to evaluate the effects of area closures. In addition to providing insights into how alternative fishery management policies will affect the profitability and sustainability of primary fisheries, the model illustrates the wider ecosystem impacts of fishery management policies.

For more information please contact Dr. Isaac Kaplan at Isaac.Kaplan@noaa.gov

d) Development of a spatially explicit ecosystem model to examine effects of fisheries management alternatives in Central California

We are developing an Atlantis ecosystem model to address marine management questions on the Central California Coast. The model is based on Brand et al.'s 2007 model of the California Current ecosystem (NOAA Tech Memo. NMFS-NWFSC-84). Our project aims to 1) develop a range of policy scenarios that consider tradeoffs and benefits of the multi-agency management of the system, with advice particularly targeted at the National Marine Sanctuaries Program 2) identify ways to monitor and assess nearshore fisheries and Marine Protected Areas (MPAs), with advice targeted towards the California Ocean Science Trust Monitoring Enterprise.

Model building has involved gathering data for every major biological group in the California Current, especially abundance, size/age distribution, diet data, growth rate, mortality rates, fecundity rates, movement rates, and functional response to prey resources, among others. The model synthesizes biological monitoring data from NMFS, NMS, DFG, PISCO, and others institutions. It is driven by oceanographic output from a Regional Ocean Modeling System (ROMS).

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e) Quillback otolith chemistry: life-history information obtained from opportunistic sampling

Information regarding population structure is important for fisheries management. The elemental composition of otoliths is a tool that is increasingly used to resolve population structure. Our goals in this study were to determine the potential utility of otolith chemistry to differentiate collections of fish, and ultimately to assess population structure of a species of concern in Puget Sound, Washington. Analysis of the otolith edges from quillback rockfish (*Sebastes maliger*) revealed significant variability in elemental concentrations between Puget Sound sites in 1998 (sites were separated by 30 km), among Puget Sound and San Juan Island sites (separated by 45-150 km) in 2002, and among the central and western regions of Strait of Juan de Fuca (separated by 50 km) in 2003. These differences resulted in jack-knife classification success (using quadratic discriminant function analysis) of 100%, 93%, and 65%, respectively. When we examined elemental concentrations from whole otoliths we detected significant elemental differences among three (Puget Sound, San Juan Islands and Georgia Strait) of the five regions studied. The relatively small overlap in otolith elemental concentrations observed between these three regions suggests low to moderate degrees of mixing among them. The results suggest a relatively greater degree of mixing between fish from Strait of Juan de Fuca and all other regions. The results of this study further resolve the population structure of quillback rockfish and highlight the utility of otolith chemistry to improve our understanding of this and possibly other species in the Georgia Basin.

For more information please contact Dr. Paul Chittaro at Paul.Chittaro@noaa.gov

f) Diel activity patterns of sixgill sharks *Hexanchus griseus*: The ups and downs of a large predator

The patterns of activity for most animals are determined through a trade-off among competing processes, such as optimal foraging, predator or competitor avoidance, and maintaining bioenergetic efficiency. We used active and passive acoustic telemetry to examine what processes may contribute to diel and seasonal patterns of vertical movement in 27 sixgill sharks *Hexanchus griseus* in Puget Sound, WA from December 2005 – December 2007. We found clear and consistent patterns of diel activity where sixgill sharks were typically shallower and more active at night than during the day. In Elliott Bay, WA, sixgill sharks made direct vertical movements at sunrise and sunset, while vertical movements were more variable in deeper, main channel waters. The greatest rates of ascent and descent in sixgill sharks occurred most often during nighttime ebb tides and were slower than maximum rates of ascent or descent for many other fish species. Seasonally, sixgill sharks occupied deeper habitats during the autumn and winter than spring and were more active in the summer than during the autumn and winter. We also found synchronous vertical movements in three of four shark pairs tracked simultaneously, evidence that these sharks were responding to similar stimuli. Clear and consistent patterns of diel activity across size and sex of sharks and across multiple spatial scales is most consistent with the hypothesis that foraging behaviour is responsible for the patterns of diel vertical movement of sixgill sharks in Puget Sound.

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g) Trophic relationships and movement patterns of sixgill sharks (*Hexanchus griseus*) in the Puget Sound - Georgia Basin: Inferences about their ecosystem role from stable isotope analysis

The sixgill shark (*Hexanchus griseus*) is a large predator and passive scavenger thought to forage across the entire marine food web, making it a good candidate as an indicator species for the overall health of the Puget Sound-Georgia Basin aquatic ecosystem. However, persistent questions remain about sixgill shark population demographics, diet information that clarifies energy flow, and movement patterns of the breeding population within the region. We compared stable isotope ratios ($\delta^{15}N$ and $\delta^{13}C$) of white muscle tissue collected from over 70 sixgill sharks to describe their trophic level within the aquatic food web and to clarify broad movement patterns. Nitrogen stable isotope ratios of sixgill sharks (mean $\delta^{15}N$: 16.5‰) were enriched relative to most other aquatic species, confirming that sixgill sharks represent one of the top trophic levels in the Puget Sound food web. Carbon stable isotope ratios of sharks, which are indicators of the sources of food web production, reflect strong spatial patterns of resource use. Sharks from central Puget Sound were exclusively subadults (150 cm to 315 cm TL) with highly enriched $\delta^{13}C$ ratios (mean $\delta^{13}C$: -12.8‰), possibly reflecting dependence on benthically-derived nearshore primary production and suggesting little movement outside the Sound. Clustering of $\delta^{13}C$ ratios revealed two distinct groups of subadult sharks that could not be differentiated based on time of capture, size, or sex. We are analyzing acoustic tag movements from a subset of animals in each group to determine if the distinctive $\delta^{13}C$ signatures reflect differences in foraging behavior with depth or spatial extent of movement within central Puget Sound. In contrast, $\delta^{13}C$ ratios of a mature female (430 cm TL) and her neonates found stranded in south Sound were highly depleted (mean $d^{13}C$: -20.0‰), reflecting the phytoplankton based food web typical of marine waters on the outer coast. This strongly supports the nursery hypothesis that pregnant females migrate from offshore to protected inshore waters for parturition. Finally, $\delta^{13}C$ ratios of subadult sharks collected from the Strait of Juan de Fuca (mean $\delta^{13}C$: -18.4‰) were intermediate between the Puget Sound subadults and the stranded adult female. Together these studies aid our understanding of the ecology and behavior of large apex predators in the Puget Sound – Georgia Basin, progress that is crucial to clarifying a broad range of ecosystem interactions and a critical component of any rigorous ecosystem-based management plan.

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h) Evaluating ecological and economic impacts of individual quotas for the groundfish trawl fleet

In November, the Pacific Fisheries Management Council decided to begin implementing an individual quota system for the West Coast groundfish trawl fleet. Under the individual quota system, each vessel will now have dedicated access to a portion of the quota for groundfish, such as rockfish and flatfish. This is a radical departure from the traditional competitive "race to fish". The modeling work presented here investigates the ecological and economic effects of this new management regime. An integrated ecosystem model of the US West Coast (Atlantis) was used to simulate the abundance of target fish species and other biological groups. Fleet dynamics were simulated for the 12 major groundfish fleets, with each fleet choosing fishing locations that maximize net revenue. Net revenue includes landed value of the catch, minus the cost of quota and fixed and variable costs. I explicitly include the penalty that fishers expect if they exceed their quota. The main findings are: 1) Even with crude spatial resolution, under the individual quota scenario the simulated fleets show some improved targeting behavior, avoiding overfished rockfish species and aiding recovery of these stocks. 2) The penalty fishermen expect for exceeding quota has a large effect on fleet behavior. This points to the importance of monitoring and enforcement.

For more information please contact Dr. Isaac Kaplan at Isaac.Kaplan@noaa.gov

i) Using ecological thresholds to inform benchmarks for marine ecosystem-based management

Practitioners of ecosystem-based management (EBM) require sensible tools to support ecosystem-scale management decisions. A major challenge to advancing EBM has been a lack of scientifically-based approaches for defining management targets. We outline an approach for identifying management benchmarks that is based on the existence of nonlinearities in the relationship between fundamental attributes of the ecosystem and human-induced perturbations. In this approach, we 1) identify a set of ecosystem attributes; 2) use a food web model (for Northern British Columbia) to simulate increasing levels of perturbation to the ecosystem, and measure the response of the attributes to those perturbations; 3) locate a threshold on the ecosystem attribute-perturbation curve when the relationship between attribute and perturbation is nonlinear; 4) identify empirically-tractable indicators for the ecosystem attributes which are tightly correlated with the attribute values observed in the simulations; and, 5) suggest methods for designating management benchmarks. This method draws attention to trade-offs inherent to implementing EBM, and in so doing enhances the ability of policymakers to understand and manage natural ecosystems.

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8. Acoustic Modeling and Research

a) Processing of the acoustic data collected during the 2007 Joint U.S.-Canada acoustic survey

The data from the Joint U.S./Canada Integrated acoustic and trawl survey was processed to provide the estimate of the abundance and spatial distribution of the coastal Pacific hake stock shared by both countries. The survey covered the slope and shelf of the Pacific coast from approximately 35º N to 55º N with acoustic transects spaced 10-20 nm apart. With the unexpected sidelining of the CCGS W.E. Ricker, the NOAA ship Miller Freeman completed the entire survey by combining survey time with inter-vessel (NOAA ship Oscar Dyson) calibration time. The survey resulted in 132 transects with over 12,000 miles of fishing and other operations. Pacific hake were observed from approximately 36.5º N (Pt. Sur) to 55º N (Dixon Entrance), the northern extent of the survey. Data were collected on 18-, 38-, 70-, 120-, and 200-kHz EK60 echo sounder. Midwater and bottom trawls were conducted to verify size distribution and species composition and to obtain biological information (i.e. age composition, sex). A total of 92 successful trawls resulted in a total catch of 47,571.3 kg (90.3% hake by weight). The data analysis was completed by Dec. 5 to provide necessary information to Hake stock assessment group. The estimated total biomass of Pacific hake was 0.88 million metric tons. The stock was dominated by hake in the 45-50 cm length range. Additionally, there was a strong showing of one and two year old hake, which appeared further north relative to previous years.

Also on the joint US/Canadian survey, the NWFSC Digital Video Plankton Recorder (DVPR) was used to give a complete picture of the plankton community, including gelatinous zooplankton not identifiable from net tows. The goal of this work is to identify plankton that affects acoustic backscatter during hake surveys. The DVPR is shown in Figure 5.

Figure 5. NWFSC Digital Video Plankton Recorder

For more information please contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

b) Automated acoustic calibration system

To improve the efficiency and accuracy of the acoustic calibration, we have developed a prototype of computer-controlled automated acoustic calibration system. In contrast to the conventional calibration system, which is operated by manually controlled the downrigger motors to move the calibration sphere around and requires an experienced operator to run the system, this automated system consists of a laptop computer running MatLab control software that controls three automated downriggers (motors). The Laptop program calculates and issues commands to the motor controller of the downriggers for bring in or paying out lines to raise, lower, and move the calibration sphere in three dimensional space precisely. In the summer of 2008 during the Inter-Vessel Calibration cruise, the system prototype was built and tested on the NOAA ships Miller Freeman and the Oscar Dyson. It worked fairly well except when line tensions were too tight or too loose, which fouled the line. The automated downriggers are being upgraded and a new wire tension feature has been added. This will allow for keeping wire tension within desired limits and prevent line fouling.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

c) Pilot work using a codend video camera for improved groundtruthing of fisheries acoustic data

One challenging but crucial element of fisheries acoustic surveys is to obtain accurate groundtruthing of the echo returns. However, it is extremely difficult, if not impossible, to determine the depth at which each species is caught. Therefore, it is problematic when multiple scattering layers are present. In addition, small organisms, such as siphonophores which are strong acoustic scatterers, are missed by regular midwater trawls. To address these issues and to achieve more objective interpretation of the acoustic data, Lisa Bonacci (FRAM acoustics team), along with Waldo Wakefield (Habitat), have constructed a Codend Video Camera System and conducted a pilot study by mounting the system in the codend of an open midwater trawl which enabled us to look at several scattering layers during each tow. For each of eight successful test tows conducted during the 2008 hake Inter-Vessel Calibration cruise several different backscatter layers in the water column were examined. The recorded video tapes were analyzed and the percent and size composition of the species in different layers were determined. Additionally, closed codend tows were conducted with no camera at the same location, which enabled a comparison of backscatter measurements between the two tow types. From the preliminary data analysis, it was found that this method appeared to provide improved knowledge of acoustic backscatter observed during fisheries acoustic surveys and could be integrated into future surveys.

For more information, contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

d) ICES Symposium on the Ecosystem Approach with Fisheries Acoustics and Complementary Technologies (SEAFACTS)

Members of the NWFSC FRAM Division Acoustics Team (Dezhang Chu, Rebecca Thomas and Larry Hufnagle) attended the 2008 SEAFACTS meeting in Bergen, Norway June 15-20.

During the conference, Dezhang Chu presented a talk entitled “Modeling of broadband backscattering by swimbladder-bearing fish over a wide range of frequencies,” by Dezhang Chu and Timothy K. Stanton; Rebecca Thomas presented a talk entitled “Results of multi-frequency echogram species classification using image processing techniques,” by Will Tesler, Robert Kieser, and Rebecca Thomas, and presented a poster entitled “Removing data contaminated by bubble sweepdown: tests on paired CCGS *W. E. Ricker* and CCGS *J. P. Tully* acoustic transects,” Rebecca Thomas, Patrick Ressler, Taina Honkalehto, Ken Cooke, Robert Kieser, Steve de Blois, and John Holmes; Larry Hufnagle presented a poster entitled: “Acoustic characterization of scattering layers of dominant fish and zooplankton species off the West Coast of the United States and Canada” Lawrence C Hufnagle Jr., Steve de Blois, Lisa Bonacci, Rebecca Thomas, Dezhang Chu, Ken Cooke, George Cronkite, and John Holmes

In addition, On June 20, 2008 Larry Hufnagle and Dezhang Chu attended a roundtable discussion on the new ME70 Multibeam Sonar that allowed users from several countries and the manufacturer, Kongsberg, to share their experiences with the new system and discuss system successes, problems and improvements with the Kongsberg scientists and engineers. This meeting will help us to operate the ME70 that will also be installed on NOAA ship Bell Shimada.

For more information please contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

e) Acoustic characterization of scattering layers of dominant fish and zooplankton species off the West Coast of the United States and Canada

Pacific hake, *Merluccius productus*, is an important commercial and ecological marine fish off the West Coast of United States and Canada. Acoustic surveys of Pacific hake involving scientists from the United States and Canada have been conducted on either a triennial or biennial basis since 1977. In recent years the Simrad EK series echo sounders (EK500/EK60) consisting of multiple frequencies have been the primary acoustic sampling instrument. Ground truthing was obtained by biological sampling using mid-water and bottom trawls at various depths from about 100 m to as deep as 500 m. The intercomparison of trawl data to the acoustic signatures, including the volume backscattering strength, an absolute quantity, and the frequency dependence, a relative quantity, allow us to verify the commonly accepted theoretical interpretations and advance towards establishing automated identification and classification algorithms. We will present a variety of echograms with distinct acoustic signatures, representing two stages of identification and classification. The first is to determine whether the echograms are hake or non-hake, while the second is to further classify what type of marine organisms corresponds to the non-hake echograms. Most of the characteristics of the hake echograms can be explained based on the scattering physics. However, some hake echograms are different from the theoretical predictions of swimbladder-bearing fish and require additional investigation and interpretation.

For more information please contact Lawrence Hufnagle at Lawrence.C.Hufnagle@noaa.gov

f) 2008 inter-vessel calibration (IVC) cruise

Scientists from the U.S. Northwest Fisheries Science Center (NWFSC) and Fisheries and Oceans Canada, Science Branch (DFO) conducted an Inter-Vessel Calibration (IVC) on Pacific hake (*Merluccius productus*) along the west coast of Vancouver Island, BC, Canada between the NOAA ships *Miller Freeman* and *Oscar Dyson*. The CCGS *W.E. Ricker* participated in the IVC however due to acoustic equipment malfunction onboard the CCGS *W.E. Ricker* an IVC was not conducted between the NOAA Ships and CCGS *W.E. Ricker*. The CCGS *W.E. Ricker* did contribute to the IVC by conducting fishing operations and measuring oceanographic conditions by CTD and Bongo Nets. The cruise began and ended in Seattle, Washington and lasted from August 10 to August 30, 2008, covering the west coast of Vancouver Island, BC, Canada focusing on hake aggregations near Barkley Sound/La Perouse Bank, Nootka Sound and Kyoquot Sound. We are in the process of analyzing the IVC data. Initial analysis indicated that there is no significant difference in biomass estimate between two ships.

For more information please contact Dr. Dezhang Chu at Dezhang.Chu@noaa.gov

9. Economic Data Collection and Analysis

a) Commercial Fishing Economic Cost-Earnings Data

During 2008, the West Coast Open Access Survey was completed. This data was merged with data from other sources such as PacFIN landings data and vessel registration data to produce the first cost earnings data set for the open access fleet. This data was used to develop inputs for the regional economic model being developed by economists at the NWC, and to support a project (managed by NOAA economists outside of the NWC) to estimate the impacts of the recent reductions in salmon harvests in southern Oregon and northern California.

The NWC also continued working with the data collected in its initial Limited Entry Trawl and Limited Entry Fixed Gear Surveys. Data from the Limited Entry Trawl survey was used as the basis for analysis of the economic effects of moving the limited entry trawl groundfish fishery to an ITQ management regime, and results from this study were presented to the Pacific Fisheries Management Council by an economist under contract to the NWC. Planning for a follow-up cost earnings survey of the limited entry trawl and fixed gear fleets began during 2008, and fielding of this follow-up survey is expected during 2009.

For more information please contact Dr. Carl Lian at Carl.Lian@noaa.gov

b) Survey of the economic value of sport fishing

During 2008, data sets and initial summaries of the Washington and Oregon valuation data were completed. During 2009, econometric models will be used to estimate the value of a fishing trip, the value of a catch for both groundfish and salmon, and how changes in regulations are expected to affect participation rates.

For more information please contact Dr. Todd Lee at Todd.Lee@noaa.gov

c) Regional economic impact analysis

A West Coast input-output model to calculate the backward- linked multiplier effects of changes in fishing regulations has been in development for the past year. The first phase of model development, which is intended to estimate the multiplier effects from the commercial sector, is nearing completion. The second phase of development will be to incorporate recreational fishing into the model, and to expand the coverage of commercial fleets. There will be ongoing improvements to the model as additional data are made available.

One source of new data will be the Western Community Survey, which is a survey of business and households in eight communities along the west coast. The survey will obtain data such as the location of expenditures by businesses and households, household income from marine related endeavors, extent of income from non-labor sources, and some more sociological questions about people's preferences and values for marine resources. Paperwork Reduction Act clearance has been received from OMB, and fielding of the survey will begin during 2009. Experience gained developing this survey enabled NWC economists to provided assistance in survey design and planning for a NOAA funded project to estimate community economic impacts of fisheries on the Gulf Coast.

For more information please contact Jerry Leonard at Jerry.Leonard@noaa.gov

10. Observer Data Collection and Analysis

The FRAM division's At-Sea Hake and West Coast Groundfish Observer Programs continued collecting fishery-dependent data during 2008 on groundfish fleets along the entire west coast.

a) At-sea hake observer program

The At-Sea Hake Observer Program deployed two fisheries observers on each of fifteen at-sea Pacific hake processing vessels for every fishing day during the 2008 season, exceeding 1,500 observer days at sea. Due to low total catch limits on some bycatch species in this fishery, observer data is crucial to the successful management of the fishery. Beginning in 2005, program staff has taken an active role in conducting pre-cruise meetings between vessel crew and the observers. These meetings provide an opportunity to outline observer duties, expectations, and identify solutions to meet both the needs of the observer program and the vessel through increased communication and cooperation. The observers sample nearly 100% of the hauls in this fishery. Through the hard work of the observers and vessel cooperation, the average sample size of each haul has increased from roughly 30% to around 50% during recent seasons.

b) West Coast groundfish observer program

During 2008, the West Coast Groundfish Observer Program deployed observers in bottom trawl and fixed-gear fisheries along the entire U.S. West Coast, exceeding 2,900 observer days at sea on over 300 vessels. The observer program currently conducts observation aboard vessels ranging in size from skiffs to large trawlers, which fish in depths ranging from less than 20 fm to more than 500 fm. Due to its unique data collection circumstances, the program continues to stress safety and data quality.

c) Data and analytical reports

The WCGOP collects at-sea data from limited-entry trawl and fixed-gear fisheries as well as from open access nearshore, prawn/shrimp, California halibut, and deep water fixed-gear fisheries. The WCGOP's goal is to improve total catch estimates by collecting information on the discarded catch (fish returned overboard at-sea) of west coast groundfish species. The data are used in assessing and managing a variety of groundfish species.

Summaries of data collected on observed trips are routinely published on the NWFSC web site. Several fleet-specific reports, which are detailed in the table below, were completed during the fall and winter of 2008. In 2008, improvements were made to the discard estimation process and three new fisheries were reported, the open-access deep-water fixed-gear fishery, the California halibut bottom trawl fishery, and the California and Oregon pink shrimp fisheries.

Report Title	**Fisheries in Report**	**Date Range of Data**
Limited Entry Groundfish Trawl	Limited Entry Groundfish Bottom Trawl	January 1, 2007 – April 30, 2008
Non-Nearshore Fixed-Gear	Limited Entry Sablefish-endorsed fixed gear, Limited entry non-sablefish-endorsed fixed-gear, open access fixed-gear	January 1, 2007 – April 30, 2008
Nearshore Fixed-Gear	California nearshore fixed-gear, Oregon nearshore fixed-gear	January 1, 2007 – April 30, 2008
California Halibut	California halibut bottom trawl	January 1, 2002 - April 30, 2008
Pink Shrimp Trawl	California Pink Shrimp Trawl, Oregon Pink Shrimp Trawl	January 1, 2004 - December 31, 2005 and January 1, 2007 - December 31, 2007

In addition to yearly, fishery specific discard reports, the WCGOP also publishes reports on estimated annual total fishing mortality, Pacific halibut bycatch, and marine mammal and seabird bycatch. The most recent total fishing mortality report is for the calendar year 2007. The Pacific halibut bycatch report uses data collected between January 1, 2007 and December 31, 2007 to estimate Pacific halibut bycatch rates for the limited-entry groundfish trawl fishery. Finally, WCGOP data collected between 2002 and 2005 and At-Sea Hake Observer Program data collected between 2002 and 2006 were summarized in a report estimating the marine mammal and seabird bycatch of the west coast groundfish fisheries.

All reports can be obtained at:
http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/index.cfm.

For more information please contact Janell Majewski at Janell.Majewski@noaa.gov

d) Recent trends in bycatch and discard in the U.S. West Coast groundfish trawl fishery

The West Coast Groundfish Observer Program was initiated by NOAA Fisheries' Northwest Fisheries Science Center in the fall of 2001. Since that time, the Pacific Management Council has initiated numerous measures, such as closed areas, gear restrictions, and explicit modeling of bycatch, which have been intended to constrain the catch of species for which rebuilding plans have been developed. In 2007, FRAMD examined the trends in the trawl fleet's discard and overall bycatch of these rebuilding species since 2002, and related these changes to the evolution of groundfish management and its effect on the magnitude and distribution of fishing effort over this period. In addition to rebuilding species, FRAMD also reviewed changes in trawl discard species since 2002. Improved understanding of how bycatch and discard in this fishery have responded to recent management actions will enhance the ability to identify future groundfish management approaches that are effective with respect to achieving bycatch and economic objectives.

For more information, please contact Dr. Jim Hastie at Jim.Hastie@noaa.gov

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NMFS Southwest Fisheries Science Center

Draft Agency Report to the Technical Subcommittee

of the Canada-U.S. Groundfish Committee

April 2009

Edited by E.J. Dick, Anne Allen and John Field

With contributions from Carlos Garza, John Hyde,
David Demer, Cynthia Thomson, William Watson and Mary Yoklavich

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 acting Science Director is Dr. Norman Bartoo, and the acting deputy director is Dr. Frank Schwing. All three SWFSC laboratories have supported the essential needs of the NMFS and the Pacific Fishery Management Council (PFMC) for groundfish, including as 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. George Watters) , the Protected Resources Division (led by Dr. Lisa Ballance), and the Fisheries Resources Division (led by Dr. Russ Vetter). 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 (CalCOFI) surveys that have taken place along most of the California coast since 1951. 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 advice to the fishery management and scientific communities; and (5) provide professional services (many of which fall in the above categories) at all levels, including inter-agency, state, national and international working groups.

The 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

1. Research

Ichthyoplankton Surveys
The CalCOFI ichthyoplankton time series, the longest such time series in existence, dates 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 and shortbelly rockfishes, and may provide fishery-independent time series information for many other groundfish species. 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 are centered north of Point Conception.

Over the 58+ years of the CalCOFI time series substantial advances have been made in ichthyoplankton identifications and many species identifiable only to the level of genus or above in earlier years now are identified to species. To increase the consistency of identifications through the time series, we are systematically working back through the archived CalCOFI ichthyoplankton samples to bring all identifications up to current standards; to date we have completed all samples collected from 1969 to the present. In addition, we are re-identifying fish eggs collected in the CalCOFI bongo net samples, and are adding the count data for eggs of Pacific whiting (hake) and jack and Pacific mackerels to the database. Egg re-identifications have been completed for samples collected from 1989 to the present and we continue to work back through the time series for both eggs and larvae.

Finally, larvae of most of the rockfish species cannot be reliably identified to species using standard visual techniques. However, one side of each bongo net sample collected during the Cowcod Conservation Area (CCA) surveys was preserved in ethanol, thus these larvae can be identified using molecular techniques. Currently, about 60% of the “unidentified rockfish” larvae collected during the 2001 CCA survey have been identified, representing 27 species and dominated by squarespot and swordspine rockfishes. The results of this work will greatly enhance the number of species identified in such surveys and assist in the validation of pigment/morphology-based identifications.

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 have historically used this pelagic juvenile index to estimate impending recruitment. In 2004 the geographic coverage of the SWC 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. From 2005-2007, pelagic juvenile rockfish catches in the core part of the survey area were at very low levels, with some evidence of a redistribution of fish to the north and the south in 2007. Catches in 2008 improved slightly relative to 2007, but overall rockfish catch remained lower than average. There is typically strong covariance among the ten most frequently encountered rockfish species in the survey. However in 2008 most of the rockfish observed were "northern" species such as widow, canary, and yellowtail rockfish, while the traditionally most abundant species in this region, particularly shortbelly rockfish, remained at record low levels. Market squid were also encountered at below average numbers in 2008, but had increased over the 2005-2007 period. By contrast, Pacific sardine numbers were down modestly in 2008, and northern anchovy numbers were down significantly, relative to the 2005-2007 period. The trends observed in these four indicators are consistent with trends across a number of other taxa, and ongoing efforts include characterizing these assemblages and their relationship to physical conditions in the California Current.

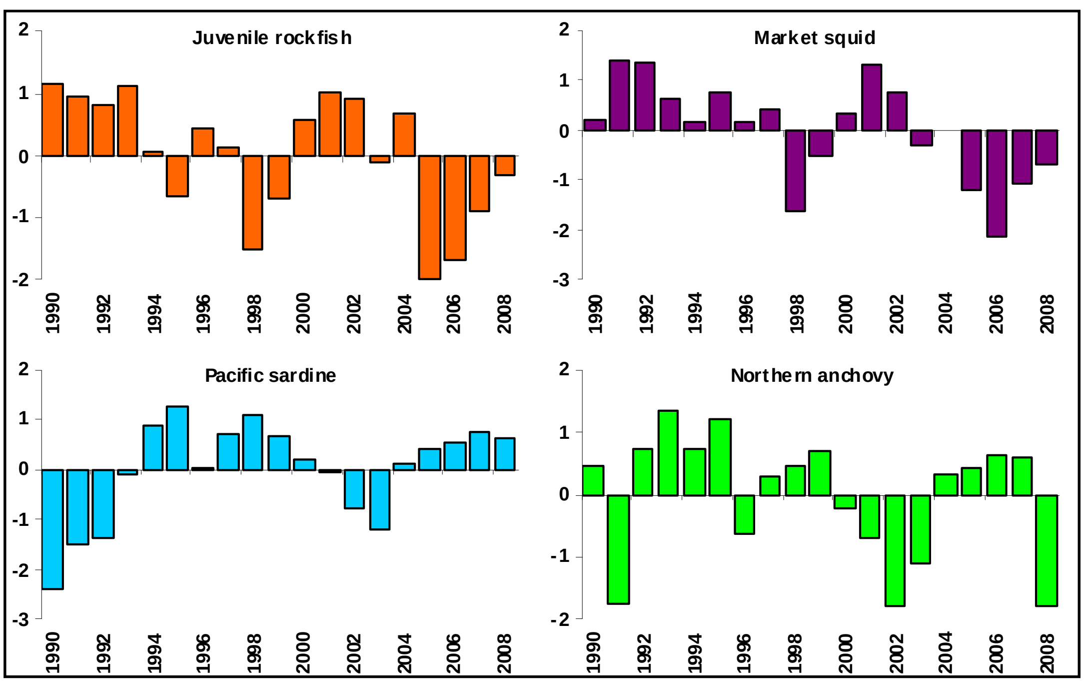

Figure 1. Standardized anomalies of the log of mean values by year for four key forage species that are well sampled in the SWFSC juvenile rockfish midwater trawl survey (figure reflects catches in the historical Central California core survey area only).

Adult Surveys
The Advanced Survey Technology (AST) and In-Situ Survey groups have made operational a Collaborative Optically-assisted Acoustic Survey Technique (COAST) to survey rockfish and evaluate their biotic and abiotic requirements for habitat. The COAST can provide estimates of biomass and dispersion by species, throughout the Southern California Bight (SCB), with practical sampling effort (Fig. 1). The techniques were developed in 2003/04 from the Commercial Passenger Fishing Vessel (CPFV) Outer Limits; applied throughout the SCB in 2004/05 and 2007 (COAST07), largely from NOAA Ship David Starr Jordan. The COAST will provide a time-series of data for improving rockfish stock assessments. Efforts are underway to also apply the COAST to rockfish off central California.

2. Stock Assessment Support

The Fisheries Ecology Division (FED) is currently the SWFSC lead for stock assessments of groundfish for the PFMC, and supports stock assessment science through the maintenance of data systems and the development of new analytical techniques. The FED works closely with the Pacific States Marine Fisheries Council (PSMFC) and 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. In addition to maintaining the CalCOM database and supporting port sampling and sample expansion efforts, the FED has also participated in the PFMC process since its inception. FED staff scientists have been represented on the Groundfish Management Team (GMT) in every year since its establishment, and have also been active participants in the Scientific and Statistical Committee (SSC) for the PFMC.
Depletion-Corrected Average Catch

FED staff developed Depletion-Corrected Average Catch (DCAC), an extension of the potential yield formula, that provides robust estimates of sustainable yield for data-poor fisheries on long-lived species (MacCall, in review). The catch stream is divided into a sustainable yield component and an unsustainable "windfall" component associated with a one-time reduction in stock biomass. The size of the windfall is expressed as being equivalent to a number of years of sustainable production, in the form of a "windfall ratio." DCAC is the cumulative catch divided by the sum of the number of years in the catch series and this windfall ratio. Input information includes the sum of catches and associated number of years, the relative reduction in biomass during that period, the natural mortality rate (M, which should be less than 0.2), and the assumed ratio of F_{MSY} to M. These input values are expected to be approximate, and based on estimates of their imprecision, the uncertainty can be integrated by Monte Carlo exploration of DCAC values.

C. BY SPECIES, BY AGENCY

2. Nearshore Rockfish

Research
The Early Life History Team continues to conduct research 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. 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. These studies were expanded in 2008 to additional species common in deeper habitats (Sogard et al., 2008). This issue is widely recognized by researchers and assessment scientists as important in evaluating the productivity and sustainability of West Coast groundfish fisheries, and insights gained from ongoing research will be incorporated into scientific assessments and management advice as it becomes available. In addition to research examining maternal effects, we have completed experiments testing for multiple paternity in kelp rockfish, with the finding that multiple paternity appears to be common.

Assessment

FED biologists assisted in the development of a blue rockfish (*Sebastes mystinus*) stock assessment led by the California Department of Fish and Game (Key et al. 2008). The 2008 assessment indicated that increased catches in the 1970s resulted in a continuous decline in spawning biomass through the early 1990s. Spawning biomass was estimated to have reached a minimum (10% of unexploited) in 1994 and 1995; with a constant increase since that time, such that the current relative depletion level in 2007 is 30% of the unfished. The base model estimated that the stock could support an MSY of 275 metric tons. Although the assessment was fairly data poor and several key uncertainties were characterized in the assessment, including expected results from ongoing genetic studies that suggest that "blue rockfish" may in fact be represented by two closely-related species.

3. Shelf Rockfish

Research

Modeling the reproductive potential of rockfishes

Members of the FED Groundfish Analysis Team completed a meta-analysis of rockfish fecundity to better characterize the reproductive output of exploited populations. Results indicate that target harvest rates are sensitive to changes in relative fecundity with size, and that Bayesian hierarchical models are a useful tool to inform predictions of fecundity at size, quantify uncertainty about those predictions, and provide predictive distributions of model parameters for unobserved species. State dependent life history models for optimal resource allocation were also developed to evaluate potential mechanisms driving these trends. Patterns of growth, maturation and reproduction observed in rockfishes are consistent with the hypothesis of a trade-off between reproduction and natural mortality.

Estimating rockfish abundance based on larval production

Ongoing efforts are underway to develop a spawning biomass point estimate of bocaccio (*S. paucispinis*) in the southern California Bight (SCB) using data collected during standard winter CalCOFI surveys and enhanced ichthyoplankton sampling surveys (Figure 3). Standard and enhanced ichthyoplankton sampling conducted during 2002 and 2003 were used to generate independent estimates of spawning biomass in those two years through the analysis of larval catch curves. Larval production was then linked to spawner biomass based on information obtained from adult fish recently collected in Ensenada, Mexico (i.e., maturity and fecundity data). The results will be evaluated by FED staff for use in the 2009 bocaccio rockfish stock assessment.

Sounds of Captive Rockfishes

The Advanced Survey Technologies group at the Southwest Fisheries Science Center has recently been investigating sound production in rockfishes. Sound production by many fish species has been studied extensively, but little is known about sound production by rockfishes (genus *Sebastes*), and only a few species have been reported to be soniferous. To determine if additional rockfish species produce sounds, passive acoustic recordings were made during 2007/08 at Hubbs-SeaWorld Research Institute and Southwest Fisheries Science Center in tanks containing bocaccio (*S. paucispinis*), cowcod (*S. levis*), starry rockfish (*S. constellatus*), and sunset rockfish (*S. crocotulus*). Data were collected using pre-amplified hydrophones (HTI-94-SSQ) and digitized at sample rates of 44,100 or 8,000 Hz (using an Edirol R-09 recorder, or Edirol UA-5 sound card and Ishmael software, respectively). Three distinct sounds were recorded in tanks containing only *S. paucispinis* and two of those sounds occurred at different

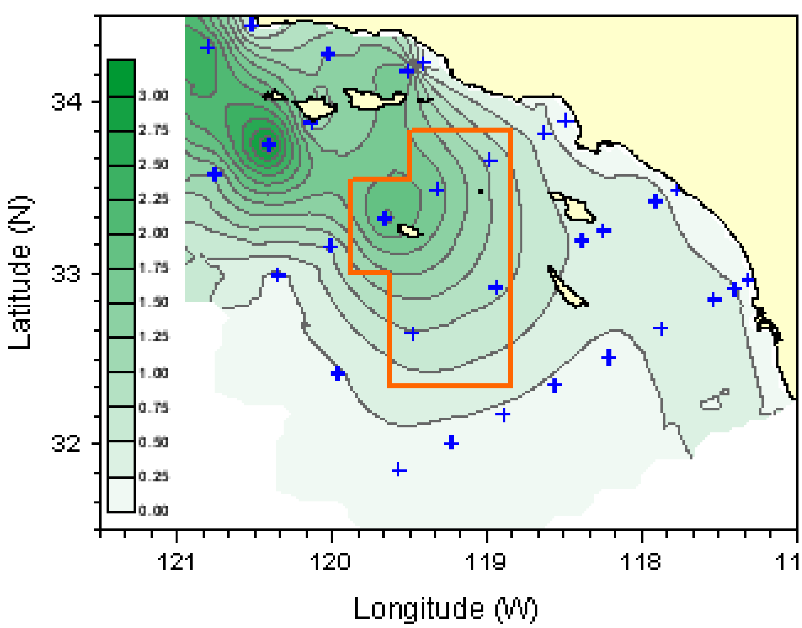

Figure 2: Historical distribution of bocaccio larval abundance (# ≅ 10 m^{-2}) from the CalCOFI database. Shown are contours of the estimated station effects from a Δ-lognormal GLM, with blue "+" symbols indicating actual station locations. The western Cowcod Conservation Area is delimited in orange.

rates during light and dark conditions (Širović and Demer, 2009). Their common characteristics were low frequency (below 800 Hz), short duration (<4 s), and low source levels (103-113 dB re: 1μPa at 1m). Also, there was evidence one or more other species produced sounds. These findings indicate that more rockfishes produce sounds than previously known.

Rockfish sounds and their potential use for population monitoring in the Southern California Bight

Southwest Fisheries Science Center is a leader in the development of non-lethal methods to assess and monitor the depleted rockfish stocks off Southern California. For example, data from multifrequency echosounders and underwater cameras have been combined to map the dispersions and estimate the abundances of rockfish at the historical fishing sites within this region. From August to October 2007, this ship-based technique was augmented with two passive-acoustic seabed recorders. One collected data at the 43 Fathom Bank for 46 d, while the other was serially deployed at 13 locations for shorter periods (1–8 d). Passive-acoustic data were analyzed for the presence of rockfish sounds. Potential sources of five pulsing sounds were identified from the optically estimated species compositions at each location, as well as from known rockfish recordings collected in aquaria. All sounds had a low frequency (900 Hz). Some were short individual pulses (0.1 s), while others were repetitive. A repetitive pulsing from bocaccio (*Sebastes paucispinis*) was the most commonly recorded sound and it occurred predominately at night. The daily calling rates at each site were quantitatively compared with the rockfish abundance estimates obtained from the active-acoustic survey, and they were positively correlated (Širović et al. 2009). These results suggest it may be feasible to use passive acoustic tools to efficiently monitor changes in rockfish populations.

A statistical-spectral method for echo classification

The frequency dependence of sound-scatter intensity is commonly exploited to classify fish, zooplankton and seabed observed in acoustic surveys. Although less utilized, techniques based on scattering statistics of echo amplitudes can also be used to extract information. For example, single-frequency echo statistics have been used to determine whether backscatter originates from single or multiple fish or from rough or smooth seabeds, and estimate scatterer sizes and densities. The efficacies of the amplitude-based techniques are challenged, however, by the usual requirement to group echo measurements to facilitate meaningful comparisons with model predictions. Groupings of data over space, time, or both, can combine scatter from multiple taxa or species, confounding the comparisons. Scientists in the Advanced Survey Technologies group at Southwest Fisheries Science Center have improved these methods with a hybrid, statistical-spectral method for target identification (SSID), which incorporates information contained in both the signal amplitudes and phases. The SSID uses multifrequency echo statistics from individual timespace intensities (pixels) to identify general scattering types, before applying model-based identification schemes for target identifications (Demer et al. 2009). The effectiveness of the SSID is demonstrated for fine-scale separation of scatter from demersal fish and the seabed and estimating seabed depth, within-beam slope, hardness and roughness, and the height of the dynamic acoustic dead zone.

Assessments

FED staff have led the development of stock assessments for three overfished rockfish species in 2009: bocaccio (*S. paucispinis*), widow rockfish (*S. entomelas*), and cowcod (*S. levis*). All three assessments with be finalized in mid- 2009 following critique by independent review panels and the Scientific and Statistical Committee of the PFMC. The widow rockfish assessment will be the first full assessment since 2005, and the bocaccio assessment will be the first full assessment since 2003. The cowcod assessment is an update of the 2007 full assessment.

Assessments of greenspotted rockfish (*S. chlorostictus*) and bronzespotted rockfish (*S. gilli*) are also in preparation, outside of the PFMC process. These are the first assessments of these two species. Greenspotted rockfish is not uncommon in commercial fisheries landings, and bronzespotted rockfish have similar life histories and habitat associations to cowcod. Assessments of these species provide an opportunity to apply recently developed methods in assessment of data-poor stocks.

D. OTHER RELATED STUDIES

1. Historical Catch Reconstruction and Evaluation of the Reliability of Landings Data

The Fisheries Ecology Division's Groundfish Analysis Team completed initial work to reconstruct historical commercial groundfish landings from 1916 through 1969, based on analysis of recently digitized California commercial landings data. Spatially explicit (CDF&G block) landings information from 1931 through 1968 were recovered using funds and services provided by the NESDIS Climate Database Modernization Program (CDMP). The recovered data, when combined with more recent landings estimates from the California Cooperative Groundfish Survey from 1969-2007, forms one of the longest detailed catch records in the U.S. This effort centered on fulfilling a Pacific Fishery Management Council request to develop a single methodology for estimating historical catches of groundfish to the species level for use in West Coast Groundfish Stock Assessments. Recreational catches of rockfish (*Sebastes* species) were also reconstructed in a parallel effort based on historical Commercial Passenger Fishing Vessel (CPFV) logbook data that exists back to 1936 and species composition information from both recent and historical monitoring programs. A draft document (Ralston et al. in prep) has been distributed to stock assessment authors for use in this year's stock assessments, and these data are expected to be highly influential in several assessments. FED staff, working together with PSMFC and CDF&G personnel, also examined the reliability of California's commercial groundfish landing estimates from 1969-2006. Landings estimates for most species were found to be generally reliable. Issues associated with species misidentification, landing receipt errors, and unusual patterns in landings were identified and described. A technical memorandum (Pearson et al., 2008) provides users of the data (e.g. stock assessors and managers) with species-specific accounts of data reliability.

2. Molecular Genetics

Recent genetic studies at Southwest Fisheries Science Center, Fisheries Resources Division, have revealed that the heavily exploited vermilion rockfish, *Sebastes miniatus*, is really a cryptic species pair (Hyde et al. 2008a). The splitting of this species impacts stock size estimates and draws attention to the unintended consequences of depth-based management policies. Distinct differences in exploitation level between the two species necessitated an evaluation of population structure and connectivity among regional management segments of the fishery.

Staff from the Fisheries Resources Division analyzed gene flow between populations and calculated larval dispersal values using 782 bp of DNA sequence data from the mitochondrial cytochrome b gene of 681 vermilion rockfish sampled from 16 sites between Kyuquot Sound, Canada and San Quintin, Mexico. Significant genetic heterogeneity was found among sample sites (FST = 0.0742, $p < 0.001$). Isolation by distance analysis produced a strong and significant correlation, suggesting that average larval dispersal distance is on the order of 10's of kilometers (Hyde and Vetter, Accepted). Analysis of molecular variance showed strong and significant partitioning of genetic variance across the biogeographic boundary at Point Conception (FCT = 0.0923, $p < 0.001$). Additional genetic barriers were found across Cape Mendocino, Punta Colnett, Santa Monica Bay, and along the coast of Washington. These genetic barriers conform to oceanographic compartments previously proposed for the California Current ecological geography province and suggest natural management units for this species at Cape Mendocino and Point Conception.

Additionally important to the proper management of exploited species, particularly highly fecund, r-selected fishes, which often show strong discrepancies between census and effective population sizes, such as *Sebastes* spp., is the understanding of mating systems. Fisheries Resources Division staff performed paternity analysis on a phylogenetically and ecologically diverse sample of *Sebastes* species, with multiple paternity found in 14 of the 35 broods and 10 of the 17 examined species (Hyde et al. 2008b). This finding suggests that this polyandrous mating system is not a rare event within a single species and is likely common throughout the genus. Additionally we found that at least 3 sires can contribute paternity to a single brood. Hyde et al. (2008b) suggest that multiple paternity may be a form of bet hedging that serves to maximize genetic diversity within broods and that, regardless of the selective value at the level of individual fitness, the net effect at the population level may be a genetic buffer to the consequences of overexploitation.

Staff from the Fisheries Ecology Division have been investigating population structure of several species of *Sebastes* - shortbelly, kelp, widow, blue and black rockfish - in the California Current using data from 14-17 microsatellite markers per species. These studies have revealed a general lack of population structure in the Central/Northern California portion of this ecosystem (Gilbert-Horvath et al. 2007; Petersen et al. in prep). However, in blue rockfish a substantial signal of population structure was confirmed to be due to the presence of two cryptic groups of blue rockfish with little gene flow between them. These groups have tentatively been referred to as incipient species and assigned the interim names blue-sided and blue-blotched rockfish. These two fishes were found to be broadly sympatric, with separation between them not geographically-based (Petersen et al., in revision).

Patterns of paternity are being assessed in several species of *Sebastes* through the analyses of larvae from broods of gravid fish collected in various surveys by Fisheries Ecology Division staff. Broods from approximately 30 females from five species- widow, chilipepper, yellowtail, shortbelly and kelp rockfish (Sogard et al. 2008). Analyses have used 6-9 microsatellite loci in samples of almost 100 larvae per female to detect and quantify multiple paternity. To date, multiple sires have been found to contribute to broods of females in all but one species, yellowtail rockfish, but substantial variation in frequency of multiple paternity were found and are under continuing investigation. Two NOAA Hollings Scholarship interns have assisted in the genetic analyses of multiple paternity in these species and subsequently used the research experiences for senior theses at the University of Hawaii and Scripps College.

3. SWFSC Current Habitat Activities

The SWFSC currently has about 33 full-time-equivalent staff members that conduct research on marine habitats of over 110 stocks and species being tracked within four FMPs (i.e. Coastal Pelagic, Pacific Coast Groundfish, Pacific Coast Salmon, and Highly Migratory) of the PFMC. Most of this effort is focused on collecting habitat data and processing and converting these data into usable products. Over the last decade, SWFSC researchers also have been refining existing habitat survey methods and tools and developing new ones. SWFSC habitat research is designed to respond to the mandates of the Magnuson-Stevens Reauthorization Act of 2006 to characterize and protect EFH and to improve stock assessments, as well as to understand and predict the effects of climate and environmental change on fish populations and marine ecosystems at global to local scales. The goal is to provide sound scientific information for effective decision-making and ecosystem management.

Researchers at SWFSC have been using a variety of survey tools and approaches to improve our assessments of demersal fishes, macro-invertebrates (including deep-water coral communities and endangered white abalone), and associated seafloor habitats in relatively deep water off central and southern California. Habitat-specific distribution (Level 1 EFH) and densities (Level 2 EFH) of juvenile and adult life stages of a few of >90 species in the Pacific Coast Groundfish FMP have been determined from non-extractive, visual surveys conducted with remotely operated vehicles (ROV), a manned submersible, scuba, laser line scan, and high-definition drop cameras, often coupled with acoustic surveys and seafloor maps of the continental shelf and upper slope off California. These methods have resulted in habitat-specific assemblage analyses on multiple spatial scales; a fishery-independent stock assessment; baseline monitoring of MPAs, and are being used in the California-NOAA-USGS Seafloor Mapping Program.

A SWFSC/FED staff member serves as chair of a team of NMFS scientists that are developing NOAA NMFS' Marine Fisheries Habitat Assessment Improvement Plan (HAIP). The HAIP presents an evaluation of NMFS' current habitat science capabilities and unmet needs, and provides recommendations for addressing deficiencies in marine habitat research. This Plan will assist NMFS in meeting the mandates of the Magnuson-Stevens Reauthorization Act, and more specifically will help to improve identification of EFH, improve stock assessments by explicitly incorporating ecosystem and habitat considerations and spatial analyses, and contribute to Ecosystem-based Fishery Management and Integrated Ecosystem Assessments.

Scientists on the SWFSC/ FED Habitat Ecology Team have been surveying fish and habitats in depths to 365 m (1200 feet) off the California coast, making direct observations from the manned submersible Delta over the last 15 years. A new review paper "Twenty years of research on demersal communities using the Delta submersible in the Northeast Pacific", co-authored by Mary Yoklavich (SWFSC FED) and Tory O'Connell (Alaska Dep. Fish Game), has been published in the monograph "Marine Habitat Mapping Technology for Alaska" (eds. J. Reynolds and G. Greene). This is one of 17 scientific papers written by international experts on the topics of remote sensing for broad-scale mapping, visual surveys for direct characterization of habitats and associated organisms, and examples of major habitat mapping programs. The publication will be useful to the broad community in marine resource management as well as researchers in Alaska and worldwide. This publication is available online at: http://seagrant.uaf.edu/bookstore/pubs/AK-SG-08-03.html.

Members of the SWFSC/FED Habitat Ecology Team completed the second year of monitoring MPAs in deep water off central California: 2008 IMPACT Submersible Baseline Survey. This program is funded by CA Ocean Protection Council, CA Dep. Fish Game, Sea Grant, and NMFS, and is a collaborative effort among researchers from SWFSC-FED, UC Cooperative Extension Sea Grant Program, Washington State University, UC Santa Barbara, and Stanford Research Institute Intl. They made 300 dives and conducted over 700 quantitative visual transects from the manned submersible Delta to survey all demersal fishes, structure-forming invertebrates, and habitats from 24 to 365 meters deep inside and out of eight newly designated MPAs in Monterey Bay and along the Big Sur coast. This multi-year baseline will be used in the future to critically evaluate the effectiveness of the new MPAs by assessing changes in the diversity, density, and size composition of species using seafloor habitats in these areas.

SWFSC/FED researchers presently have quantified the types and locations of marine debris found during submersible surveys of seafloor habitats. The extent of marine debris and its potential impacts on organisms living in deepwater habitats on the sea floor was largely unknown off California… until now. Commercial and recreational fishing activities were the primary source of debris. Most debris in this study was made of plastic, which likely will persist in the environment for many years. The most obvious negative impacts of the debris were from commercial traps and nets that continued to capture and kill organisms, such as crabs. On the other hand, debris also provided habitat to some fishes and large invertebrates. A manuscript on their findings is in review, and a public-service video, "Keepers of the Deep," has been screened at various film festivals and is available at (http://swfsc.noaa.gov/news.aspx?id=13064). This new video hopefully will increase public awareness of marine debris in deepwater habitats off California.

Habitat data and methods developed by the SWFSC/FED Habitat Ecology Team were used in the recent risk assessment and policy development for EFH of groundfishes on the West Coast. A SWFSC/FED biologist is a member of the PFMC Ad Hoc EFH Review Committee, which is a neutral advisory body comprised of diverse disciplines including scientists (federal, tribal, and academic), managers, the fishing industry, and non-governmental organizations. This Committee advises the Council on proposals to change designations of EFH, Habitat Areas of Particular Concern, and Ecologically Important Habitat Closed Areas, which have been implemented as part of the West Coast Groundfish EFH-EIS to identify and protect EFH and to mitigate for the adverse effects of groundfish fishing activities. The Groundfish FMP requires review and update of these designations during a periodic 5-year review process, and also allows for reviews as needed during interim periods.

4. 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). This 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. The project is currently focused on the relationship between fishery behavior and port-level fishery infrastructure. Related efforts include the development of a Bayesian approach to estimating technical efficiency in the limited entry groundfish trawl fleet, in which an analysis is currently focused on the effects of the 2003 trawl vessel buyback program on technical efficiency in that fishery.

The Economics Team is also working in collaboration with the Environmental Research Division on an analysis of the economic effects of the Rockfish Conservation Areas on the groundfish trawl fleet. The ERD has expanded its mapping of groundfish trawling to cover all of California's offshore waters out to 700 fathoms. Data consists of start and end locations of all tows from trawl logbooks from 1977 to 2005 linked to landings receipts for weight of market species. Maps were created of the distribution and density of species from the trawl fishery for years before and during rockfish conservation area closures. Files of the 25 different RCA boundaries from 2002 to 2005 were created to overlay these maps. These data are being analyzed to quantify changes in fishing location and effort of the limited entry trawl fleet resulting from the RCA closures, including the spatial distribution of trawling by vessels from each port. To facilitate this analysis a manuscript has been drafted reviewing the history of groundfish trawl management, including trip limits and spatial closures. This project will include analysis of (a) adaptations made by West coast groundfish trawlers in terms of movement between fisheries, and (b) adaptations by California groundfish trawlers in terms of spatial redistribution of effort and changes in fishing strategies.

The Economics Team is conducting economic surveys of southern and northern California recreational anglers. Both surveys involve collection of data on angler fishing patterns, preferences, expenditures and demographics. In addition, conjoint methods are being used in the southern California survey to determine angler preferences for rockfish versus other species, and in the northern California survey to determine angler preferences for differing combinations of groundfish regulations (bag limits, area and season closures) The survey will be conducted in summer 2009.

5. MPA Center Density Ratio Working Group

The MPA Science Center and Fisheries Ecology Division have been wrapping up their efforts to evaluate the efficacy and policy implications of using marine protected areas as reference sites for data poor fisheries (such as nearshore groundfish). The premise of this collaboration is the recognition that marine reserves introduce several new sources of uncertainty to traditional fisheries stock assessment and management, requiring new tools for managers. For data poor stocks and assemblages (such as most California nearshore fisheries), it is possible that the resulting heterogeneity in stock abundance and distribution could be used to provide guidance to management, by adjusting catch or effort limits based on the relative abundance of target species in the fished area relative to the unfished area. Cooperative surveys to develop relative abundance indices could improve industry acceptance as well as supplement survey funding.

At the final meeting of the Density Ratio working group in Santa Barbara on February 23-24, 2009, several members of the group presented results that evaluated the feasibility of such methods using management strategy evaluations. Although these simulation studies have uncovered some potential problems in implementing such an approach, they generally suggest that it is tractable and may hold promise. Other members of the working group have been evaluating the institutional barriers that would challenge such management regimes, with a particular focus on how co-management systems for marine resources could be defined and implemented. Three meetings of this group, in addition to summer support for a graduate student, have been supported by the MPA Science Center over the last two years, but support has now been exhausted. Several members of the group have therefore begun to investigate alternative sources of funding to continue the effort. The meeting included participants from NOAA (FED/SWFSC and Channel Islands National Marine Sanctuary), the California Department of Fish and Game, the University of Washington, the University of California Santa Barbara, Hopkins Marine Station, Pew Charitable Trusts, Commonweal, and Environmental Defense.

GROUNDFISH PUBLICATIONS OF THE SWFSC, 2008 – PRESENT

1. Primary Literature Publications

Black, B.A., G. W. Boehlert, and **M. M. Yoklavich.** 2008. Establishing climate–growth relationships for yelloweye rockfish (*Sebastes ruberrimus*) in the northeast Pacific using a dendrochronological approach. Fisheries Oceanography 17:368-379.

Botsford, L. W., D. R. Brumbaugh, **C. Grimes,** J. B. Kellner, J. Largier, **M. R. O'Farrell, S. Ralston,** E. Soulanille, and V. Wespestad. 2009. Connectivity, sustainability, and yield: bridging the gap between conventional fisheries management and marine protected areas. Reviews in Fish Biology and Fisheries 19(1):69-95.

Copps, S., **M. Yoklavich,** G. Parkes, W. Wakefield, A. Bailey, H. G. Greene, and C. Goldfinger. in Press. Applying habitat data to fishery management on the US West coast. In: Todd, B. and H.G. Greene (eds.) Proceedings of GeoHab: Marine Geological and Biological Habitat Mapping.

Demer, D.A., G.R. Cutter, J.S. Renfree and J.L. Butler. 2009. A statistical-spectral method for echo classification. ICES Journal of Marine Science, 66: In press.

Gilbert-Horvath, E. A., R. J. Larson, and **J. C. Garza**. 2006. Temporal recruitment patterns and gene flow in kelp rockfish (*Sebastes atrovirens*). Molecular Ecology 15(12):3801-3815.

Hamel, O., **K.R. Piner** and J. Wallace. 2008. A robust deterministic model describing the bomb radiocarbon bump for use in fish age validation. Transactions of the American Fisheries Society 137:852-859.

Hess, J.E., P. Moran and **R. Vetter.** A steep genetic cline in yellowtail rockfish, *Sebastes flavidus*, suggests limited dispersal across the Cape Mendocino faunal break. Submitted to Molecular Ecology.

Hyde, J. and R. Vetter. (Accepted). Population genetic structure in the redefined vermilion rockfish (*Sebastes miniatus*) indicates limited larval dispersal and reveals natural management units. Canadian Journal of Fisheries and Aquatic Sciences.

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STATE OF ALASKA
GROUNDFISH FISHERIES

ASSOCIATED INVESTIGATIONS IN 2008

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

May 5-6, 2009

With new contributions from:
Cleo Brylinsky, Mike Byerly, Barbi Failor, Kenneth J. Goldman, Lee Hulbert, Mike Jaenicke, Scott Meyer, Krista Milani, Kristen Munk, Nick Sagalkin, Gail Smith and Charles Trowbridge

April 2009

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION of COMMERCIAL FISHERIES & DIVISION of SPORT FISH
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STATE OF ALASKA GROUNDFISH FISHERIES AND ASSOCIATED INVESTIGATIONS IN 2008

AGENDA ITEM VII. REVIEW OF AGENCY GROUNDFISH RESEARCH, STOCK ASSESSMENT, AND MANAGEMENT

A. AGENCY OVERVIEW

1. 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. The North Pacific Fisheries Management Council (NPFMC) took action in 1997 to remove black and blue rockfish from the Gulf of Alaska FMP and in 2007 to do the same with dark rockfish, 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. The State of Alaska manages some groundfish fisheries occurring in Alaska waters in parallel with NMFS, adopting Federal seasons and in some cases allowable gear types as specified by NMFS. 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) and Cook Inlet including the North Gulf District off Kenai Peninsula. 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.

a. Southeast Region

The **Southeast Region** Commercial Fisheries Groundfish Project is based in Sitka with the groundfish project leader, fisheries biologist, full-time fisheries technician, and seasonal research analyst located there. One full-time biologist and one full-time fisheries technician for this project are based in Douglas. Seasonal technicians and port samplers are employed in Petersburg, Ketchikan and Sitka. The project also received biometrics assistance from the regional office in Douglas and from headquarters in Juneau.

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 demersal shelf rockfish, black and blue rockfishes, dark rockfish 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 federally-managed fisheries; dockside sampling of sablefish, lingcod, Pacific cod, and rockfish landings; and skipper interview and logbook collection and data entry. Four resource assessment surveys were conducted during 2008. The Southeast Groundfish project is funded in part with NOAA Grants NA06NMF4370212, and NA08NMF4070534

b. 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, three marine research biologists, five seasonal technicians, 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 serves as a member of both the North Pacific Fishery Management Council's Gulf of Alaska Groundfish Plan Team and Non-Target Species Committee. 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 include research and management of groundfish species harvested in territorial waters of **Central Region**. Within Central Region, groundfish species of primary interest include sablefish, rockfish, pollock, Pacific cod, lingcod, flatfishes, 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. For some fisheries, logbook data are required and these are collected and data-entered to provide additional depth to harvest data.

c. 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 trawl survey biologist, two seasonal fish ticket processing technicians, and several seasonal dockside samplers. A full-time assistant area groundfish management biologist and a seasonal fish ticket processing technician are located in the Dutch Harbor office. Seasonal dockside sampling also occurs in Chignik, Sand Point, and King Cove, and there was dockside sampling in

Adak in 2008. 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 (Dave Barnard) and the Gulf of Alaska Groundfish Plan Team (Nick Sagalkin).

d. Headquarters

The 1996 Magnuson-Stevens Act called for developing regional fishery databases coordinated between state and federal agencies. The Alaska Fisheries Information Network (AKFIN), created in 1997, accomplishes this objective. The AKFIN program provides the essential fishery catch data needed to manage Alaska's groundfish and crab resources within the legislative requirements of the Act in Section 303(a)5. Alaska has diverse data collection needs that are similar to other states but the extensive geographic area and complexity of fisheries management tools used in Alaska have resulted in AKFIN becoming a cooperative structure that is responsive to the needs to improve data collection. The Pacific States Marine Fisheries Commission (PSMFC) manages the AKFIN grant with the funding shared by the Alaska Department of Fish and Game's (ADF&G) statewide AKFIN contract and the PSMFC sponsored AKFIN Support Center (AKFIN-SC) in Juneau, Alaska. The ADF&G has primary responsibility for collecting, editing, maintenance, analysis, and dissemination of these data and performs this responsibility in a comprehensive program.

With few exceptions, groundfish resources in Alaska's Exclusive Economic Zone (from 3 to 200 nautical miles offshore) are managed by the National Marine Fisheries Service (NMFS), and groundfish within 3 nautical miles of shore are managed by the state of Alaska. Two fishery management plans (FMPs) require the collection of groundfish harvest data (fish tickets) in the north Pacific: the Gulf of Alaska Groundfish FMP, and the Bering Sea and Aleutian Islands Groundfish FMP. The AKFIN program is necessary for management and for the analytical and reporting requirements of the FMPs.

Implementation of the FMP for the Commercial King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands (BSAI) resulted in additional responsibilities for data collection, analysis, and reporting by the state, which manages the 17 stocks of crabs covered by the FMP.

The overall goal of ADF&G's AKFIN program is to provide accurate and timely fishery data that is essential to management, pursuant to the biological conservation, economic and social, and research and management objectives of the fishery management plans for groundfish and crab. The specific objectives are:

1) to collect groundfish fishery landing information, including catch and biological data, from Alaskan marine waters extending from Dixon Entrance to the BSAI.;
2) to collect crab fishery landing information, including catch and biological data, from the BSAI;
3) to determine ages for groundfish samples using age structures such as otoliths, vertebrae, and spines arising from statewide commercial catch and resource survey sampling conducted by ADF&G;
4) to provide the support mechanisms needed to collect, store, and report commercial groundfish and shellfish harvest and production data in Alaska;
5) to integrate existing fishery research data into secure and well maintained databases with consistent structures and definitions;
6) to increase the quality and accuracy of fisheries data analysis and reporting to better meet the needs of ADF&G staff, AKFIN partner agencies, and the public, and to make more of this information available over the Internet while maintaining the department's confidentiality standards;
7) to provide GIS services for AKFIN fishery information mapping to ADF&G Division of Commercial Fisheries staff and participate in GIS and fishery data analysis and sharing with other AKFIN partner agencies;
8) to support economic analysis as needed prior to implementation of state and federal fishery regulations; and
9) to provide internal oversight of the AKFIN contract between the ADF&G and the Pacific States Marine Fisheries Commission (PSMFC).

Groundfish species include walleye pollock, Pacific cod, sablefish, skates, various flatfish, various rockfish, Atka mackerel, lingcod, sharks, and miscellaneous species. Crab species in the BSAI include red, blue, golden, and scarlet king crab; several Tanner crab species; snow crab; and hair crab.

The foundation of the state's AKFIN project is an extensive port sampling system for collection and editing of 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. A dockside sampling program provides for collection of accurate biological data (e.g., size, weight, sex, maturity, and age) and verifies self reported harvest information submitted on fish tickets from shoreside deliveries of groundfish throughout coastal Alaska and of crab in the BSAI region.

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 and the internet. 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 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.

The fishery information collected by the AKFIN program is not only essential for managers and scientists who must set harvest levels and conserve the fisheries resources, but it is also valuable for the fishermen and processors directly involved in the fisheries, as well as the general public. To meet those needs, the department has designed, implemented, and continues to improve database systems to store and retrieve fishery data, and continues to develop improvements to fishery information systems to provide data to other agencies and to the public.

The department also conducts economic analyses of these data for use in the NPFMC arena. The need for an economic analysis component of the AKFIN program arises from jurisdictional obligations, pressing economic needs, and impacts of environmental regulations. The ADF&G is the management agency for state fisheries under its jurisdiction, and also a lead agency in policy making for federal fisheries of the region through its role in the NPFMC and the Pacific Salmon Commission (PSC). Economic analysis of seafood and fishery management policy is essential for the state to determine how proposed policies will impact the industry, Alaska regions, and coastal localities of the state. The role of state staff is especially crucial under the rationalization plan currently being refined by the NPFMC, which will directly impact the state managed groundfish fisheries in the Gulf of Alaska.

Milestones for this ongoing ADF&G AKFIN program are primarily the annual production of catch records and biological samples. In calendar year 2008 ADF&G AKFIN staff processed approximately 21,262 groundfish fish tickets and 840 shellfish fish tickets. Also, in calendar year 2008 ADF&G AKFIN staff processed approximately 26,000 shellfish and 27,000 groundfish biological samples and measured more than 16,000 age structures. These basic measures of ongoing production in support of marine fisheries management by AKFIN funded ADF&G staff are representative of the level of annual productivity by the AKFIN program since it's inception in 1997. (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 wide-area network.

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). Beginning in 2001, these agencies developed a consolidated landing, production, and IFQ reporting from a sole source. This collaborative effort, the Interagency Electronic Reporting System (IERS), was developed with initial funding provided through the Pacific States Marine Fisheries Commission. The web-based reporting component of this system is ***eLandings*** and the desktop application for the at-sea catcher processor fleet is seaLandings. Vessels using the seaLandings application email landing and production report to the centralized database as an email attachment.

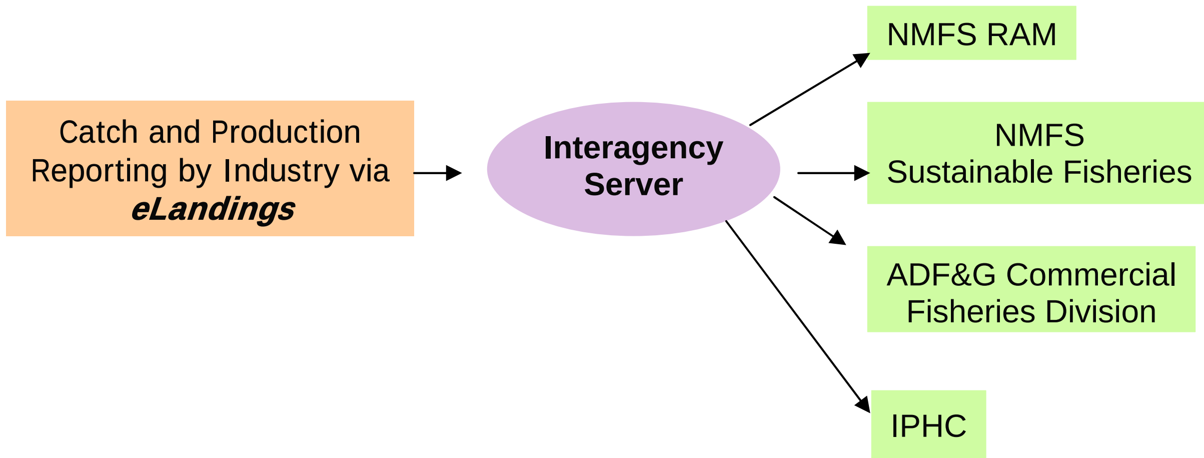
The IERS has been in successful operation in the groundfish and IFQ halibut/sablefish fisheries since July 2006. Program standards and goals for this project have been met. The ADF&G plans to have the system implemented in all Alaska fisheries by 2011.

AKFIN funded ADF&G personnel participate in the IERS project on the development, implementation, and maintenance levels. The IERS provides processors with a web-based online electronic catch and production reporting program. The IERS features include electronic landing and production reports, real time quota monitoring, immediate data validation, and printable (.pdf) fish ticket reports. To date, IERS is required in all groundfish and IFQ crab fisheries and extensively used in the Western Gulf and Bering Sea crab fisheries and halibut/sablefish IFQ fisheries – statewide. The ADF&G is currently beginning to implement the eLandings System in salmon fisheries. The challenges associated with implementation of the system with salmon are significant. These fisheries are seasonal and high volume. Approximately seventy-five percent of all landings occur to small and mid-sized tender vessels, at sea.

Our approach, throughout this project has been staged implementation, which allows a small staff to successfully manage this ambitious project and will continue as we implement the IERS in the state managed salmon fisheries. We expect the IERS will be fully implemented in this fishery by the end of the 2010 season.

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



The Interagency Electronic Reporting System provides several benefits for fisheries management agencies and industry, when compared to paper-based systems. 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.
- Consolidated trip level landing reports that accommodate fishery permit stacking.
- 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.

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, has improved data quality and allows personnel to function at a higher level. 24/7 user support is being provided by NMFS Data Technicians and to GCI, an Alaska based telecommunications company.

Landing and production data are submitted to a central database, hosted by the State of Alaska, 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 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.

e. Gene Conservation Laboratory

In the past, the ADF&G Gene Conservation Laboratory collected genetic information on black rockfish, light and dark dusky rockfish, and pollock (a list of *Sebastes* and pollock tissue samples stored at ADF&G's Gene Conservation Laboratory can be found in Appendix III).

f. Age Determination Unit

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 2008. Age structures from approximately 8,830 groundfish, representing 16 species, were received from statewide commercial and survey harvest sampling efforts. A total of 10,913 age data were released back to managers, which included data from samples received in previous years and also approximately 2,500 Clarence Strait sablefish which were re-aged. Over 2,277 additional age data were produced through precision testing. A total of 20,282 otoliths (representing ≥10,141 specimens) were measured. The majority (73%) of funding for this project is through the Alaska Fisheries Information Network, and the remaining is from State funding. Four people (2 successively) were employed for approximately 35 work months to age groundfish and invertebrate age structures (2 people) or conduct associated work (1 person), for example, sample preparation, data entry, archiving, otolith measurements, and project work. Two employees are full-time and funded year round and other employees were seasonal. An attempt to fill a vacant age reader position was unsuccessful in the fall of 2008, and will be reattempted early in 2009.

Quality of age data is routinely assessed through second-reading of 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 2008 the ADU was in production status for all species received except gadids. However, aging of sablefish dominated the reading schedule. This is due to substantial increases in sampling of sablefish and the need for these data in age structured models. Effort continued toward increasing objective information (age structure measurements, age validation) to strengthen foundation of pattern interpretation for all species.

The ADU continued radiocarbon studies to validate age of species and identify regional differences in the radiocarbon signal. Staff is concluding work and scientific manuscripts for possible publication in 2009. Staff have validated high ages (and there-in age reading criteria) for at least 8 species with an additional 5 species having at least one individual specimen age validated, and 2 more species with radiocarbon values landing on the reference curve (however data-to-date are not yet sufficiently without ambiguity to claim validation). Validated species and their highest validated age are as follows: sablefish (48y), thornyhead (46y), dusky/dark (44y), black (43y), tiger (46y), shortraker (49y), rougheye (46y), and redbanded (43y) rockfishes. In 2008 and continuing into 2009, black rockfish otolith core samples from 3 Alaska locales will be submitted for radiocarbon analysis, in order to evaluate regional differences in the bomb radiocarbon profile. Preliminary information suggests that the radiocarbon signal west of Kodiak may differ from the highly utilized radiocarbon reference curve for Southeast Alaska.

The ADU also continued their culture of pollock from the 2006 year class. These fish are under tank culture at the NMFS Auke Bay Marine Station, Juneau Alaska. Growth is monitored with quarterly live sampling of fish size with annual subsampling for otoliths. In 2008, ADU staff also tagged and released 999 wild pollock in Auke Bay. A total of 423 of these pollock were also injected with oxytetracycline. These fish were tagged to assess residency to Auke Bay. Two of these tagged fish were recovered 65 and 74 days from tagging (32 and 42d in the wild) and indicated growth of 0.65 and 0.38mm per day. Additional tag recovery effort of these fish will occur in 2009.

The ADU Oracle database *AegIS*, Age Information System, was used for logging in samples, importing and exporting of data, importing field data, and direct entry of age structure measurements. Commencement of Phase 3 development of *AegIS* continues to be postponed due to lack of availability of programmers. Phase 3 will incorporate a web-based sample invoicing procedure for use by Regional Sampling Coordinators and Port Samplers. Refinements to the ADU website (http://tagotoweb.adfg.state.ak.us/ADU/) were made and included a "Tagged Fish Alert" webpage which listed ADFG contact information in the event of recovery of a tagged fish. (Contact Kristen Munk)

2. 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 groundfish 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 charter boat fishery. The Assistant to the Commissioner, Douglas Vincent-Lang, located in Anchorage, is the statewide lead in federal-state jurisdictional management issues. The statewide bottomfish coordinator (Scott Meyer) coordinates federal data requests and develops scientifically-based advice for assessment and management of halibut and groundfish.

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 was funded through the Federal Aid in Sport Fish Restoration program and through NOAA grant NA07NMF4370168 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.

a. 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 are also located in Ketchikan (Kathleen Wendt) and Juneau (Diana Tersteeg). The project biometrician (Sarah Power) is located in Juneau. A total of 25 technicians worked at the major ports in the Southeast region, where they interviewed anglers and charter operators and collected data from sport harvests of halibut and groundfish while also collecting data on sport harvests of salmon. Data collected on groundfish were limited to species composition, length and weight of rockfish species, length of halibut and lingcod, and sex of lingcod; no otoliths or other age structures were collected. Data were 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. The demersal shelf rockfish and lingcod sport fisheries are managed under the direction of the Demersal shelf rockfish delegation of authority and provisions for management (5 AAC 47.065) and the Lingcod delegation of authority and provisions for management (5 AAC 47.060) for allocations set by the Alaska Board of Fish. In general, sport fisheries for groundfish are managed preseason, rather than inseason.

b. Southcentral Region Sport Fish

The **Southcentral Region** groundfish staff consists of the area management biologists and assistants for the following areas: (1) PWS and the North Gulf areas (Daniel Bosch), (2) Lower Cook Inlet (Nicky Szarzi), and (3) Kodiak, Alaska Peninsula, and the Aleutian Islands (Len Schwartz). In addition, a region-wide harvest assessment project was based in the Homer office, consisting of a project leader (Barbi Failor), project assistant, and six technicians. The research project biometrician (Steve Fleischman) was located in Anchorage. Ongoing assessment of sport harvest and fishery characteristics at major ports throughout the region is the primary activity. Data were collected from harvested halibut, rockfishes, lingcod, and sharks, and anglers and charter boat operators were interviewed for fishery performance information. All age reading was 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 three 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 conservative 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 included 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

1. 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.

a. Research

The **Westward Region** has continued the cod-tagging program that was initiated in 1997 in the Central and Western Gulf of Alaska. Approximately 962 fish were tagged in 2008, bringing the total number of tags released to 15,432. By year's end, 30 tags had been recovered. 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.

b. Stock Assessment

No stock assessment programs were active for Pacific cod during 2008.

c. 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 in state waters 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 GHLs 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 all five areas. For the Cook Inlet Area the BOF also adopted a harvest cap for vessels >58’ that limited harvest to a maximum of 25% of the GHL. The fishery management plans also provided for removal after October 31 of restrictions on exclusive area registrations, vessel size, and gear limits to increase late season production to promote achievement of the GHL. In addition, observers are occasionally used on day-trips to document catches and at-sea discards in the nearshore pot fisheries.

In February of 2006 the Alaska Board of Fisheries adopted a Pacific cod Management Plan for a nonexclusive Aleutian Islands District, west of 170° W longitude, state-waters fishery. Included within the plans were season, gear and harvest specifications. The fishery GHL was set by regulation at three percent based on the estimate of allowable biological catch (ABC) of Pacific cod as established by the NPFMC for the Bering Sea –

Aleutian Islands area with a maximum of 70% of the GHL available before June 10. By regulation the fishery opened on or after March 15, at the conclusion of the initial parallel catcher-vessel trawl fishery for Pacific cod in the federal BSAI Area. Non-pelagic trawl, longline, jig and pot gear were all permissible in the 2006 fishery.

In October of 2006 the Alaska Board of Fisheries amended the Pacific cod Management Plan for the **Aleutian Islands**. Beginning in 2007 a new regulation set the opening date of the fishery at four days after the initial closure of the federal Bering Sea – Aleutian Islands catcher vessel trawl season. Additional regulations introduced new vessel size limits of 125’ or less overall length for pot vessels, 100’ or less overall length for trawl vessels and 58’ or less overall length for longline and jig vessels.

There is no bag, possession, or size limit for Pacific cod in the recreational fisheries in Alaska, and the season is open year-round. Recreational harvest of Pacific cod is estimated through the Statewide Harvest Survey (SWHS). Limited information is collected through the Sport Fish Division’s Southcentral Region port sampling program. Specifically, numbers of cod kept and released by stat area is recorded by ADF&G groundfish stat area for each vessel-trip interview. No size or age data are collected. No information is collected in the Southeast Region creel survey program on the Pacific cod sport fishery.

d. Fisheries

Most of the Pacific cod harvested in **Southeast Alaska** are taken by longline gear in the Northern Southeast Inside (NSEI) area 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. In the Aleutian Islands trawl gear took 60% of the harvest, pot gear took 31%, and the remainder was split between longline and jig gear. Trawl gear was used primarily during the A season and pot gear in the B season.

Prior to 1993 much of the cod taken in **Southeast** was utilized as bait in fisheries for other species. In recent years in Southeast Alaska the Pacific cod harvest has been largely sold for human consumption. Specifically in 2008 only 6% was recorded as being used for bait. 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 in the Southeast state-managed (internal waters) fishery during 2008 totaled 229 mt. This is a decrease from the 2007 catch of 288 mt.

The 2008 GHLs for the state-managed Pacific cod seasons in the Cook Inlet and Prince William Sound Areas of the **Central** Region were set at 1,421 mt and 266 mt, respectively. Harvest from the Cook Inlet Area state-managed Pacific cod fishery totaled 1,086 mt while the Prince William Sound Area harvest totaled 3 mt. Harvest from the 2008 state managed Aleutian Islands Pacific cod fishery totaled 5,313 mt , 33 mt more than 2007. Harvest from the 2008 state managed fishery in the Kodiak Area totaled

4,735 mt, while 3,042 mt of cod were harvested in the Chignik Area, and the South Alaska Peninsula Area harvest totaled 6,133 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. Action by the Alaska Board of Fisheries during 2004 increased the Pacific cod allocation in the Cook Inlet Area to its maximum allowable 3.75% of the Central Gulf ABC, the maximum allowed under regulation and Prince William Sound remains at its minimum allocation of 10% of the Eastern Gulf ABC.

Estimates of the 2008 recreational harvest of Pacific cod are not yet available from the statewide harvest survey, but the 2007 estimates were 9,267 fish in **Southeast** and 10,967 fish in **Southcentral Alaska**. The average estimated annual harvest for the most recent five-year period (2003-2007) was 8,180 fish in **Southeast** Alaska and 10,224 fish in **Southcentral** Alaska. There are no estimates of average weight in the sport harvest in either region.

2. 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, dark, yellowtail, and widow. Black and blue rockfish were removed from the PSR assemblage in the federal fisheries management plan (FMP) and placed totally under state management in 1998. The North Pacific Fisheries Management Council (NPFMC) removed dark rockfish also from the PSR assemblage in the FMP and turned management of them over to the State effective January 1, 2009. Slope rockfish contain all other *Sebastes* and *Sebastolobus* species.

a. Research

In the **Southeast Region** port sampling and the mandatory logbook program for all groundfish fisheries continued. The logbook program is 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. In 2008 the directed fishery for demersal shelf rockfish (DSR) opened in the EYKT and SSEO areas of the Southeast Outside District (SEO). Length, weight and age structures were collected from 688 yelloweye rockfish caught in the directed fishery. The remaining areas of SEO (CSEO and NSEO) did not open to directed fishing because the portion of the TAC allocated to those areas was not large enough to support an orderly fishery. The directed fishery for DSR opened in internal waters but landings were minimal and only 71 biological samples of yelloweye rockfish were collected from the internal waters fishery. The Southeast Groundfish Project contracted with the International Pacific Halibut Commission (IPHC) for the collection of biological data and age structures from 874 yelloweye rockfish caught as bycatch on the IPHC Annual Stock

Assessment Survey during the summer of 2008. Over 700 yelloweye rockfish landed as bycatch in the commercial halibut fishery were also sampled for AWL data throughout the halibut season in southeast Alaska.

Rockfish habitat mapping projects continue in the **Southeast Region**. The objective of this project is to continue to collect and evaluate data in the Eastern Gulf of Alaska for the purpose of identifying potential habitats 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 goals of this project are 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. Data was collected at Learmonth Bank in the SSEO area through collaboration with the Canadian Geologic Survey in the summer of 2008. This shallow bank is in both US and Canadian waters and is fished in the directed DSR fishery. (Contact Cleo Brylinsky).

Skipper interviews and port sampling of commercial rockfish deliveries in **Central Region** during 2008 occurred in Homer, Seward, Whittier, Anchorage and Cordova. Efforts during the first half of the year were directed at the sampling of rockfish delivered as bycatch in other groundfish and halibut fisheries, primarily slope and demersal shelf species. The directed jig fishery that targets pelagic rockfish begins July 1 and is normally the focus of rockfish sampling during the last half of the year. However, very limited fishing effort drastically reduced sampling opportunities during 2008. 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. Additional sampling occurred during the Cook Inlet and PWS trawl surveys. (Contact Charles Trowbridge).

Work continued in 2008 on the development of a marine habitat GIS for **Central Region**. Additional NOAA multibeam bathymetry and backscatter data were collected. Bathymetry data were gridded and incorporated while preliminary attempts were undertaken to analyze the backscatter data. Margaret Spahn, ADF&G Homer, the lead on this project started a graduate program in September, 2007 at Oregon State University in geography to develop more skills to further this project. Multibeam and side scan sonar projects continue to be a major focus of the Central Region research program. The Nuka Island/Pye Island area was mapped in 2008; ROV assessment work on yelloweye rockfish and lingcod are scheduled for that area in 2009 as well as a combined ROV-jig assessment of lingcod in lower Resurrection Bay.

Experiments were conducted in August, 2007 to test two assumptions of strip transect sampling with an ROV. The experiments assessed the responsive movement of rockfishes and lingcod to an ROV under different artificial light levels and assessed the detection of those animals. The results from direct testing of these two assumptions of strip transect sampling will; 1) determine if the assumptions are likely to be violated, 2) determine possible biases – either positive or negative, 3) possibly quantify their effects, and 4) understand their effects to the extent that methods to overcome them may be incorporated in future surveys. Data analysis of this project is near completion (Contact Mike Byerly or Ken Goldman).

The **Westward Region** continued its port sampling of the commercial rockfish and Pacific cod harvests in 2008. Rockfish sampling consisted mainly of black rockfish with opportunistic sampling of duskys, darks, 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 Sonya El Mejiati). Staff from the Kodiak office has completed aging black rockfish otoliths through the 2008 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 and dark rockfish. The acoustic tagging of black rockfish and dark rockfish continued throughout 2008. An array of 16 moored receivers was deployed on the east side of Spruce Island, just north of the city of Kodiak. Tags were surgically implanted in 75 black rockfish and 20 dark rockfish to monitor their daily and seasonal movements. In addition, hydroacoustic surveys of black and dark rockfish in the Northeast Section of the Kodiak Management Area were conducted in 2008 in an effort to generate biomass estimates and develop a management strategy for dark rockfish. Surveys are planned for the Eastside, Southeast, and Afognak Sections in the Kodiak Area in 2009 (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. Rockfish objectives included estimation of 1) species composition, 2) weight and length composition, and 3) the geographic distribution of harvest by the fleets by port. Primary species harvested in Southeast Alaska included yelloweye, black, and quillback rockfish. Approximately 5,440 rockfish were sampled at Ketchikan, Craig, Klawock, Wrangell, Petersburg, Juneau, Sitka, Gustavus, Elfin Cove, and Yakutat in 2008 (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 2,600 rockfish were sampled at Seward, Valdez, Whittier, Kodiak, and Homer in 2008 (Contact Barbi Failor).

b. 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. No new density surveys were conducted during 2008. Yelloweye rockfish density for this stock assessment is based on the latest best estimate by management area. The CSEO area was last surveyed in 2007, the EYKT and SSEO areas were last surveyed in 2003 and 2005 respectively, NSEO was surveyed in 2001. Density estimates by area range from 1,068 to 3,557 adult yelloweye per km^2.

In the **Southeast Region** no black rockfish surveys were conducted in 2008.

In the **Westward Region** hydroacoustic equipment was deployed in a preliminary effort at stock assessment of black and dark rockfish. Surveyed areas included the Northeast Section of the Kodiak Management Area (contact Carrie Worton).

In the **Central Region** no rockfish stock assessment surveys were conducted in 2008.

c. 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 in all areas except for EYKT where the trip limit is 12,000 pounds, and added a requirement that logbook pages must be submitted with fish tickets for each fishing trip. At the Board of Fish meeting in early 2006 the season for the directed fishery of DSR in SEO was changed to occur in the winter only from January 5^{th} until the day before the start of the commercial halibut IFQ season, or until the annual harvest limit is reached whichever occurs first. At this meeting the total allowable catch for DSR was allocated 84% to the commercial sector and 16% to the sport sector.

The 2008 TAC for DSR in SEO was 382 mt which resulted in an allocation of 321 mt to commercial fisheries and 61 mt to sport fisheries. A significant portion of the total commercial harvest is taken as bycatch mortality during the halibut fishery. In 2006 an alternate method to the one used in past years was implemented to try to be more precise in our estimation of bycatch of yelloweye rockfish in the halibut fishery. This new method recognizes the significance of depth as a component of the bycatch rate. Using the new method the estimate of yelloweye that was anticipated to be caught as bycatch by the halibut fleet in outside waters in 2008 ranged from 54-243 mt (95%CI) with the point estimate at 149 mt. Full retention of DSR has been in regulation in state waters since 2002 and in Federal water since 2005. Landed catch of DSR in the halibut fishery in 2008 was 143 mt which was just 4% under the estimation for yelloweye provided using the new method (yelloweye comprises 96% of the landed catch of DSR).

The commercial fishery for DSR in SEO opened in EYKT and SSEO in 2008. Sportfish harvest estimates have been used since 2005 to add to our knowledge of what we determine to be the total harvest of DSR in other fisheries. The sportfish preliminary estimate for 2008 was 70 mt. (Contact Cleo Brylinsky).

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 continues to have very little participation with 0.8 mt landed in directed and bycatch fisheries combined in 2008.

Shortspine thornyhead, shortraker rockfish, rougheye rockfish and redbanded rockfish may be taken as bycatch only (no directed fishing). A total of 111 mt of slope rockfish were landed in NSEI and SSEI during 2008.

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 68 mt GHL into a harvest cap for all rockfish species in Cook Inlet and PWS and adopted 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, 5% during the parallel Pacific cod season and 10% during other directed fisheries. Proceeds from rockfish landed in excess of allowable bycatch levels are surrendered to the State of Alaska. (Contact Charles Trowbridge)

The **Westward Region** has conservatively managed 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 GHLs 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 Chignik Area; that area was also designated as super-exclusive for the black rockfish fishery beginning in 2003.

In 2008, 65 mt of black rockfish were harvested from six sections in the Kodiak Area. Guideline harvest levels were attained in four sections. The 2008 black rockfish harvest in the Chignik and South Alaska Peninsula areas remains confidential because of minimum participation. In 2008 no vessels made directed black rockfish landings in the Aleutian Islands Area. Fishers are allowed to retain up to 5% of black rockfish by weight incidentally during other fisheries. The incidental harvest in the Aleutian Islands Area is confidential due to limited participation. 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).

Statewide, the majority of **sport caught** rockfish is taken incidental to recreational fisheries for halibut or while trolling for salmon. Size limits have never been set for rockfish harvested in the sport fishery, although there has been a progression of bag and possession limit changes over the last 20 years.

Prior to 1988, there were no bag or possession limits on rockfish in **Southeast Alaska's** sport fishery. In 1988, a bag and possession limit of 8 rockfish was applied to the waters near Sitka (Sitka Sound, Salisbury Sound, and Peril Strait). The remaining waters of Southeast Alaska had no bag or possession limit on rockfish species for 1988. During 1989 to 1993, for the majority of the marine waters of Southeast Alaska (except Yakutat) the bag and possession limit was 5 rockfish per day and 10 in possession, of which only 2 per day, 4 in possession could be yelloweye; however, for the Sitka area (Sitka Sound, Salisbury Sound, and Peril Strait) and the Ketchikan area (Behm Canal, Clarence Strait, Tongass Narrows, Nichols Passage, George Inlet, Carroll Inlet, Thorne Arm, Revillagigedo Channel) the bag and possession limit was three rockfish, of which only one could be a yelloweye.

Prior to 1994, the Yakutat area did not have any bag or possession limits on rockfish caught in the sport fisheries. Since 1994, the **recreational rockfish regulations for Southeast Alaska** (including Yakutat) have been split into "pelagic" and "other" (other being non-pelagic), with a region wide bag and possession limit of pelagic rockfish of 5 per day, 10 in possession and a bag and possession limit of "other" rockfish of 5 per day, 10 in possession of which only 2 per day, 4 in possession could be yelloweye. However, in the Sitka area (Sitka Sound, Salisbury Sound, and Peril Strait) and the Ketchikan area (Behm Canal, Clarence Strait, Tongass Narrows, Nichols Passage, George Inlet, Carroll Inlet, Thorne Arm, Revillagigedo Channel) the bag and possession limit was three rockfish, other than pelagic rockfish, of which only one could be a yelloweye.

For the 2007 and 2008 season, the entire **Southeast Alaska** region's sport bag and possession limit for pelagic rockfish remained at 5 fish per day, 10 in possession. The non-pelagic rockfish regulations were set as follows: 1) resident bag limit was 3 fish, only 1 of which could be a yelloweye; 6 fish in possession, of which no more than 2 could be yelloweye; all non-pelagic rockfish caught must be retained until the bag limit is reached; 2) nonresident bag limit was 2 fish, only 1 of which could be a yelloweye, 4 fish in possession, of which no more than 2 could be yelloweye; all non-pelagic rockfish caught must be retained until the bag limit is reached; and an annual limit of 2 yelloweye rockfish, which must be recorded in ink on the back of the sport fishing license or on a harvest record at the time of harvest; 3) Charter operators and crewmembers could not retain rockfish while clients are on board the vessel (Contact Robert Chadwick).

In most of the recreational 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, and Cook Inlet are five rockfish daily, with no more than one or two being non-pelagic (DSR and slope) rockfish. The bag limit in the North Gulf was four rockfish daily with no more than one being a non-pelagic 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.

d. Fisheries

Directed fisheries for demersal shelf rockfish and black rockfish occurred in **Southeast** in 2008. Effort in the directed black rockfish fishery was minimal and the harvest is confidential, but was down from 2007. The directed DSR fishery in 2008 in outside waters was opened in two areas, EYKT and SSEO for a total harvest of 41 mt. There was also a directed DSR fishery in internal waters (SSEI and NSEI); the total harvest was 5.5 mt. The total amount of rockfish taken as bycatch in all southeast fisheries in 2008 in state and Federal water was 688 mt. DSR bycatch made in conjunction with the IFQ halibut fishery in outside as well as internal waters contributed 193 mt to this total. 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 2008 **Cook Inlet Area** directed rockfish fishery opened July 1 and closed December 31 with a harvest of 4 mt. Total rockfish harvest including bycatch to longline, pot and jig fisheries was 14 mt. Total rockfish harvest for the PWS Area rockfish bycatch-only fishery was 46 mt. This included a 10 mt incidental catch of demersal and slope rockfish from the walleye pollock trawl fishery and a 36 mt incidental harvest of demersal and slope rockfish primarily 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 2008 harvest are not yet available from the statewide harvest survey, but the 2007 estimates were 94,538 fish in Southeast and 103,007 fish in Southcentral Alaska. The average estimated annual harvest for the most recent five-year period (2003-2007) was 82,614 rockfish (all species) in Southeast Alaska and 87,965 fish in Southcentral Alaska.

Creel survey data for Sitka indicates that 7,368 individual yelloweye (approximately 26 mt) were retained by anglers in an area roughly equivalent to the CSEO in 2008. This is a 9% decrease in the harvest (by number of fish) of yelloweye in Sitka compared to the 2007 season, and is 17% below the 2001 yelloweye creel harvest estimate of 8,854 fish. Projections based on creel and SWHS data for SWHS Area B (Prince of Wales Island) indicates that approximately 4,000 yelloweye (approximately 11 mt) were retained in 2008 in the SSEO area of Prince of Wales Island. These numbers do not include harvest of other species of DSR although yelloweye compromise the majority of the sport harvested DSR by biomass harvested in CSEO (~86%) and SSEO (~69%), based on the 2008 projections

3. Sablefish

a. Research

In 2008, sablefish longline surveys were conducted for both the NSEI and SSEI areas. 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.

In the NSEI survey, the 2008 overall CPUE (kg/hook) was 1.1, up slightly from 2007 (1.08). Thornyhead rockfish dominated the bycatch with skates as the second most dominant species group.

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) decreased again in 2008 to .17 round kg/hk compared to 0.22 round kg/hook in 2007. In the NSEI fishery, the overall CPUE adjusted for hook spacing expressed in round kg/hook for vessels was 0.41, continuing the trend upward from 2007 (0.34) and 2006 (0.32).

In 2008, ADF&G continued a mark/recapture study in NSEI, tagging and releasing 5,450 sablefish. Pot gear was used to capture the fish from June 1st to 25th one and a half months prior to the start of the fishery which commenced on August 15, 2007. Using pot gear to capture the fish for tagging has minimized the apparent "hook shyness" pattern of tag returns observed in 1997, 1998 and 1999 when longline gear was used to catch fish for tagging.

Within **Central Region,** ADF&G initiated a limited tagging study in 1999 within PWS. Fish tagged were captured on the biennial bottom trawl survey. Tagging was continued through the 2003 survey. Longline surveys were conducted through 2006 and may be reconstituted in the future. (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 Charles Trowbridge).

b. 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 June, 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. No stock assessment was performed in 2007 for 2008 so the previous year stock assessment and forecast was rolled forward for the 2008 season. Based on Chapman's modification of the Petersen estimator (Chapman 1948), there were an estimated 2,427,828 sablefish in NSEI at the time of the 2006 fishery. The 90% confidence interval for the 2006 sablefish abundance estimate was 2,259,843 – 2,620,065 sablefish. The forecast for 2007 was made by decrementing the 2006 estimate to account for natural mortality, and adding a number of age-4 recruits equal to that of 2006. The forecast for 2007 was 2,203,396 sablefish and 16,750,915 round pounds of sablefish. An $F_{40\%}$ (=0.116) harvest rate was applied to the lower confidence interval of the forecasted biomass to give a preliminary ABC of 1,623,219 round pounds. In addition to the mark-recapture work, an annual longline survey is conducted in NSEI to provide biological data as well as relative abundance information (Contact Sherri Dressel). In SSEI only an annual longline survey is conducted to provide biological data as well as relative abundance information.

A longline survey, using ADF&G vessels, has been conducted in **Prince William Sound** annually since 1996. Mean CPUE between 1996 and 2002 ranged from 0.08 to 0.17 sablefish/hook, with an overall mean CPUE of 0.12 (all years combined). Longline survey effort was extended into the North Gulf District in 1999, 2000 and 2002. The 2005 and 2006 PWS survey covered all of PWS, and data will be analyzed during the winter of 2008-2009 to determine the veracity of the data for setting harvest limits on the PWS fishery. Survey costs are partially offset by the sale of fishes caught in the survey, however, Central Region staff is considering a switch to a pre-fishery pot survey that would use tag and recapture methods to set harvest limits, which would not sell the fishes caught (Contact Ken Goldman).

c. 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 1997 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) was set using an $F_{40\%}$ applied to the lower 90% confidence limit of the forecasted estimate of biomass. The TAC is then decremented by estimating 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). In 2006 the 2005 quota was used rather than base the quota on the recommendation put forward by the biometrician. There were 105 permit holders eligible to fish in NSEI in 2006. Data collected during 2006 was used to determine an updated stock assessment as referenced in the "stock assessment" section in this report. The use of this updated stock assessment with the forecast for 2007 resulted in a drop in the TAC to 675 mt down 28% from the TAC used in 2006. There were 103 permit holders participating in the fishery in 2007. In 2008 the stock assessment from 2006 and the forecast for 2007 were used to set the TAC for the 2008 fishery. In 2008 there were 96 permit holders eligible to fish. The Commercial Fisheries Entry Commission predicts that the number of permits will continue to be reduced over the next three years until the optimum number of 73 permits remains in the fishery.

The SSEI quota was set at 316 mt in 2000, and has remained the same thru 2008. From 2000 to 2005 there were 28 permit holders (4 pot gear, 24 longline) legally permitted to fish in this fishery. In 2006 the Commercial Fisheries Entry Commission (CFEC) allowed 4 permits back into the fishery bringing the total permits to 32 (28 longline and 4 pot gear).

During the February 2009 Board of Fisheries (BOF) meeting, the BOF made no changes affecting the regulation of commercial sablefish fisheries. The BOF did however establish bag and possession limits for sablefish in the sportfish fishery.

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 Cook Inlet Area's North Gulf District and the Aleutian Island District, are open access in state waters, as the state cannot legally implement IFQ management at this time. The fishery GHLs are based on historic catch averages and closed once these have been reached.

Within the **Central Region** the North Gulf District sablefish GHL is set using an historic baseline harvest level adjusted annually by the same relative change to the TAC in the Central Gulf Area. The 2008 fishery GHL was 30 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 in 2003 into a shared quota 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 from these fisheries in the ports of Cordova, Whittier, Homer and Seward.

The GHL for the Aleutian Island District is set roughly at 5% of the BSAI TAC. The state GHL can be adjusted according to recent state-waters harvest history when necessary. From 1995 to 2000 the fishery opened concurrently with the EEZ IFQ sablefish fishery. In 2001 the Board of Fish changed the opening date of the state-waters fishery to May 15 so as to provide small vessel operators an opportunity to take advantage of potentially better weather conditions. From 1995 to 2000 all legal groundfish gear types were permissible during the fishery. Effective in 2001, longline, pot, jig and hand troll became the only legal gear types. Vessels participating in the fishery are required to fill out logbooks and processors are required to send the Department weekly processing reports.

There were no bag, possession, or size limits for sablefish in the recreational fisheries in Alaska in 2008. Sablefish harvest is not explicitly estimated by the SWHS and no information is collected in the creel surveys and port sampling of the recreational fisheries in Southcentral Alaska. Sablefish are caught incidentally to other species and the total harvest is believed to be quite small. The creel surveys in Southeast Alaska in 2008 began collecting information only on number of harvested sablefish at all sampled ports, and encountered a regional total of 9 harvested sablefish landed at the sampled ports during the 2008 season. At the February BOF meeting a bag, possession and annual limit was set for sablefish in the recreational fisheries in Southeast Alaska. Starting in summer 2009 sportfish charter logbooks will capture the harvest of sablefish.

d. Fisheries

In the **Southeast Region** the 2008 NSEI sablefish fishery opened August 15 and closed November 15. The 96 permit holders landed a total of 686 mt of sablefish. The fishery is managed by equal quota share; each permit holder was allowed 7.1 mt. The 2008 SSEI sablefish fishery opened June 1 and closed November 15. Thirty permit holders landed a total of 280 mt of sablefish, each with an equal quota share of 9.8 mt. In SSEI 28 permits were designated to be fished with longline gear and the remaining four fished with pot gear. Two of the longline permits did not fish in 2008. (Contact Cleo Brylinsky)

In the **Central Region** the 2008 open access sablefish fishery in the Cook Inlet North Gulf District opened at noon July 15 and closed at noon on August 9. Eleven vessels harvested 31 mt. In 2008, PWS season dates were modified by emergency order because of orca depredation of an unknown extent during the spring season which resulted in reduced effort. The result was that the spring opening remained from March 15 - May 15 but the second opening (August 1 – 21) was increased to July 25-August 31. The 2008 PWS harvest totaled 93 mt. Biological sampling was conducted in-season which gathered age, length, weight, sex and gonad condition data. Effort, location and CPUE information was gathered via mandatory logbooks. (Contact Charles 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 2008 Aleutian Island fishery opened on May 15, 2008. Additional requirements for the fishery include registration and logbook requirements. The GHL was set at 265 mt for the state managed fishery. The preliminary harvest from the 2008 Aleutian Islands sablefish fishery was 67 mt. The season remained open until the November 15 closure date (Contact Krista Milani).

4. Flatfish

a. Research

There was no research on flatfish during 2008.

b. Stock Assessment

There are no stock assessments for flatfish.

c. 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.

Within **Central Region** flatfish may be harvested in a targeted fishery only under the authority of a permit from the commissioner of ADF&G. The permit may stipulate fishing depth, seasons, areas, allowable sizes of harvested fish, gear, logbooks, and "other conditions" the commissioner deems necessary for conservation or management purposes.

There are no bag, possession, or size limits for flatfish (excluding Pacific halibut) in the recreational fisheries in Alaska. Harvest of flatfish besides Pacific halibut are not explicitly estimated by the SWHS and no information is collected in the creel surveys and port sampling of the recreational fisheries in Southcentral or Southeast Alaska. Flatfish are occasionally taken incidentally to other species and in small shore fisheries, but the recreational harvest is believed to be very small.

d. Fisheries

There has been almost no effort in the **Southeast** fishery for the past seven years, with no harvest reported for the 2007-2008 season. The Southeast flatfish trawl areas are also the sites of a shrimp beam trawl fishery. In the past most of the Southeast harvest is starry flounder. NMFS manages the flatfish fishery and harvest in the state waters of **Westward Region**. No flatfish harvest permits were issued in **Central Region** during 2008.

5. Pollock

State-managed pollock is limited to the Central Region and Aleutian Islands

a. 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 2008 included commercial fishery catch sampling and a biennial bottom trawl survey for Tanner crab that captures some of the summer (post-spawning) pollock population. Skipper interviews and port sampling of **Central Region** commercial pollock deliveries during 2008 occurred in Kodiak and Seward. 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 Charles Trowbridge).

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.

Beginning in 1998, spatial patterns of genetic variation were investigated in six populations of walleye pollock from three regions: North America – Gulf of Alaska; North America – Bering Sea; Asia – East Kamchatka. The annual stability of the genetic signal was measured in replicate samples from three of the North American populations. Allozyme and mtDNA markers provided 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 consideration 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. This study was published in 2002 in the Fishery Bulletin (Olsen et al. 2002). (Contact Bill Templin).

b. 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).

c. 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, check-in and check-out provisions, and accommodation of a department observer upon request. The Prince William Sound Inside District is divided into three 'sections" for pollock management: Port Bainbridge, Knight Island, and Hinchinbrook, with the harvest from any section limited to a maximum of 60% of the GHL. Additionally, the fishery is managed under a 5% maximum bycatch allowance that is further divided into five species or species groups. (Contact Robert Berceli). For **Cook Inlet** directed fishing for pollock is managed under a "Miscellaneous Groundfish" commissioner's permit. However, due to pelagic trawl closures associated with Stellar Sea Lion conservation measures no directed fishing has occurred in the Cook Inlet Area since 2000.

In October of 2006 the Board of Fish adopted regulation for a state-waters Aleutian Islands pollock fishery between 174° W long. and 178° W long. Regulation stated that the GHL would be set at 3,000 mt, reduced by the amount of walleye pollock authorized to be taken by the federal exempted fisheries permit fishery inside critical habitat areas. Participating vessels are restricted to pelagic trawl gear and may not be more than 58 feet in overall length. Daily reporting is required throughout the fishery. In addition all state waters within 20 miles around a Steller sea lion rookery and all waters within three miles around a Steller sea lion haulout are closed. This fishery was repealed by the Board of Fish in October 2007 due to low abundance of pollock in the registration area.

d. Fisheries

The 2008 **Prince William Sound** fishery opened on January 20 with a GHL of 1,651 mt. Catch and effort remained low until early March. The Hinchinbrook section closed by emergency order on March 30 while the Knight Island and Bainbridge sections closed by regulation on March 31. Total pollock harvest for all sections combined was 1,179 mt. As in past years, fishery bycatch was dominated by squid (5.1 mt), rockfish (4.3 mt), and sharks (1.2 mt).

The **Aleutian Islands** pollock fishery which was developed by the BOF in 2006 did not open in 2007 because NMFS authorized the entire 3,000 mt to be taken by the federal exempted fisheries permit fishery inside critical habitat. ADF&G issued three commissioner permits to allow pollock fishers participating under the federal exempted fishery permit to harvest inside of state waters resulting in a harvest of 1,170 metric tons. In November of 2007 the BOF repealed the walleye pollock fishery due to NMFS concerns regarding the apparent low abundance of pollock in the area and the potential adverse effects on Steller sea lion populations.

6. Sharks

a. Research

In the **Central Region** spiny dogfish and Pacific sleeper sharks were tagged annually from 1997 to 2006 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 2005 muscle tissue samples from 49 spiny dogfish caught in the PWS longline survey were sent to Alaska Department of Environmental Conservation for analysis of mercury levels. Results were received in 2006 and incorporated into DEC’s Fish Monitoring Program. Total mercury concentrations ranged from 0.1 to 1.3 ppm with a mean concentration of 0.8 ppm. (Contact Ken Goldman)

The **recreational** fishery targeting salmon sharks in Prince William Sound continues. Little information is available to assess the status or structures of targeted stocks. The Division of Sport Fish initiated a cooperative tagging program with a few charter boat operators in 1998 and continues to collect biological data on all sharks harvested in the sport fishery through the port-sampling program.

b. Stock Assessment

Among **Central** Region assessment projects sharks are caught in 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 Ken Goldman).

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 of some species can be estimated using multiple years of data. In 2008, 26 salmon sharks and 5 spiny dogfish were sampled for length, sex, and age structures from the sport harvest throughout the region. Interviews also provided estimates of the numbers of salmon sharks and spiny dogfish kept and released by ADF&G statistical area (Contact Barbi Failor).

c. 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. However in 2004 the BOF amended Cook Inlet Area regulations to provide for a directed fishery for spiny dogfish in the Cook Inlet area under terms of a permit issued by the commissioner.

Also in 2000 the BOF prohibited the practice of "finning", requiring that all sharks 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.

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 over harvest, 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 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.

d. Fisheries

The Department received no requests for permits to target spiny dogfish in Cook Inlet during 2008.

Estimates of **recreational shark harvest** in 2008 are not yet available from the Statewide Harvest Survey, but in 2007 an estimated 349 sharks of all species were harvested in Southeast Alaska and 773 were harvested in Southcentral Alaska. Confidence in these estimates is low. The statewide charter logbook program also required 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 2007, charter operators reported harvesting 54 salmon sharks in Southeast Alaska and 190 salmon sharks in Southcentral Alaska.

7. Lingcod

a. Research

Beginning in the spring of 1996 and over the thirteen years since, in the **Southeast Region** 9,076 lingcod have been tagged and 421 fish recovered. Opportunistic tagging of 70 lingcod in Sitka Sound occurred during 2008. Length, sex and tagging location are recorded for all tagged fish. Dockside sampling of lingcod caught in the commercial fishery continued in 2008 in Sitka and Yakutat with over 272 fish sampled for AWL. Otoliths were sent to the ADU in Juneau for age determination. (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. Otoliths were sent to the ADU in Juneau for age determination. Gonad condition was generally not determined as nearly all fish delivered were already gutted (Contact Charles Trowbridge).

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 2008 included Juneau, Sitka, Craig/Klawock, Wrangell, Petersburg, Gustavus, Elfin Cove, Yakutat, and Ketchikan. Length and sex data were collected from 1,144 lingcod in 2008, 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 737 lingcod were sampled from sport harvest at Seward, Valdez, Whittier, Kodiak, and Homer in 2008. These ports accounted for the majority of recreational lingcod harvest in Southcentral Alaska (Contact Barbi Failor).

b. 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 2002-2008 shows CPUE in fish per hook hour trending up in CSEO, EYKT and SSEOC. In IBS and NSEO the CPUE is relatively flat. In EYKT effort has been steady since 2002, CSEO had an increase in directed fishing in 2007 and 2008 and SSEOC has only had sporadic participation in the last 5 years. The IBS super-exclusive registration area commercial quota was harvested almost exclusively by the directed fishery and as bycatch in the longline fisheries.

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.

c. 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 commercial** 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. Resurrection Bay, near Seward is closed to commercial harvest of lingcod.

In **Southeast Alaska**, the sport fishery for lingcod prior to 2000 had a open season of May 1 to November 30, and a region wide bag and possession limit of two per day, four in possession, with no size limits. Area-specific exceptions to this included: 1) The Pinnacles area near Sitka has been closed to sport fishing year-round for all groundfish since 1997, and 2) the nonresident sport anglers bag and possession limit for the Sitka Sound LAMP area was one per day, two in possession during 1997-2000.

Beginning in 2000, the open season has been set at May 16 to November 30. Sport harvests of lingcod in Southeast Alaska as of the year 2000 have been incorporated into a region wide lingcod management plan, which reduced GHLs 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 2007 and 2008, lingcod bag limits were reduced from 2 to 1 fish per day region wide for all anglers, lingcod possession limits were set at 2 fish for nonguided residents and 1 fish for nonresidents and guided anglers, slot limits were imposed for guided and nonresident anglers in all management areas, and the season was closed in northern Southeast management areas (NSEI, CSEO, and NSEO) from June 16 through August 15. In addition, in all management areas in Southeast Alaska (except the Yakutat area) there were the following restrictions: a nonresident annual limit of 1 lingcod with harvest record required, and captain and crew on charter vessels with clients could not harvest any fish species (Contact Robert Chadwick).

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).

d. 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 everywhere except IBS where the bycatch is 10%), and as bycatch in the salmon troll fishery. The directed fishery landed 122 mt of lingcod in 2008 and an additional 60 mt was landed as bycatch in other fisheries. The halibut longline fishery accounted for roughly 80% of lingcod bycatch in the Southeast Region and the salmon troll fishery accounted for 20%.

Central Region commercial lingcod harvests have primarily occurred in the North Gulf District of Cook Inlet and PWS. In 2008, the Cook Inlet GHL was 24 mt and the PWS GHL was 15 mt. Lingcod harvests in 2008 totaled 20 mt in Cook Inlet and 18 mt in PWS. The majority of the Cook Inlet Area lingcod harvest was from longline bycatch to other directed (primarily halibut) fisheries. Directed jig fishing accounted for 68% of the Cook Inlet harvest.

No directed effort occurred for lingcod in the **Westward Region** during 2008. A large jump in the amount of incidental harvest in the bottom trawl fisheries occurred. Incidental harvest totaled 23 mt in 2007 and 250 mt in 2008. 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 2008 harvest are not yet available from the statewide mail survey, but in 2007 an estimated 14,085 lingcod were harvested in Southeast Alaska while 27,436 lingcod were taken in Southcentral Alaska. The average estimated annual harvest for the most recent five-year period (2003-2007) was 16,278 fish in Southeast Alaska and 17,044 fish in Southcentral Alaska.

8. 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. 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. 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 2008, interest continued for a skate fishery in the Cook Inlet and Kodiak Areas; however no skate fishing permits were issued in 2008 due to the closure of directed skate fishing in adjacent federal waters 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.

A data summary was conducted on skate species collected during **Central Region** historical large-mesh trawl, small-mesh trawl, and longline surveys, and commercial fisheries. The project 1) compiled historical ADF&G, NMFS, survey catch and biological data on skate species groups for southcentral Alaska; 2) summarized data to describe the spatial and temporal patterns of survey and fishery catches, and assessed spatial and temporal size and sex distributions for skate species; 3) assessed the feasibility of using ADF&G bottom trawl survey data to produce area-swept estimates of skate biomass; and 4) guided the collection of additional biological data on skate species. This data summary represented a first look at skate distribution, size composition, and survey catch-effort trends for Central Region. Strong regional trends were detected both within and among species and bathymetric trends among species. There were 3,509 skates sampled for biological data (size, weight, and maturity) and 1,595 vertebra collected for age determination. Age structures were sent to the NMFS, AFSC and Moss Landing Marine Lab. Results of the life history studies are now published on big and longnose skates (*Raja binoculata* and *R. rhina*, respectively). Biomass estimates for those two species were derived from the ADF&G biennial trawl survey in PWS and used to provide a fishery opportunity in 2009 for skates in PWS.

Work on a "Developing Fisheries" policy, intended to reduce the potential for a fishery to escalate beyond management control, has 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.

The BOF took action in 2000 prohibiting the development of a live fish fishery for groundfish in the Southeast District.

C. Other Related Studies

Staff in the **Central Region** continued the development of an Oracle database, currently named "Sedna", for historical multi-species large-mesh and small mesh trawl survey data. Though these surveys originated as Tanner crab and shrimp surveys many groundfish species are captured and in fact compose most of the catches in recent years. They therefore, represent a valuable tool for monitoring groundfish population trends and collecting biological data. These database projects are error-checking, reformatting, and consolidating survey data for all years so they can be captured in a standardized database format to facilitate convenient access for analyses and timely reporting. All data are being additionally captured in a GIS for spatial analysis.

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.

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.

1. Dixon Entrance Area

Total removals (including those from test fishing) from the Dixon Entrance area (Alaska statistical areas 325431, 315431, 325401, and 315401) have dropped since last year due to a decline in sablefish removals from that area. The table below lists the catch by species group from 1988 through 2008 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	23	26	Tr	9	138	Tr	148
2006	43	32	1	12	167	1	181
2007	32	31	Tr	19	165	1	184
2008	28	32	1	16	101	Tr	118

2. 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, bryozoans 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.

3. User Pay/ Test Fish Programs

The state of 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 receipt authority is approximately 600k), notably the sablefish longline assessments and mark-recapture work, the king crab survey, the herring fishery and some salmon assessments.

4. GIS

The ADF&G Division of Commercial Fisheries Headquarters Office is using ArcGIS 9.2 for general map production, project planning and spatial analysis. Basemaps are maintained in ArcGIS format. Statistical area charts have been updated using ArcGIS 9.0 and the NAD83 datum. All data and map 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. Users in other divisional and area offices use ArcGIS 8, ArcView 3.x, and Mapinfo 9.0 for their GIS work.

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.php. (Contact Mike Plotnick)

5. 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 2008 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	139	97	closed	283	40	23	3	closed
2005	17	53	closed	249	52	23	2	closed
2006	8	65	closed	241	97	8	0	closed
2007	2	83	closed	200	115	2	0	closed
2008	26	80	closed	190	101	2	0	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. In 2008, catch and harvest were reported for each individual angler, along with their name and fishing license number (if required). Other data collected for each vessel trip included port of landing, statistical area fished, effort for salmon and bottomfish, and harvest and/or release (in numbers) of Chinook, coho, sockeye, pink, and chum salmon, pelagic rockfish, yelloweye rockfish, other rockfish, lingcod, and salmon sharks. The Sport Fish Division is conducting a three-year evaluation of logbook data, including comparisons to an independent end-of-season survey of anglers, to estimates from the statewide harvest survey, and to data from onsite interviews. This evaluation will be presented to the North Pacific Fishery Management Council in October 2009.

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Commercial Fishery Division Home Page: http://www.cf.adfg.state.ak.us/

News Releases: http://www.adfg.state.ak.us/news/dept_news.php

Sport Fish Division Home Page: http://www.sf.adfg.state.ak.us/statewide/sf_home.cfm

Sport Fish Division Southcentral Region Halibut and Groundfish Program:
http://www.sf.adfg.state.ak.us/region2/groundfish/gfhome.cfm

Age Determination Unit Home Page: http://tagotoweb.adfg.state.ak.us/ADU/default.asp

Region 1 Groundfish Home Page:
http://www.cf.adfg.state.ak.us/region1/finfish/grndfish/grndhom1.php

Region II Groundfish Home Page:
http://www.cf.adfg.state.ak.us/region2/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

Demersal shelf rockfish stock assessment document:
http://www.afsc.noaa.gov/REFM/docs/2008/GOAdsr.pdf

Adobe PDF versions of groundfish charts can be viewed or downloaded at
http://www.cf.adfg.state.ak.us/geninfo/statmaps/charts.php

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APPENDIX I.
ALASKA DEPARTMENT OF FISH AND GAME
PERMANENT FULL-TIME GROUNDFISH STAFF DURING 2008.

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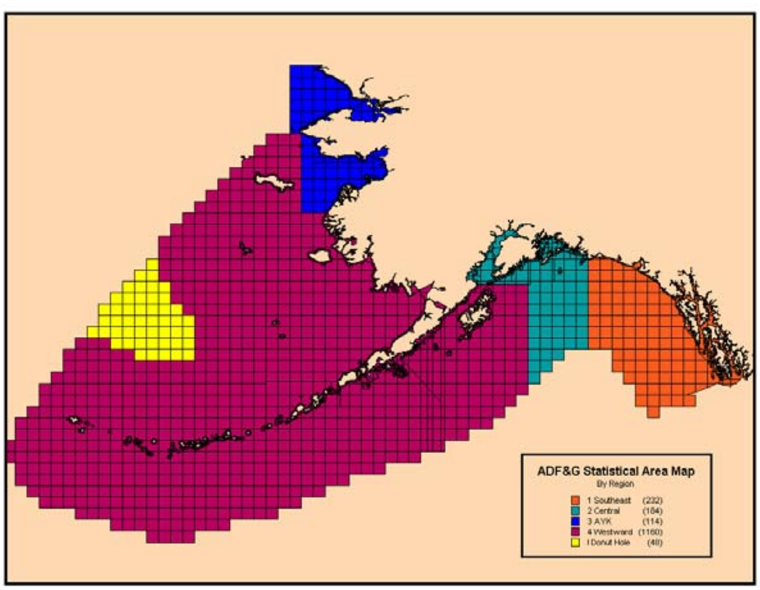
APPENDIX II.

Map Depicting State of Alaska Commercial Fishery Management Regions.



APPENDIX III.

Tissue samples of Sebastes species and pollock collected for genetic analyses and stored at Alaska Department Fish and Game, Gene Conservation Laboratory, Anchorage. Species, sampling location year collected, sample size, and tissue type are given.

Species	Location	Year	Sample size	Tissues
Yelloweye rockfish *Sebastes ruberrimus*				
	Gravina,Danger,Herring	1991	27	muscle, liver, eye
	Knight Is./Naked Islands area	1998	100	fin
	Whittier	2000	97	fin
		2000	50	fin
	Kachemak Bay	1999	58	fin
	Kodiak Island	1999	115	fin
	Resurrection Bay	1999	100	fin
	Fairweather Grounds	1999	100	fin
	Flamingo Inlet	1998	46	fin, larvae
	Tasu Sound	1998	50	fin
	Topknot	1998	49	fin
	Triangle Island	1998	63	fin, larvae
	Sitka	1998	49	fin
	SE Stat Areas 355601, 365701 (CSEO)	1999	100	fin
Black rockfish *S. melanops*				
	Carpa Island	1998	40	fin
	Castle Rock near Sand Point	1999	60	fin
	Akutan	1999	100	fin
	Dutch Harbor	2000	6	fin
	Chignik	2000	100	fin
	Ugak Bay, Kodiak Island	1997	100	muscle, liver, heart, eye
	Eastside Kodiak Is.: Ugak and Chiniak Bays	1998	100	fin
	Southwest side Kodiak Island	1998	86	fin
	Westside Kodiak Island	1998	114	fin
	Kodiak Island	1996	2	muscle, liver, heart, eye
	North of Fox Island	1998	24	fin
	Resurrection Bay - South tip Hive Island	1997	82	muscle, liver, heart, eye, fin
	Yakutat Bay	2003	130	fin
	Valdez	2000	13	fin
		2001	50	fin
	Whittier	2000	16	fin
		2001	93	fin

Species	Location	Year	Sample size	Tissues
	Oregon - Pacific Northwest	1999	50	muscle, liver, heart
	Washington - Pacific Northwest	1998	20	fin
	Sitka	1998	50	fin
	SE Stat Areas 355631, 365701 (CSEO)	1999	83	fin
	Sitka Sound Tagging study	1999	200	fin
Dusky rockfish *S. ciliatus*				
	Sitka	2000	23	liver, fin
		2000	23	fin
	Sitka Black RF Tagging study	1999	15	muscle, liver, heart, eye
	Harris Bay - Outer Kenai Peninsula	2002	37	muscle
	North Gulf Coast - Outer Kenai Peninsula	2003	45	fin
	Resurrection Bay	1998	3	fin
	Eastside Kodiak Is.: Ugak, Chiniak, Ocean Bays	1998	100	muscle, liver, heart, eye
	Kodiak Island	1997	50	muscle, liver, heart, eye
Walleye pollock *Theragra chalcogramma*				
	Exact location unknown; see comments	1997	402	fin
	Bogoslof Island	1997	120	muscle, liver, heart
		1998	100	muscle
		2000	100	muscle, liver, heart
	Eastern Bering Sea	1998	40	muscle, liver, heart
	Middleton Island	1997	100	fin
		1998	100	muscle, liver, heart
		2000	100	muscle, liver, heart
	NE Montague/E Stockdale	1997	100	fin
	Orca Bay, PWS	1997	100	fin
	Prince William Sound	2000	100	muscle, liver, heart
	Port Bainbridge	1997	100	fin
		1998	100	muscle, liver, heart
	PWS Montague	1999	300	heart
	Eastern PWS	1999	94	heart
	Resurrection Bay	1998	120	fin
	Kronotsky Bay, E. Coast Kamtchatka	1999	96	muscle, liver, heart, eye, fin
	Avacha Bay	1999	100	
	Shelikof Strait	1997	104	muscle,liver,heart,eye,fin
		1998	100	muscle,liver,heart
		2000	100	muscle,liver,heart

OREGON'S GROUNDFISH FISHERIES AND INVESTIGATIONS IN 2008

OREGON DEPARTMENT OF FISH AND WILDLIFE

2009 AGENCY REPORT
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A. AGENCY OVERVIEW - MARINE RESOURCES PROGRAM

MRP Program Manager	Dr. Caren Braby
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The Marine Resources Program (MRP) is within the Oregon Department of Fish and Wildlife (ODFW) and has jurisdiction over marine fish, wildlife, and habitat issues coast-wide. MRP is headquartered at Newport in the Hatfield Marine Science Center, with field stations at the coastal cities 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 60 permanent and more than 70 seasonal or temporary positions. The program budget is approximately $6.5 million yearly, with about 70% of funding from state sources (sport and commercial fishing licenses and fees, and state general fund) and 30% federal sources.

B. MULTISPECIES STUDIES

1. Sport Fisheries Project

Sampling of the ocean boat sport fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2008. Starting in November 2005 major ports were sampled year round. We continue to estimate catch during unsampled periods in minor ports. The estimates are based on the relationship of effort and catch in minor ports relative to major ports observed during summer-fall periods when all ports are sampled. Black rockfish remains the dominant species caught in the ocean boat fishery. Lingcod, several other rockfish species, cabezon and kelp 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.

The ORBS program continued species composition and biological sampling (length and weight) of groundfish species at Oregon coastal ports during 2008. As part of a related marine fish research project active since 2003, otoliths were gathered from several species of nearshore groundfish including rockfish, kelp greenling and cabezon, in addition to lingcod fin rays, for ageing studies. Staff also scanned Pacific halibut for PIT tags. Starting in 2001, from April through October, 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 2003, the harvest of several groundfish species was monitored inseason for catch limit tracking purposes. Inseason action was taken in 2008 to prohibit retention of cabezon. The shore fishery remained open. Depth restrictions were implemented to reduce the incidental catch of yelloweye rockfish. As in recent years the retention of canary rockfish and yelloweye rockfish was prohibited year round. Landings in the sport Pacific halibut fisheries were monitored weekly for tracking the status of catch limits. The majority of halibut continue to be landed in the central coast sub-area and Newport was the top port for landings. Other ODFW management activities included participation in the U.S. West Coast Recreational Fish International Network (RecFIN) process, data analysis, and public hearings to discuss changes to the management of Pacific halibut and groundfish fisheries for 2009 and 2010.

Informational kiosks were constructed in the ports of Newport and Brookings during 2007-08. The kiosks provide anglers with detailed and up to date information on marine fishing regulations and species identification, especially for prohibited species.

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 taken and surfperch made up the majority of shore-based catch by weight. Salmon dominate estuary boat landings by weight. Pacific herring historically have made up the majority of both shore-based and estuary boat landings by number of fish, but have not dominated catch in recent years.

Contact: Don Bodenmiller (541) 867-0300 ext. 223 (Don.G.Bodenmiller@state.or.us)

2. Developmental Fisheries Project

The Developmental Fisheries Program and Developmental Fisheries Board (Board) were created by the 1993 Oregon State Legislature (Legislature) with the responsibility of making recommendations to the Oregon Fish and Wildlife Commission (Commission) on developing fisheries. State policy gives the Commission the authority to institute a management system for developmental fishery resources that addresses both long term commercial and biological values and that protects the long term sustainability of those resources through planned commercial development when appropriate (ORS 506.455).

In 2007, the Oregon Department of Fish and Wildlife (ODFW) received authorization from the Legislature for a one-time funding distribution to evaluate the program and to fund specific research on one or more of the developmental fisheries. Staff has formed a diverse and productive Board to assist with the evaluation and in February 2008, with guidance from the Board, began to examine how the program and the Board operate, where to improve efficiencies, and how to manage the program on an extremely limited budget.

As initial steps of the evaluation, staff began review and assessment of the two main permitted developmental fisheries, the hagfish and spot prawn fisheries. At-sea observing and market sampling for these fisheries began in March, 2008 and will continue the duration of the evaluation, through June, 2009. These sampling efforts yield information on the landed catch and discard of hagfish and spot prawns, including length/weight, sex, and maturity data. Staff also began a short-term fishery independent research project in 2008 to augment information collected on the hagfish fishery. The goal of this research is to characterize the length selectivity of commercial gear, the length structure of the population, hagfish behavior around baited gear, and short-term discard survivability.

Additionally, during the annual review of the program in December, 2008 staff was able to greatly reduce the number of permitted fisheries within the program based on interest and effort in each permitted fishery. The number of permitted fisheries was reduced from 11 to five. Permitted fisheries for 2009 include: hagfish, spot prawn, box crab, anchovies, and swordfish. As of April, 2009 a total of 31 developmental fisheries permits have been issued including all 10 spot prawn permits, 16 hagfish permits, four anchovy permits, and one box crab permit.

Contact: Kelly Ames (541-867-4741) or (Kelly.L.Ames@state.or.us)

3. Commercial fisheries monitoring and sampling

Data from commercial goundfish landings are collected throughout the year and routinely analyzed by ODFW to provide current information on groundfish fisheries and the status of the stocks. This information is used in management, including inseason adjustments of the commercial nearshore fishery, which is conducted in state waters. Species composition sampling of rockfish and flatfish continued in 2009 for commercial trawl, fixed gear, and hook and line landings. Biological data including length, age, sex, and maturity status continued to be collected from landings of major commercial groundfish species.

Contact: Carla Sowell (Carla.Sowell@state.or.us)

4. Maturity studies

We continued research begun several years ago to produce histologically verified female maturity data for a variety of species for which maturity data is unavailable or outdated. This work continued in 2008, with a focus on nearshore rockfish, and poorly known slope rockfish species (aurora, redbanded). We completed our work on yelloweye and aurora rockfish and have begun work on a paper summarizing these results. Progress was also made on cabezon maturity. Results from cabezon and yelloweye rockfish work were made available to 2009 stock assessment authors. Additional sampling of Pacific ocean perch was also conducted to examine interannual variation in abortive maturation (skip spawning) as a function of maternal age.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

5. Testing a “motion sensing” acoustic tag

We deployed surgically implanted “motion sensing” acoustic tags in two cabezon, releasing back within passive receiver grids to determine the utility of this new tag technology in studying survival and movement of fish that are very strongly demersal. Interpretation of pressure data from acoustically tagged fish that are very strongly demersal is difficult; sometimes it’s hard to tell if the fish is alive because it shows so little vertical or spatial movement. If motion sensing tags can reliably indicate survival of acoustically tagged fish then spatial and vertical movement information can be interpreted with more confidence.

Contact: Bob Hannah, (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

6. Movement of rockfishes using acoustic telemetry

We completed field work on a study using acoustic telemetry to monitor the vertical and horizontal movement patterns of rockfishes captured by hook and line and released using recompression techniques at Siletz Reef. Data analysis is underway on this project.

Contact: Bob Hannah, (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

7. Discard mortality of rockfishes

We began work in 2008 to develop a "rockfish friendly" caging system for use in estimating short-term discard mortality of individual specimens on the open coast. The system is based on a double anchor system to eliminate cage movement and a smooth plastic "pickle barrel" for holding individual fish. The barrel is screened against carnivorous amphipods. In tests, this system seemed to have very minimal impact on rockfish health during confinement of up to 4 days. In 2009, 15 of these cages will be utilized to systematically estimate discard survival of black rockfish as a function of depth of capture and vertical temperature profile (thermocline). Some other species will be included in the study as encountered (yelloweye, canary, china).

Contact: Bob Hannah, (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

8. Effects of barotrauma on rockfish

We completed a study in 2008 in which we described the internal anatomical changes related to the external signs of barotrauma in rockfish. This work suggested that the external signs of barotrauma are typically due to the anterio-lateral escape of swimbladder gas as it follows a "path of least resistance" within the body of a rockfish. This research suggests particular internal injuries that likely result from barotrauma and how they differ between some rockfish species. This work was published in Aquatic Biology.

Contact: Bob Hannah, (bob.w.hannah@state.or.us), or Polly Rankin (polly.s.rankin@state.or.us)

9. Effects of barotrauma on rockfish physiology and survival in the laboratory

Alena Pribyl of Oregon State University is nearing completion of her dissertation research on the physiological effects of barotrauma in Pacific rockfish. In 2008, her work focused on data analysis and examination of gene expression in control fish and those with barotrauma.

Contact: Alena Pribyl (OSU) or Bob Hannah (bob.w.hannah@state.or.us)

10. Evaluating selective flatfish trawls

The selective flatfish trawl became required fishing gear for all U.S. groundfish vessels trawling shoreward of the Rockfish Conservation Area on January 1, 2005. Work in 2006 and 2007 with the selective flatfish trawl focused on using a DIDSON 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 work continued in 2008 with additional comparisons of fish behavior at night and during daylight hours, again using a DIDSON imaging sonar. This was a cooperative project with Waldo Wakefield of NMFS Northwest Fishery Science Center.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

11. Angling selectivity studies

We completed our study of how increasing the height of angled baits above the bottom using long leaders (3.0 and 4.6 m) inserted between the lowermost bait and the terminal weight (long leader gear) altered the species and size composition of the catch off the Oregon coast. A report describing these studies is now available. A larger scale industry-led EFP is planned for 2009 to apply the “long leader” approach to develop an alternative offshore recreational fishery targeting yellowtail rockfish.

Contact: Bob Hannah (bob.w.hannah@state.or.us) or Don Bodenmiller (Don.G.Bodenmiller@state.or.us)

12. Shrimp trawl impacts on mud seafloor macroinvertebrate populations

In 2008, we completed the write-up of our 2007 study using our ROV to examine impacts of shrimp trawls on macroinvertebrate populations in mud habitats typically trawled by ocean shrimp fishers. The primary focus of the study was to complete a baseline survey of the mud habitat areas in the vicinity of Nehalem Bank that have recently been closed to trawl gear, with the hope of monitoring changes over time as these areas recover from historical trawl impacts. A report summarizing this study will be available soon.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

13. Tests of grid orientation and effects of a “down panel” in shrimp Bycatch Reduction Devices (BRDs)

We conducted a brief field study in 2008 that examined two questions with regard to BRD performance in the pink shrimp fishery. First, we examined if the bar orientation (vertical or horizontal) in a rigid-grate BRD influenced exclusion performance. Testing was minimal but failed to show any difference in exclusion efficiency for fish from bar orientation but surprisingly, showed that orienting the bars horizontally increased shrimp loss. A second test examined whether or not a “down panel” (a panel of netting preceding a BRD that concentrates all of the catch at the bottom of the net and also creates a backward water jet) was a necessary part of an efficient BRD. Testing was minimal, but did not suggest an important role for down panels in BRD performance.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

14. Marine Finfish Ageing Unit

In 2008, our ageing unit worked on three primary tasks: production ageing of sport and commercial cabezon and kelp greenling samples, aging of otoliths from rockfishes collected as part of the maturity study and an age validation research project. The research project applied image analysis and dendrochronological techniques to indirectly validate the bands on aurora rockfish otoliths as “year marks”. The study also showed a strong positive correlation between interannual growth increments in aurora rockfish and the Norther Oscillation Index and a strong negative correlation with the Pacific Decadal Oscillation and a 1 year index of sea level. We hope to complete the write-up of this work in 2009.

Contact: Josie Thompson (541) 867-0300, ext. 292. (josie.e.thompson@state.or.us)

15. Hypoxia effects on seafloor communities

In 2008, personnel from ODFW’s Marine Habitat Project partnered with the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) to document the ecological effects of recently discovered hypoxia events on seafloor communities. We conducted two surveys of seafloor biota offshore of Cape Perpetua (south of Newport) with a Remotely Operated Vehicle (ROV) during June and August 2008. In concert with PISCO’s efforts to collect oceanographic data (e.g., temperature, salinity, dissolved oxygen content), which documented the spatial extent and degree of hypoxia in the study area over a seasonal time scale, we collected video footage of organisms occurring on the seafloor along a previously-established (i.e. “fixed”) transect line. Our objective was to collect ROV video data along the transect line before, during, and after hypoxia events. Hypoxic events did occur on the inner shelf in 2008, but the extent and duration of these events were not as extreme as in prior years (e.g., 2002 and 2006). We were able to document pre- and post-hypoxic conditions, and qualitative observations indicated that no significant die-offs of sessile or mobile species were detectable in 2008. We have monitored the Cape Perpetua transect regularly since 2002.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

16. Remotely Operated Vehicle survey of habitat and fish communities at Redfish Rocks

We surveyed benthic habitat and fish communities at Redfish Rocks Reef, an approximately 9 km2 area of high-relief rocky reef on Oregon’s south coast that has been proposed as a marine reserve. We coordinated our study with the Port Orford Ocean Resource Team (POORT), a community-based fishing interest group actively exploring innovative community-based fisheries management approaches. POORT secured funding for a multibeam bathymetry survey of the study area, which was largely completed in fall 2008.

We identified 9 taxa to species and 6 species groupings. Blue rockfish were the most abundant species observed (30%; n = 149), followed closely by black rockfish (28%; n = 138), and both species were primarily observed in bedrock and large boulder habitat. Canary rockfish were observed infrequently (n = 23), and most if not all of these fish appeared to be less than 36 cm in total length (determined by the presence of a black spot on the dorsal fin). Canary rockfish, also a schooling species, were observed in only a few locations, either as solitary individuals or in small groups, and on one occasion, a small school. They occurred primarily in large and small boulder habitat that fringed the core bedrock reef area of Redfish Rocks. Demersal rockfish such as China, Copper, Quillback, and Vermilion, were rarely observed (n = 4, 2, 4, and 1, respectively). These fish were observed primarily in bedrock and large boulder habitat. Kelp greenling were relatively abundant (n = 49), and individuals were more uniformly spaced than the other species observed. They occurred over every habitat type, though were most prevalent in bedrock and small boulder habitats. Lingcod were few in number but were observed using various habitats. These surveys build upon past work that our project has conducted at Redfish Rocks, which has included a sidescan sonar survey and diver surveys of habitat and the fish community. A report summarizing this study is now available.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

17. Resolving spatial scales of nearshore rocky reef groundfish-habitat relationships

To work towards our ultimate goal of habitat-based stock assessments for nearshore fish species, we conducted a study to further develop our understanding of fish-habitat affinities at Siletz Reef (offshore of Lincoln City in central Oregon). High-resolution multibeam bathymetry data exist for Siletz Reef, and we will quantitatively assess differences in fish densities relative to different multibeam-derived landscape measures at various spatial scales (e.g., seafloor slope, rugosity, Bathymetric Position Index). Most fieldwork is complete for this study and we are currently in the video processing stage. We plan to complete the analysis and written report for this work by June 30, 2009.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

18. Remotely Operated Vehicle survey of habitat and fish communities at Otter Rock

We surveyed benthic habitat and fish communities offshore of Otter Rock, a proposed marine reserve on Oregon’s central coast between Lincoln City and Newport. This survey was conducted in partnership with the United States Geological Service (USGS) and Oregon State University’s Seafloor Tectonics Laboratory. USGS conducted a multibeam bathymetry survey of the area during summer 2008, and we conducted ground-truthing of the remote sensing data with our ROV in addition to conducting surveys of seafloor biota. Most fieldwork is complete for this study and we are currently in the video processing stage. We plan to complete the analysis and written report for this work by July 30, 2009.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

19. Development of marine reserves in Oregon

The Oregon Ocean Policy Advisory Council (OPAC) has been working on a process to identify possible marine reserve sites in Oregon's Territorial Sea since 2007. OPAC has defined marine reserves as follows:

"A marine reserve is an area within Oregon's Territorial Sea or adjacent rocky intertidal area that is protected from all extractive activities, including the removal or disturbance of living and non-living marine resources, except as necessary for monitoring or research to evaluate reserve condition, effectiveness, or impact of stressors."

In March 2008, Governor Kulongoski of Oregon issued an Executive Order (EO-08-07) that placed ODFW as the lead agency working with OPAC to develop a list of recommended marine reserve sites for further evaluation. Key sideboards identified in the Executive Order included: limiting recommendations to nine or fewer sites; ensuring sites are ecologically meaningful without causing significant socio-economic hardship; and prioritizing sites developed collaboratively with coastal communities, ocean users and the public.

During the summer of 2008, community groups and citizens developed proposals for sites for further evaluation as potential marine reserves. Twenty proposals were submitted to OPAC for consideration. In November 2008, OPAC developed final recommendations to the Governor. OPAC recommended a total of six areas to move forward in the marine reserves process:

Four areas were recommended to move forward for further development and evaluation, with additional socioeconomic and ecological information to be gathered, as well as more extensive collaboration among ocean users (particularly fishing interests), coastal communities, and other interested parties.

Two additional areas were recommended for designation as pilot marine reserve sites beginning the summer of 2009, following appropriate rulemaking and baseline data collection. These areas were recommended for pilot marine reserve designation as they were considered to already have extensive community collaboration, sufficient existing biological and socioeconomic information, and broad community support.

Governor Kulongoski is supporting implementation of the OPAC recommendations. The Governor's Recommended Budget, which has been submitted to the 2009 Oregon State Legislature, includes funding for state agencies to implement the next phase of the Oregon marine reserves process. If funded, ODFW's work on the six areas moving forward will include the following elements, focusing primarily on gathering baseline information and additional collaboration with coastal communities and affected ocean users: a) habitat and biological resource surveys, b) economic and social surveys, c) coordination and support of local community ocean resource teams, and d) outreach support.

Contact: Cristen Don (Cristen.N.Don@state.or.us)

20. Port Orford pilot project

The Port Orford Ocean Resource Team (POORT) is a community-initiated and inclusive 501(c)(3) organization founded in 2001. The Team works to empower members of the Port Orford fishing fleet and other citizens to participate in bottom-up ocean management efforts, focusing on collaborative science, management, and stewardship.

In September 2008, POORT and ODFW entered into a Memorandum of Understanding to create a five year pilot project in the Port Orford area to focus on collaborative nearshore research, monitoring, and adaptive/experimental management. The Pilot Project is intended to:

Implement collaborative research and monitoring projects that can help inform nearshore resource management on local and/or broad scales

Provide for local involvement in and input on nearshore research, monitoring, and management efforts

Provide an opportunity for testing, on a small-scale, experimental management that may be better responsive to the scales of populations of organisms and/or coastal communities, their fisheries, and their social and economic structures and dynamics.

Current efforts of the Pilot Project are focused on POORT and ODFW jointly identifying several priority projects to be implemented first.

Contact: Cristen Don (Cristen.N.Don@state.or.us)

C. BY SPECIES

1. Black rockfish PIT tagging

Oregon's primary recreational groundfish fishery targets the nearshore species, black rockfish. Historically, assessments of black rockfish have relied on CPUE data from recreational fisheries to estimate the trend of relative population abundance. However, these data are not robust to problems of sampling bias, or to changes in fishing distribution, bag limits, or fishing power. The need to independently estimate exploitation rates and population abundances 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. 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 released at depth. In 2008, 4100 black rockfish were marked with PIT tags (12mm x 2mm) during 17 days of fishing near Newport, Oregon, bringing the total number tagged to 21,703 since the project began in 2002. Carcasses of black rockfish are counted and electronically scanned for tags year-round upon being landed by recreational fishers. In 2008, 78% of the black rockfish landed in Newport and 39% of those landed in Depoe Bay were scanned for tags. We recovered 341 tags in Newport and 1 tag in Depoe Bay. All seven tag cohort years were recovered. We have had good recoveries each year and exploitation rates are within expected assessment values of approximately 5%. However, survival rate estimates remain poor and imprecise, likely due to problems with non-mixing. If catch rates allow, the number of fish tagged in 2009 will be maintained at approximately 4,000 (a significant increase from our previous goal of tagging 3,000 fish annually) in an effort to increase tag recoveries and decrease variation in parameter estimates. Black rockfish populations off Oregon and California underwent a full assessment in 2007. Results from this study were included in the 2007 assessment as an index of abundance for the assessed population and may be incorporated in future assessments.

Contact: Greg Krutzikowsky (Greg.Krutzikowsky@state.or.us) or David Wolfe Wagman (David.W.Wagman@state.or.us)

2. Pacific hake

In 2008, the responsibility for monitoring catches and bycatch in the shoreside Pacific hake (Merluccius productus) fishery transitioned from ODFW to NMFS's Northwest Region. The Shoreside Hake Observation Program (SHOP) was established in 1992 to provide information for evaluating bycatch in the directed shorebased fishery, and for evaluating conservation measures adopted to limit the catch of salmon, other groundfish and prohibited species. This program was operated by ODFW at the Marine Resources Program headquarters in Newport with funding from industry. The fishery was allowed to exceed federal trip limits and retain all catch through use of a federal Exempted Fishing Permit (EFP). The Pacific Fishery Management Council adopted final recommendations for developing regulations and a monitoring program for the shoreside hake fishery in June, 2007. These recommendations have not yet been implemented by NMFS, and the fishery is expected to operate under an EFP in 2009.

Contact: Kelly Ames (Kelly.L.Ames@state.or.us)

3. Investigation of survey methods for yelloweye rockfish in rocky habitat

In 2008, we investigated the utility of the annual survey of the International Pacific Halibut Commission (IPHC) as a platform for surveying rockfish populations, in particular yelloweye rockfish, in rocky habitat not typically accessible to bottom trawl surveys. Rocky habitat was defined by Essential Fish Habitat (EFH) designation of rocky areas. We provided funding for the IPHC survey vessel to sample 20 additional survey stations focusing on offshore rocky habitat in conjunction with their standard survey. The experiment was divided into two parts; a paired station experiment using 5 survey stations to investigate the possibility of localized depletion of sedentary yelloweye rockfish at fixed survey stations, and 15 stations used to evaluate the utility of a random stratified survey design for developing an index of abundance for yelloweye rockfish. The longline gear used was identical to IPHC survey gear except that only 3 skates were set at ODFW stations while 5 skates are used in the standard survey. While average yelloweye rockfish catch per unit effort (CPUE, number of yelloweye rockfish per skate of longline gear) was slightly higher for ODFW paired stations than for the standard stations they were paired with, the results were not statistically significant and we do not view this as strong evidence of localized depletion. However, the average length of yelloweye rockfish was approximately 4 cm greater at both ODFW station types compared to standard stations ($p<0.05$). In the random stratified survey, 138 yelloweye rockfish were captured at 9 of the 15 stations. Average yelloweye rockfish CPUE was greater for random stations placed in rocky habitat (3.067) than for the standard survey (0.43), but no yelloweye rockfish were captured at the four random stations off the south coast while 8 yelloweye rockfish were captured at standard survey stations in the same geographic area. This could indicate errors in the designation of rocky habitat off the south coast or simply a lower abundance of yelloweye rockfish in this area. We were unable to secure funding to continue this work in 2009, but will re-evaluate the usefulness and design of our survey in light of the yelloweye rockfish assessment scheduled for fall 2009. Continuation of this project is under consideration for 2010.

Contact: Troy Buell (troy.v.buell@state.or.us)

D. PUBLICATIONS

Brill, R., C. Magel, M. W. Davis, R. W. Hannah and P. S. Rankin. 2008. Effects of rapid decompression and exposure to bright light on visual function in black rockfish (Sebastes melanops) and Pacific halibut (Hippoglossus stenolepis). Fishery Bulletin 106:427-437.

Chan, F., J. Barth, J. Lubchenco, A. Kirincich, H. Weeks, W. Peterson, B. Menge. 2008. Emergence of anoxia in the California Current Large Marine Ecosystem. Science. V. 319.

Donnellan, M., A. Merems, W. Miller. 2008. Developing fish monitoring methods on southern Oregon's reefs. Final report to the Department of Land Conservation and Development in fulfillment of 2006-07 Coastal Zone Management Section 309 Grant, Cooperative Agreement PS06005.

Hannah, R. W., P. S. Rankin, A. N. Penny and S. J. Parker. 2008. Physical model of the development of external signs of barotrauma in Pacific rockfish. Aquatic Biology 3:291-296.

Hannah, R. W., T. V. Buell and M. T. O. Blume. 2008. Reducing bycatch inOregon's recreational groundfish fishery: experimental results with angling gear configured to increase bait height above bottom. Oregon Dept. Fish Wildl., Information Rept. Ser., Fish. No. 2008-03. 26p.

Hannah, R. W., S. J. Parker and K. M. Matteson. 2008. Escaping the surface: the effect of capture depth on submergence success of surface-released Pacific rockfish. N. Amer. J. of Fish. Mgt. 28:694-700.

E. PROJECTS PLANNED FOR YEAR 2009:

1. Barotrauma and movement in rockfishes

We plan to continue the telemetry work and cage survival work described above with black rockfish and other species. We also hope to work on acoustic telemetry of demersal fishes at Cape Perpetua in 2009 to investigate hypoxia-driven movments.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

2. Testing a video lander on nearshore reefs

We plan to do some small-scale tests of a video lander to determine if such a device has any potential for surveying demersal fishes on nearshore rocky reefs off Oregon.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

3. Testing rigid-grate BRDs with ¾ inch spacing

We plan to test rigid-grate BRDs with reduced bar spacing to see if these might help reduce fishery impacts on smelt.

Contact: Bob Hannah (bob.w.hannah@state.or.us)

4. Remotely Operated Vehicle (ROV) survey of habitat and fish communities at Orford Reef and Redfish Rocks

We plan to survey benthic habitat and fish communities at Orford Reef and Redfish Rocks Reef on Oregon's south coast. Orford Reef is a very important area for Oregon's state managed commercial groundfish fisheries and Redfish Rocks has been proposed as a state marine reserve. We have conducted ROV surveys in these areas previously, but for various reasons we have not yet been able to complete an exhaustive study of these reefs.

Contact Mike Donnellan (Michael.D.Donnellan@state.or.us)

5. Kelp canopy distribution and biomass survey of Oregon's kelp beds

We plan to conduct a state-wide survey of canopy-forming kelp resources in Oregon during the seasonal peak in canopy abundance in fall 2009. This survey will involve high-resolution near-infrared aerial photography and vessel-based biomass sample collections. Kelp forests are highly productive and ecologically important habitats in Oregon's nearshore environment, and we plan to assess the extent to which the canopy distribution and biomass have changed since the last state-wide aerial survey in 1990 and targeted surveys of south coast reefs in 1996-1999.

Contact Mike Donnellan (Michael.D.Donnellan@state.or.us)

6. Hypoxia effects on seafloor communities

We plan to continue collaboration with the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) to document the ecological effects (e.g., community recovery) of recently discovered hypoxia events on seafloor communities. We plan to conduct 1-2 surveys of seafloor biota offshore of Cape Perpetua (south of Newport) with a Remotely Operated Vehicle (ROV) between June and August 2009.

Contact: Mike Donnellan (Michael.D.Donnellan@state.or.us)

7. Hagfish behavior and commercial gear selectivity

In 2009, staff plans to complete a short-term fishery independent research project to augment information collected on the hagfish fishery. The goal of this research is to investigate hagfish characteristics that would assist with the management of the fishery including characterization of the length selectivity of commercial gear and the length structure of the population, hagfish behavior around baited gear, and short-term discard survivability. Staff is currently finalizing the gear building phase of the research project and plans for the completion of the at-sea portion of the project in mid-May, 2009.

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Washington Contribution to the 2009 Meeting of the Technical Sub-Committee (TSC) of the Canada-US Groundfish Committee

May 5th – 6th, 2009

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Washington Department of Fish and Wildlife

May 2009

Review of WDFW Groundfish Research, Assessment, and Management Activities in 2008

A. Puget Sound Area Activities

1. Puget Sound Groundfish Monitoring, Research, and Assessment

(Contact: Wayne Palsson 425-379-2313, Wayne.Palsson@dfw.wa.gov)

Marine Fish Science Unit Staff of the Puget Sound Marine Fish Science (MFS) Unit includes Wayne Palsson, Robert Pacunski, Tony Parra, and Jim Beam. In addition, Courtney Adkins and Pete Sergeef work as MFS employees during the spring 2008 bottom trawl survey. Unit 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 newly formed Puget Sound Partnership. The main activities of the unit include the assessment of bottomfish populations in Puget Sound, the evaluation of bottomfish in marine reserves, and the development of conservation plans for species of interest. Groundfish in Puget Sound are managed under the auspices of the Puget Sound groundfish Management Plan (Palsson, et al. 1998).

a. Rockfish Conservation Plan

Twenty-seven species of rockfishes occur in the inland marine waters of Washington, here defined as Puget Sound. The Washington Department of Fish and Wildlife manages these species and the various commercial and recreational non-tribal fisheries that have either targeted rockfishes or have caught them incidentally to other targeted species. Rockfishes and other groundfish are managed for non-tribal users under the auspices of the Puget Sound Groundfish Management Plan and are co-managed with the Treaty Tribes of Washington. We have been developing a technical review on the Biology and Status of Rockfishes in Puget Sound that will serve as a source document for the development of a Conservation Plan for Rockfishes in Puget Sound. We summarized current knowledge of Puget Sound rockfish biology (life history, habitat usage, and ecosystem linkage) and provide an overview of their exploitation history and population status through 2007.

Because the data sources are poor, we used an adaptation of the American Fisheries Society's Criteria for Marine Fish Stocks at Risk (Musick 1999, Musick et al. 2000) and available indices from fisheries dependent and independent surveys. Because of a lack of complete catch and demographic information, formal stock assessments with retrospective and predictive models could not be conducted. The status of rockfish populations in Puget Sound were evaluated in terms of their vulnerability to extinction and, and where appropriate, populations will be evaluated for their fishery potential and biological reference points. To achieve this, information on fishery landings trends, species composition trends, and yield per recruit for nine rockfish species from Puget Sound were evaluated for long-term trends. The majority of rockfish stocks or populations in Puget Sound were in the Precautionary condition, but several species once important to recreational fisheries in Vulnerable or Depleted status. The patterns of stocks status were generally similar between the two regions for the 17 species of rockfish examined. Seven (19%) of the 32 populations present in either North or South Sound were in Healthy status. Eighteen populations (56%) were in Precautionary status, while two populations (6%) were in Vulnerable status, and five populations (16%) were in Depleted status. Many of the Precautionary ratings reflected a lack of information regarding the population.

Stock condition is related to the frequency of that species in the recreational catch with more common species being in poor condition and smaller and deeper species, which are seldom caught, being in the healthiest conditions. Copper and quillback rockfishes have been the two most important species in the recreational fishery and have three of four stocks in Vulnerable or Depleted condition. Yelloweye and canary rockfishes, once infrequently fished in Puget Sound, are in Depleted condition. Six species in North Sound and seven species in South Sound are in Precautionary status. These species, such as black, yellowtail, splitnose, and bocaccio, have been secondary species of importance in recreational and commercial fisheries. Black rockfish in the western portion of the Strait of Juan de Fuca, were an exception to the overall Precautionary status, perhaps because this area is likely benefiting from the spillover of black rockfish from coastal areas. Populations of brown rockfish in South Sound are another exception: This population is Healthy but generally not present in the recreational catches. Other Healthy status populations include the deepwater redstripe rockfish, greenstriped rockfish, Puget Sound rockfish in South Sound, and shortspine thornyhead, all species that appear to be uncommon or rare in inspected catches. Many species in Precautionary status are classified in this condition because of a lack of any stock evaluation information. These species are often rare in catches or in surveys and include tiger, China, blue, brown, and splitnose rockfishes in North Sound and tiger rockfish in South Sound. Several species are generally not detected in South Sound, including China and blue rockfishes in South Sound. Vermilion rockfish appear to be invading Puget Sound from coastal waters, but their status is Precautionary until more assessment information is obtained.

b. ESA Petition for Five Deep-water Rockfishes

In 2007, NOAA Fisheries received a petition to list yelloweye, canary, bocaccio, redstripe, and greenstriped rockfishes under the Endangered Species Act. NOAA accepted this petition and formed a Biological Review Team to evaluate distinct population segments and the risks of extinction. MSU staff provided technical consultations and data to the team. A listing decision is expected in spring 2009.

c. ROV Studies

In 2007, the Washington Department of Fish and Wildlife (WDFW) partnered with the Washington Department of Natural Resources (WDNR) to purchase a Seaeye Falcon remotely operated vehicle (ROV). Robert Pacunski serves as the chief pilot for the ROV, and Lisa Hillier (Shellfish Unit) serves as the WDFW point-of-contact and backup pilot for the vehicle. In 2008 the ROV was used to conduct several studies in support of Puget Sound and Coastal MFS projects.

Investigation of seafloor mounds in Hood Canal

In September 2008, Robert Pacunski, Jim Beam and Lisa Hillier participated in a joint investigation with WDNR geologists to investigate the composition of two recently identified seafloor mounds in southern Hood Canal. Three transects were conducted with the ROV: one on each mound, and one along a rocky wall near DeWatto. The video data collected during the operation confirmed that the mounds were neither drumlins (hills of glacial drift) nor natural gas seeps as had been previously hypothesized. Instead, WDNR geologists concluded that the mounds are likely landslide deposits, based on the color, texture and coarseness of the associated substrates. While not directly intended as a fish survey, valuable video data was collected on greenstriped and splitnose rockfish that were found inhabiting one of the mounds. Because these fish were observed in an area that cannot be easily surveyed by traditional assessment methods (i.e., trawls), valuable insight was gained into the distribution and habitat use of these species in Hood Canal, which will be used to plan future assessment surveys using the ROV. Results of this investigation were presented in a poster at the 81st Annual Meeting of the Northwest Scientific Association.

San Juan Archipelago ROV survey

From 29 September to 26 November 2008, the MFS staff conducted an ROV survey of the rocky habitats within the San Juan Archipelago (SJA). The survey was designed using available high-resolution (1-5 m2) geomorphic habitat maps developed by Dr. Gary Greene and his graduate students at the UCSB Moss Landing Marine Laboratories. These maps and some previous survey results provided a sampling frame of rocky habitats in the San Juan Islands. The survey area was stratified by depth along the 20-fathom contour to allow for comparisons to earlier drop-camera surveys of the region. A total of 207 transects were completed, ranging in depth from the surface to 250 m (820 ft), with an average length of 320 m. The most common species observed were kelp greenling, copper rockfish, quillback rockfish, Puget Sound rockfish, lingcod, and juvenile gadids. Other species observed with the ROV were yelloweye rockfish, greenstriped rockfish, tiger rockfish, black rockfish, yellowtail rockfish, and brown rockfish. Approximately 50 hours of videotape were collected during the survey. Review and analysis of the videotapes is expected to begin in early April 2009. Results of the SJA survey will be used to estimate the population abundance of the most common species and to improve the habitat characterization techniques used by the geologists.

Recent Publications:

Pacunski, R.E., W.A. Palsson, H.G. Greene, and D.R. Gunderson. 2008. Conducting visual surveys with a small ROV in shallow water. Pages 109-128 in Marine Habitat Mapping Technology for Alaska, J.R. Reynolds and H.G. Greene, eds. Alaska Sea Grant Program, AK-SG-08-03. 282 p.

d. Continued investigation of the 2006 Recruitment Event of Young-of-the-Year Rockfishes in Puget Sound and the Strait of Juan de Fuca

During 2008, MFS staff reoccupied dive sites surveyed in 2006 that documented a remarkable settlement of post-larval, young-of-the-year (YOY) rockfishes in the inland waters of Washington. As in 2007, divers observed very few YOY rockfish at the eighteen index sites in Central and Southern Puget Sound in 2008. Large numbers of now 2+ year-old copper and quillback rockfish were observed on adult habitats adjacent to several of the nearshore YOY sites. Also in 2008, MFS staff observed what appears to be an immigration of 2+ year- old black rockfish to several dive sites in Puget Sound and the San Juan Islands. MFS staff hypothesize that these fish are emigrating from waters along the Washington coast and western Strait of Juan de Fuca where large numbers of juvenile pelagic rockfishes were observed during the 2006 recruitment event. Divers also documented a recruitment of copper and quillback rockfishes in 2008 in Hood Canal where few have been observed during the past nine years of surveys.

e. 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. 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, and these low concentrations have been attributed to naturally poor circulation resulting from low estuarine flow and bottom water replacement. Between 2002 and 2006, low DO concentrations have become chronic, extending into nearshore waters and possibly becoming worse due to eutrophication. Mass mortality events of fishes and invertebrates (Fish Kills) in 1926 and 1963 likely have resulted from poor water quality in this fjord naturally prone to hypoxia. Marine Fish Science staff has been conducting regular surveys at the Sund Rock Marine Reserve Site since 2001, with additional surveys conducted when extreme hypoxic conditions arise. Monitoring at this site by MFS staff continued in 2008 to detect potential impacts to fish populations inhabiting the local area. Similar to 2007, no extreme hypoxic events or fish kills were reported, thus 2008 can be classified as a low-impact year. MFS staff continued their participation in the Hood Canal Dissolved Oxygen Program as partners and scientists.

Recent Publications:

Palsson, W.A., R.E. Pacunski, T.R. Parra, and J. Beam. 2008. The effects of hypoxia on marine fish populations in southern Hood Canal, Washington. Pages 255-280 in Mitigating Natural Disasters in Fisheries Ecosystems, K.D. McLaughlin, ed. American Fisheries Society, Symposium 64, Bethesda, Maryland. 446 p.

f. Bottom Trawl Surveys of Puget Sound

Since 1987, WDFW has conducted bottom trawl surveys in Puget Sound that have proven invaluable as a fisheries-independent indicator of population abundance for fishes living on unconsolidated habitats. These surveys have been conducted at irregular intervals and at different scales since 1987. Early surveys between 1987 and 1991 were synoptic surveys of the entire Puget Sound, later were stratified, random surveys focusing on individual sub-basins, and beginning in 2008 became synoptic again with stations at fixed sites.

From 12 May through 13th June 2008, WDFW conducted a bottom trawl survey to assess the abundance of groundfishes in the inland marine waters of Washington (Puget Sound). The survey area was divided into Puget Sound's oceanographic basins including the Eastern and Western Strait of Juan de Fuca, San Juan Archipelago, Strait of Georgia, Whidbey Basin, Central Puget Sound, Southern Puget Sound, and Hood Canal. The goal of the survey was to detect long-term changes in abundance of fishes living on or near the bottom and to characterize the structure of the fish communities. The specific objectives of this survey were to estimate the relative abundance, species composition, and biological characteristics of groundfish species at pre-selected, permanent index stations. Key species of interest include Pacific cod, walleye pollock, Pacific whiting, English sole, spiny dogfish, and skates, but all species of fishes and invertebrates will be identified and recorded.

The survey design was different from previous departmental surveys and focused on permanent index stations in all basins and Puget Sound Partnership Action Areas. This new design will be used in the future to assess changes in the relative abundance of key groundfish species because reoccupying fixed stations will minimize the variation in sea floor and habitat and provide more powerful inter-annual comparisons. Previous designs targeted sampling several basins per year, rotating basins among years, and selecting stations at random within depth zones. This previous design was best used to estimate the total biomass of fish within a region. For the new survey design, we divided each oceanographic basin into two geographic components (north and south or east and west) for representative coverage. We selected previously trawled stations within each component area from pre-existing depth zones such that one station would be occupied between depths of 30 to 240 feet, from 240 to 360 feet, and greater than 360 feet. Two replicate trawl samples were collected at each stations and were spaced several hundred meters apart to be close to each other but not directly over the first trawl location. Because the logistics and scheduling were unknown, we planned to occupy between 32 and 51 index stations among eight oceanographic basins, two geographic component areas, and three depth zones (8 x 2 x 3). An additional set of three stations was planned for the central portion of Central Puget Sound to better represent this elongate basin.

While WDWF adopted a new survey design, the trawling procedure of the survey was similar to previous WDFW trawl surveys (Palsson et al. 2002, 2003). The 58-foot F.V. Chasina was the chartered sampling vessel, and it was equipped with an agency-owned 400-mesh Eastern bottom trawl fitted with a 1.25 inch codend liner. The net was towed at each station for a distance of 0.40 nautical miles at a speed of 1-3 knots, and the tows lasted approximately 12 minutes. Net openings ranged from 8 to 14 m depending upon depth and the amount of cable towing the net. The resulting catch was identified to species, weighed and enumerated, and most of the catch was returned to the sea. The density of fish at each station was determined by dividing the catch numbers or weight by the area sampled by the net. Some of the catch was taken for biological samples that were sampled on deck or preserved laboratory analysis.

During the 20 survey days, we occupied 46 stations and conducted 92 bottom trawls (Figure 1). Due to equipment problems, we only occupied three stations in the Whidbey Basin, and timing only allowed us to occupy one of the three central stations in Central Puget Sound.

We captured a total of 28,458 kg (63,000 lbs) of fish and invertebrates representing 200 species of fish and invertebrates. There were 92 recorded fish species that amassed 18,100 kg (40,000 lbs). Of the fishes, spotted ratfish accounted for 63% of the sampled weight, flatfishes 19%, and dogfish 6.5%. Two trawl samples on the last day of the cruise totaled 4,508 kg of ratfish and 559 kg of dogfish and together accounted for 28% of the entire catch of the survey. Dogfish were otherwise not very common. Dungeness crab comprised 34% of the sampled invertebrate catch with sea anemones comprising 15% of the invertebrate catch. We also collected information on marine debris collected by the trawl.

Among the biological data collected during the course of the survey, 11,484 fish were measured representing 41 species. Ageing structures and fin clips were taken from over 600 specimens including 252 Pacific hake, 200 rockfishes, 97 starry flounder, 14 lingcod, and 28 walleye pollock. Data were entered into computers in the field and error checked in the laboratory.

The survey offered the opportunity for collaborative science and participation from co-managers. We collected fin clips for genetic analysis from Pacific sanddab for a California researcher examining the population structure of that species along the west coast. We collected fish samples for several contaminant studies for harbor porpoises and seals. Voucher specimens of fishes were collected and sent to the University of Washington Fish Collection including a rare record of Pacific viperfish from the Strait of Juan de Fuca. We hosted a groundfish biologist and tribal fisher from the Makah Nation during one afternoon.

g. Marine Reserve Monitoring: Evaluation of No-Take Refuges for Rocky Habitat Fishes

WDFW has developed a system of 24 fully and partially protected marine reserves in Puget Sound, fourteen of which are significant for groundfish resources. As the system has expanded, MFS staff regularly monitors a core of the marine reserve sites on a frequent basis and visit other subtidal reserves on a periodic basis. This monitoring effort builds upon field research at many of these sites that was begun as early as 1986. The fieldwork consists primarily of scuba divers using standardized techniques to conduct visual censuses along a fixed strip transect at central Puget Sound sites or of the site "footprint" at south Puget Sound sites. Along with estimating fish density, divers measure individual fish, and in the case of lingcod, quantify nesting activity. Specific monitoring activities in 2008 included surveying a number of the Puget Sound reserves and comparable fished sites. Several reserves in central Puget Sound were visited six times during 2008 as an extension of a study initiated in 1995 that takes advantage of previous information collected at Orchard Rocks. Prior to 1998 when Orchard Rocks was declared a fully protected reserve, MFS staff conducted monitoring in 1986, 1987, and from 1995-1997. With the addition of a new fished-site treatment located 1 nm across the channel at Point Glover, the newly created Orchard Rocks refuge in a formerly monitored fished area provided MFS staff with an excellent opportunity to evaluate the before and after impacts of refuge creation with a comparable fished-site treatment. Monitoring at Zee's Reef and Colvos Passage that began in 2002 continued with six surveys conducted in 2008. Several of the sites showed a marked increase in the number of 2+ year-old copper and quillback rockfish at most sites, although brown rockfish continue to be the dominant species at most of the central Puget Sound sites, whereas a more even distribution of the three species was seen at the southern sites.

MFS staff also conducted scuba surveys at established sites in San Juan channel to examine the nesting success of lingcod in marine reserve and fished areas. An analysis of the data collected in 2008 and in the past several years shows that lingcod at the marine reserve sites continue to be larger, more abundant, and have higher nest densities than fish at non-reserve (i.e., fished) sites.

h. Other Activities

Wayne Palsson attended a workshop sponsored by the California Department of Fish and Game that focused managing fisheries in data poor environments. Wayne Palsson presented a talk on groundfish and habitat at the NOAA Northwest Center in Seattle. MFS staff continues to work with NOAA personnel regarding the issue of lingcod culture in Puget Sound. Wayne Palsson was actively involved with the evolving Puget Sound Partnership, working closely with scientists from NOAA and other State agencies to prioritize Partnership activities and establish baselines for conducting ecosystem risk assessments. Palsson also continued his groups association with the Puget Sound Assessment and Monitoring Program (PSAMP).

Robert Pacunski participated in a "Live Dive" webcast to area agencies, schools and universities as part of a WDFW Outreach and Education project. Robert Pacunski identified 39 illegally caught rockfish and wrote a Biological Opinion for WDFW Fish and Wildlife Officer Eric Olson, resulting in the conviction and revocation of fishing rights of three fishermen and a $1500 fine. In response to a request by WDFW Enforcement Sgt. Rich Phillips, MFS staff provided Marine Detachment officers with maps showing many popular lingcod fishing sites in Puget Sound, resulting in a number of citations being issued before, during, and after the lingcod season.

Tony Parra completed his analysis and a draft report on mitigation activities associated with building the Second Tacoma Narrows Bridge.

Puget Sound Herring Stock Assessment (Contact: Kurt Stick (360) 466-4345 ext. 243; Kurt.Stick@dfw.wa.gov)

Annual herring spawning biomass is estimated in Washington using spawn deposition and acoustic-trawl surveys. WDFW Region 4 staff based in the Mill Creek and La Conner offices currently conduct these assessment surveys of all adult herring populations in Washington's inside waters annually. Stock assessment activities for the 2009 spawning season are in progress.

In general, the abundance of south and central Puget Sound herring stocks in recent years is comparable to the 1970's and 1980's, while the Cherry Point stock, and cumulative north Puget Sound (excluding the Cherry Point stock) and Strait of Juan de Fuca regional spawning biomasses are at low levels of abundance.

Several genetic studies published since 2001 have demonstrated that some Puget Sound herring populations, particularly the Cherry Point stock, are genetically distinct from other Puget Sound and British Columbia sampled populations. However, a lack of differentiation has been demonstrated between other sampled Puget Sound spawning aggregations.

The herring spawning biomass estimate for all Puget Sound stocks combined in 2008 is 11,038 tons (see table and figure below). The cumulative total is a slight decrease from the 2008 total of 12,274 tons, considerably lower than the recent peak of 17,765 tons in 2006, and less than the mean cumulative total for 1998-2007 of 14,217 tons. The combined biomass of south/central Puget Sound (including Hood Canal) stocks in 2008 was comparable to 2007; a decrease from 2006, reflecting the total Puget Sound trend.

Cumulative biomass of North Puget Sound stocks is currently at a low level of abundance. The Cherry Point stock's spawning biomass decreased in 2008 to 1,352 tons, which was the lowest observed spawning biomass for this stock since 2002. The Cherry Point stock ranged from 3,100 to nearly 15,000 tons between 1973 and 1995.

Herring spawning activity for the Strait of Juan de Fuca region was low in 2008, with an estimated total of 317 tons. This followed a relatively high estimate for the Discovery Bay stock in 2006 of 1,325 tons and only 42 tons in 2007.

No surveys were completed in 2008 for coastal herring spawning grounds in Grays Harbor or Willapa Bay. In general, herring spawning biomass for these areas is considered to be relatively small compared to Puget Sound.

HERRING SPAWNING BIOMASS ESTIMATES (SHORT TONS) BY STOCK AND REGION, 1999-2008.
(blanks indicate no surveys done that year)

	YEAR									
	2008	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**
Squaxin Pass	1025	557	755	436	828	2201	3150	1597	371	474
Wollochet Bay	45	35	27	67	52	152	106	133	142	
Quartermaster Harbor	491	441	987	756	727	930	416	1320	743	1257
Port Orchard-Port Madison	1186	1589	2112	1958	700	1085	878	2007	1756	2006
South Hood Canal	223	70	244	210	176	207	166	187	140	516
Quilcene Bay	2531	2372	2530	1125	2342	916	2585	2091	2426	2464
Port Gamble	208	826	774	1372	1257	1064	1812	1779	2459	1664
Kilisut Harbor	0	24	54	170	184	448	774	612	107	802
Port Susan	345	643	321	157	429	450	775	587	785	545
Holmes Harbor	686	572	1297	498	673	678	573	275	281	175
Skagit Bay	1342	1236	2826	1169	1245	2983	2215	2170	646	905
South-Central Puget Sound Total	8082	8365	11927	7918	8613	11114	13450	12758	9856	10808
Fidalgo Bay	156	159	323	231	339	569	865	944	737	1005
Samish/Portage Bay	409	348	412	218	351	299	496	470	196	555
Int. San Juan Is.	60	33	285	41	67	72	158	219	128	197
N.W. San Juan Is.	0	0	0	0	0	13	131	62	90	
Semiahmoo Bay	662	1124	1277	870	629	1087	1012	1098	926	868
Cherry Point	1352	2169	2216	2010	1734	1611	1330	1241	808	1266
North Puget Sound Total	2639	3833	4513	3370	3120	3651	3992	4034	2885	3891
Discovery Bay	248	42	1325	33	252	207	148	137	159	307
Dungeness/Sequim Bay	69	34	0	0	22	44	131	93	138	352
Strait of Juan de Fuca Total	317	76	1325	33	274	251	279	230	297	659
Puget Sound Total	11038	12274	17765	11321	12007	15016	17721	17022	13038	15358

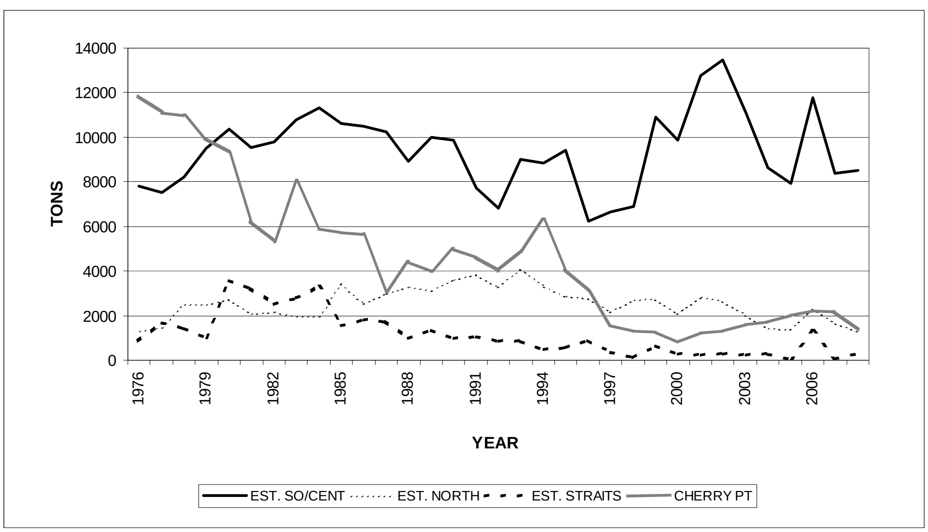

Figure 2. Puget Sound Herring Cumulative Spawning Biomass Estimates by Region and Cherry Point stock, 1976-2008 (historical mean assumed if stock not sampled).

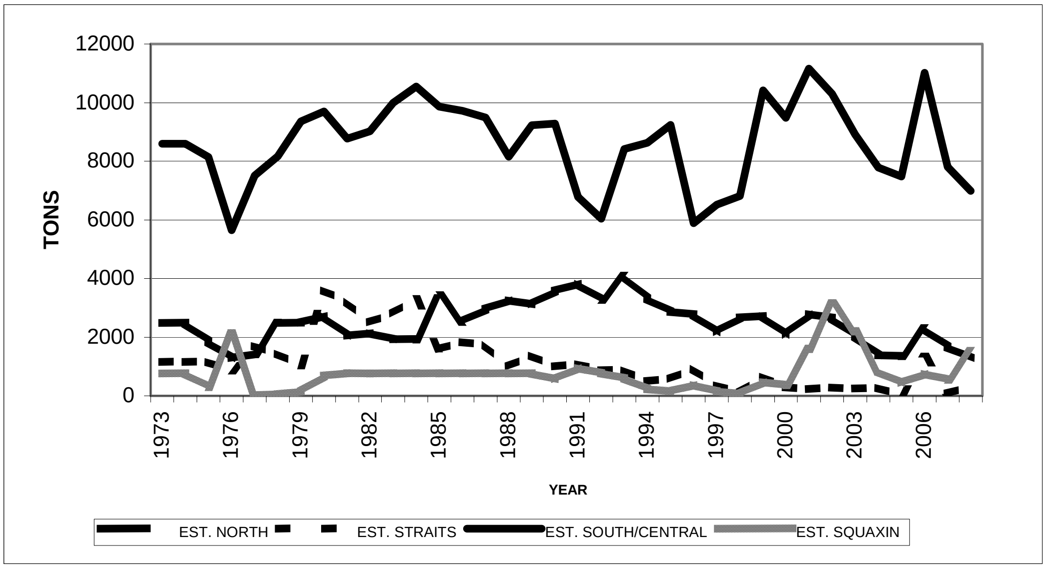

Figure 1. Puget Sound Herring Cumulative Spawning Biomass Estimates by Region and Squaxin Pass stock, 1973-2008 (historical mean assumed if stock not sampled).

2009 Scheduled acoustic/trawl surveyed stocks/areas:

Squaxin Pass
Carr Inlet
(Hale Pass) Wollochet Bay
Quartermaster Harbor
Port Orchard/Madison
Port Gamble (probably acoustic only)
Skagit Bay
Port Susan
Holmes Harbor
Cherry Point

2009 Scheduled spawn deposition survey areas:

Quartermaster Harbor	Holmes Harbor
Wollochet Bay	Fidalgo Bay
South Hood Canal	Samish Bay
Purdy (Carr Inlet)	Portage Bay
Quilcene Bay	Int. San Juans (Mud,Blind Bay, East Sound)
Port Gamble	N.W. San Juan Is. (1-2 surveys)
Kilisut Harbor	Semiahmoo Bay
Port Susan	Cherry Point
Discovery Bay	Dungeness/Sequim Bay

3. Puget Sound Ambient Monitoring Program (PSAMP)

(Contact: Jim West 360- 902-2842, James.West@dfw.wa.gov)

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 it's 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.

B. Coastal Area Activities

1. Coastal Groundfish Management

(Contact: Corey Niles, 360-249-1223, Corey.Niles@dfw.wa.gov), Intergovernmental Resource Management

a. Activities Related to Pacific Fishery Management Council

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 (Farron Wallace 360-902-2712, Farron.Wallace@dfw.wa.gov) Marine Fish Science Unit

b. Age Determination of Spiny Dogfish

Spiny dogfish is aged with the annulus ring counts on the second dorsal spine. As it grows, the enamel at the earliest formed distal tip of the spine is worn away, producing a zone of missing annulus rings. Sixty-seven male and 115 female fish specimens were randomly selected from captured spiny dogfish taken off the Washington coast in 2005-2006 and their fork lengths measured. For the second dorsal spine from each specimen, five measurements were recorded. These measurements permit the estimation of the unknown age with worn spines even if there is no repeat capture information for a specimen. We modeled the three base width measurements with mixed effects models and treated the number of missing annulus rings as random effects. Three transformations were applied in the random effects and square root transformation outperformed the other two transformations. We compared our results with Ketchen's (1975) "no wear point" method. The mean estimated number of missing annulus rings for male and female dogfish from the proposed method were 9.760 yrs and 16.136 yrs. The estimated mean numbers of male and female dogfish missing annulus rings of Ketchen's method are 23.3% and 10.8% smaller than the estimated mean number of male and feamale dogfish missing annulus rings of the proposed method. The estimated expected maximum fork lengths of male and female spiny dogfish were 86 cm and 137 cm, respectively.

c. Longline Rockfish Survey

4187 hook by hook catch information from a longline fishing survey was analyzed with Monte Carlo simulation method. They were targeting halibut and rockfish at 14 stations with 3 skates at each station along Washington Pacific coast. There are 14 types of hook results which include type of catches and hook and bait conditions, e.g. missing bait and untouched bait. There are spiny dogfish, Pacific Halibut, black cod, yelloweye rockfish, lingcod, longnose skate, arrowtooth flounder, bocaccio, sunflower sea start, petrale sole, spotted ratfish, and starry flounder in the catch. By comparing the 95% confidence intervals of random biting behavior, black cod hook by hook catches follows a random spatial distribution but not others. Spiny dogfish, yelloweye rockfish, missing bait and untouched bait hook by hook catches likely follow cluster distributions. Pacific halibut hook by hook catches follows a regular or uniform pattern. All these information can assist scientists, fishermen and managers to develop more effective longline gears targeting on specific fish species.

d. 1981-1997 Black rockfish tagging studies

Between 1981 to 1990, there were 52042 black rockfish tagged with spaghetti tag(s) within three PCA areas along Pacific Washington coast. During 1981 to 1997, 2.96% of them was returned with fork length measurement, sex and recapture location. 1.37% of them are with displacement greater than 2 km and at large greater than 90 days. There is no difference ($P=0.15$) between sex on the size of recapture. There is no difference ($P=0.50$) between sex on the displacement too. There is no difference ($P>0.10$) between sex in directional movement. Both Rayleigh and Watson test of circular uniformity of PCA1 ($P <0.01$), PCA2 ($P <0.01$), and PCA3&4 ($P <0.01$) confirm that all the directional movement of black rockfish in all PCAs are not uniformly distributed. A mixture of von Mises distributions is fitted to the bimodal distribution of angular movement in each PCA area. It shows a distinct south and north seasonal movements. All these information supports a single sex stock assessment and data collection.

e. Cooperative Rockfish Sampling Survey Update

A join rockfish longline survey with the International Halibut Commission (IPHC) was conducted in 2006, 2007, and 2008. In 2006, there were 25 rockfish added to the existing 27 IPHC survey stations off Washington coast, whereas 18 rockfish stations were added in 2007 and 2008. The locations of rockfish survey stations were selected based on an advanced systematic adaptive sampling framework that utilized historical rockfish catch from the IPHC survey stations, the Pacific Coast Groundfish EFH Mapper program, spot prawn logbook trawling data. The goals are to reduce the uncertainty of the estimation of catch per unit effort and to resolve the spatial confounding factors affecting the distribution of rockfish species. The results from the 3-year experiment showed that the adaptive sampling protocols on average reduced 32% of coefficient of variation of the abundance index when compared with the same sampling survey efforts applied with a random sampling design. One of the highlights of 2008 survey was the collection of hook-by-hook catch information, which provides insights for species spatial distribution. We used Monte Carlo simulation method to analyze the hook-by-hook distribution of the 14 species and bait conditions, eg. missing bait and untouched bait. By comparing the 95% confidence intervals of random biting behavior, black cod hook by hook catches follows a random spatial distribution but not others. Spiny dogfish, yelloweye rockfish, missing bait and untouched bait hook-by-hook catches likely follow cluster distributions. Pacific halibut hook by hook catches follows a regular or uniform pattern. All these information can assist scientists, fishermen and managers to develop more effective longline gears targeting on specific fish species.

f. Underwater Remotely Operated Vehicle Survey

WDFW conducted an underwater ROV survey in September 2008. The objectives of the survey were to gather data that could be used to determine regional abundance trends off the northern Washington coast, explore movements of yelloweye rockfish across time and area, and establish habitat associations. The survey, conducted in collaboration with SRI International and the University of Washington, began on September 10 and concluded on September 17. The stations were selected based on information previously collected from a collaborative longline rockfish survey with the International Halibut Commission (IPHC). These stations are located in areas of known high yelloweye rockfish abundance. One of the stations has historically produced more than 90 percent of the total yelloweye rockfish caught in the IPHC annual longline survey off Washington. The yelloweye abundance data from the annual IPHC survey has been incorporated into the Pacific Fishery Management Council's yelloweye rockfish stock assessment; however, the data varies from year to year, is not yet informative to the assessment model. In an effort to better understand the reasons for this variability, the ROV survey covered the same area as the IPHC survey in order to gather habitat and other species information.

g. Yelloweye rockfish tagging

In May 2008, Robert Pacunski and Lisa Hillier conducted an ROV operation off the coast of Washington to determine the location and health of several acoustically tagged yelloweye rockfish as part of a study of the species movement and behavior. The ROV was fitted with a hydrophone wired to the surface and positioned to allow for optimal detection of tagged fish. Three ROV deployments were accomplished on several small rock piles (each <0.5 hectare) approximately 15 miles offshore from the Port of Westport. Two tagged adult yelloweye rockfish were successfully located and videotaped at a depth of ~250 feet, and a third fish at the same depth was tentatively located in a crevice but was not visible to the camera. This investigation confirmed that at least two of the tagged fished had survived the tagging procedure and remained at their original capture location.